Zee op Zicht: Inzicht
Een zoektocht naar een integraal afwegingskader voor het gebruik van de zee

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Voorwoord

De veranderingen op zee gaan snel. Aan de ene kant neemt de wens voor bescherming van het marine milieu toe, aan de andere kant vormen goederen en diensten van de zee een groeiende bron van inkomsten. In het beheer van de zee is sprake van een veranderende rol van de overheid, met name de verdeling van regulerende overheden over schalen van lokaal nationaal en regionaal naar Internationaal in EU verband – maar ook in bijvoorbeeld OSPAR en Noordzee verband. Daarnaast vindt een verschuiving plaats in de opzet van governance van overheid naar bedrijfsleven, van bijvoorbeeld wet- en regelgeving naar convenanten, certificaten en *licence to produce*. Traditionele instrumenten en instituties voor regie en stuurbaarheid op zee zijn niet adequaat meer. Ook is er geen integratief raamwerk voor analyse van (internationale) ruimtelijke claims ten behoeve van ruimtelijke ordeningsvraagstukken in termen van instituties en governance.

Binnen het project Zee op Zicht hebben in de afgelopen vier jaar onderzoekers van Wageningen UR zich gebogen over de vraag wat de rol van kennis is in dit soort afwegingsprocessen en hoe je een integraal afwegingskader voor het inrichten van de zee zou kunnen ontwikkelen. Hierbij is gebruik gemaakt van de ervaringen opgedaan in een keur aan Europese projecten die elementen van dat integrale raamwerk leveren. Deze projecten richten zich op diverse aspecten van de marine wereld zoals ruimtelijke ordening op zee (MESMA), het bij elkaar brengen van stakeholders, beleidsmakers en wetenschappers rondom beleid op zee (GAP2, MASPNOSE), het operationaliseren van de ecosysteembenadering op zee (MEFEPO, ODEMM) en het ontwikkelen van nieuwe vormen van beleid (FISHVIEWS) of interactief ontwerpen van infrastructuur op zee (MERMAID).

In deze *'reader'* vindt u een doorkijk naar onze bevindingen. Aangezien het doel is om de hoofdstukken te publiceren in internationale wetenschappelijke tijdschriften zijn de teksten in het Engels. In hoofdstuk 1 gaat Luc van Hoof in op huidige ontwikkelingen in *Marine Spatial Planning* en de uitdagingen waar we voor staan. In hoofdstuk twee geven Marloes Kraan, David Goldsborough en Luc van Hoof een beschouwingen over de wijze waarop *Governance* zich op drie niveaus manifesteert en hoe de principes waarmee we naar de wereld kijken een basis kunnen zijn om een proces van *Marine Spatial Planning* te faciliteren. In hoofdstuk drie kijken Luc van Hoof, Jan Tjalling van der Wall, Robbert Jak, Christine Röckmann en Josien Steenbergen naar de toenemende concurrentie op zee, zowel concurrentie om hulpbronnen, maar nog meer een toenemende concurrentie om ruimte, en beschouwen hoe multiple gebruik van de zee hiervoor een oplossing zou kunnen bieden. In hoofdstuk 4 beschrijven Marloes Kraan en Martin Pastoors de cruciale attributen van kennis (*salience, credibility, legitimacy*) en hoe kennisinstituten hiermee een rol spelen in processen van ruimtelijke ordening op zee. In hoofdstuk 5 gaan Bas Bolman, Robbert Jak en Luc van Hoof in op de rol van *Decission Support Systemen* in processen van *Marine Spatial Planning* en met name op de vraag of al die DSS-en die worden ontwikkeld van nut zijn. Tenslotte gaat Luc van Hoof in hoofdstuk 6 op zoek naar de plek en rol van wetenschappelijke kennis in de processen van ruimtelijke ordening op zee.

Wij zijn dank verschuldigd aan al diegenen die over de achterliggende periode direct of indirect hebben bijgedragen aan het tot stand komen van deze studie. Met name de vele *stakeholders* die altijd weer bijdrage aan het succes van projecten en die bereidt zijn om tijd en moeite te stoppen om met ons van gedachten te wisselen. Dit project is tot stand gekomen middels financiering vanuit het Kennisbasisprogramma VI Transitie & Innovatie wat zich richt op het ontwikkelen van kennis over de stuurbaarheid van transitie- en innovatieprocessen, nieuwe methodieken en strategieën voor innovatie en valorisatie, en condities voor duurzame handelspraktijken van ondernemers en burgers/consumenten.

1. Balancing the scale: a participatory framework for marine spatial planning

Luc van Hoof

Ongoing population growth, technological change, and shifting consumer demands all have considerably increased the need for more food, more energy and more trade. An increasingly larger share of goods and services comes from coastal and marine resources (Douvere and Ehler, 2009). Furthermore, activities continue to expand beyond national jurisdiction of coastal states due to newly discovered natural resources and the technical capabilities to exploit them (Maes, 2008).

The significance of this is brought into sharp focus by initiatives such as the European Commission's Blue growth strategy which highlights the extensive opportunities that exist for marine and maritime economic growth and to address energy, food and other resource security concerns harnessing assets from the sea (Kidd and Shaw, 2013). For many countries, such as Ireland, Norway, the UK, Spain and Portugal in the European context, national marine boundaries are seen as increasingly important as they reveal that the greater part of their territorial area lies within the sea rather than on land (Kidd and Shaw, 2013).

The EU Integrated Maritime Policy acknowledges the fact that a coherent policy framework that will allow for the optimal development of all sea-related activities in a sustainable manner is required (Commission of the European Communities, 2007a). As experienced elsewhere, sectoral approaches have shown themselves to be inadequate and ineffective in the European context. Use conflicts, negative externalities, and environmental degradation have increased, and the need for a comprehensive approach to ocean use management has become readily apparent to EU-decision makers (Juda, 2007). Marine Spatial Planning could play a role in the co-ordination of different sector policies. To fulfil this challenge successfully, spatial planning must ensure full integration and assessment of environmental, social and economic issues (Eggenberger and Partidário, 2000). If marine resources are to be used sustainably, ways have to be found to reconcile the differing economic, social, and environmental demands that are placed on the marine environment with its capacity to accommodate these demands, particularly in view of increasing and competing use (Gilliland and Laffoley, 2008).

Hence one can see two main drivers for the development of coherent Marine spatial planning: on the one hand the implementation of the ecosystem approach, requiring an integral assessment of impact on the ecosystem; and, on the other hand, the allocation of activities over sectors in the limited space of the seas. As framed by Jentoft and Knol (2014), the idea of MSP is to foster rational use of a shared marine space that is scarce, and to secure the sustenance of fragile ecosystems. Additionally, MSP endeavours to create more conducive interactions among marine user groups in a way that balances the demands for economic development, human wellbeing and environmental conservation (Jentoft and Knol, 2014). And hence also two major planning paradigms: paraphrasing Frazão Santos *et al.*(2014): prioritisation of implementation of ecosystem based management in order to achieve Good Environmental Status or rather obtaining Blue Growth (Frazão Santos *et al.*, 2014). Although ecosystem-based MSP (hard sustainability) is more "precautionary", by putting the emphasis in achieving/ maintaining ecosystems good environmental status, there is no assurance that it will be more effective than integrated-use MSP (soft sustainability) in delivering sustainable ocean management. Ultimately, it will all depend on how marine planning and management processes are conducted, and how marine ecosystem thresholds are accounted and assessed within such processes (Frazão Santos *et al.*, 2014). This illustrates how the concept of MSP is highly adaptable to different socio-political contexts but this adaptability comes at a cost with respect to ensuring the sustainability of marine socio–ecological systems (Merrie and Olsson, 2014).

In this article we will use the results of the Dutch Government funded project Sea in Sight to develop an integrated framework that could assist in devising a method useable in MSP processes in weighing up alternative uses of the seas and oceans. In chapter two we will look into the current state of affairs in Marine Spatial Planning. In chapter three we will focus on some key challenges MSP is facing and hence aspects an integrated framework to weigh up alternative uses in the marine ecosystem should have to address. In chapter four we will present the framework. Finally in chapter five we will reflect on our findings.

Marine Spatial Planning

Marine spatial planning, compared to land use planning, is a fairly new and emerging area (Douvere and Ehler, 2009). According to De Santo (2011) the concept of spatially managing multiple uses of the marine environment can be traced back to the design and implementation of the Great Barrier Reef Marine Park (Kidd and Shaw, 2014), over 30 years ago. Spatial approaches to marine management have especially been evolving with the development of marine protected areas over the past few decades. To date, marine spatial plans have often been motivated by the emergence of a new use of the ocean that threatens to displace existing uses. For example, in many parts of the United States, the catalyst has been growing interest in developing offshore renewable energy (Collie *et al.*, 2013). With regard to Europe in particular, the European Commission envisions MSP as a means for balancing sectoral interests and achieving the sustainable use of marine resources in line with the EU Sustainable Development Strategy (De Santo, 2011).

Marine Spatial Planning does differ profoundly from land use planning. According to Jay (2010), three main challenges for the marine world, compared to land, can be found. The physical characteristics of the sea militate against detailed human organisation and manipulation, making the sea largely undevelopable and therefore unplannable; the jurisdiction of coastal states over their surrounding seas has historically been far weaker than over their land areas; and agreements regarding the governance and use of the seas, especially beyond territorial waters, have typically been made only in relation to specific marine activities, such as fishing or exploiting mineral resources, rather than covering all activities in a given area.

The conventional view of spatial planning tended to associate it with a regulatory mechanism and a sectoral approach. The plan is now understood as a “project of a city or region”, a democratic expression of what the territory should be and a frame of reference for collective action (Commission of the European Communities, 2000). In this sense planning is to be understood not only as a legal instrument or a public investment plan, but also as an operational and programmatic tool for the development of public policies as well as of private investment strategies and local initiatives (Commission of the European Communities, 2000). In this way MSP is seen as a process that can enhance sustainable growth as it provides legal certainty, predictability and transparency, thus reducing costs for investors and operators (Schaefer and Barale, 2011).

MSP is a public process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives that have usually been specified through a political process (Ehler and Douvere, 2007). An increasing number of countries are using MSP to achieve both sustainable use and biodiversity conservation in ocean and coastal areas. While some countries have specific legislation for MSP (e.g., the UK has the Marine and Coastal Access Act), most do not and certain countries use existing authorities including environmental legislation (like Belgium) or biodiversity legislation (like Australia) or existing land-use planning legislation that is extended to the sea (The Netherlands and Germany) as a basis of authority for MSP (Katsanevakis *et al.*, 2011).

According to Kidd and Shaw (2013) three trends in maritime governance can be distinguished that have resonance in European sea regions. First, historically the case for territorial innovation initially came from a growing realisation that human activities were beginning to have a negative impact on the ecological integrity of the sea. Some of the most significant institutions that have developed (e.g. OSPAR) are environmentally focused and led by the scientific community. Their importance is not in question, although their power is likely to be relatively weak. More recent initiatives are, however, increasingly seeking to exploit development opportunities that the marine environment offers, recognising that ecological integrity is crucial to many development efforts. How, therefore, competing interests for use of and access to the sea are effectively managed, and whose interests are served (and by contrast what interests may be compromised) calls for effective mechanisms for integrated spatial planning and management that are cross-sectoral in nature, operate in multidimensional space, can deal effectively with land–sea interactions and with cross-border and transnational boundaries issues. This is creating a new interlocking scalar mix of formal and informal, sectoral specific, or more integrated policy regimes at a variety of scales that relate to the sea. Exploration of the effectiveness of these regimes in dealing with these complex interactions is only just beginning (Kidd and Shaw, 2013).

This sectoralisation of control does not favour the comprehensive integration of activities that spatial planning seeks to achieve (Jay, 2010). This trend is associated with a broad shift in priorities, from managing individual marine resources for a single objective, to examining the system as a whole and looking at the cumulative effects of all human activities on the marine environment (Dickinson *et al.*, 2010). Integrated marine planning responds to these problems by approaching the management of the marine environment more holistically by taking into consideration economic, environmental, social, and cultural concerns, and utilizing governance structures designed to incorporate the needs of multiple uses and sectors, along with multiple authorities, organizations and individuals (Dickinson *et al.*, 2010).

Other reasons to begin marine spatial planning include (Ehler and Douvere, 2009):

- To provide a vision and consistent direction not only of what is desirable, but what is possible in marine areas;
- To protect nature, which has its own requirements that must be respected if long-term sustainable human development is to be achieved and if large-scale environmental degradation is to be avoided or minimized;
- To reduce fragmentation of marine habitats (that is, when eco- systems are split up due to human activities and therefore pre- vented from functioning properly);
- To make efficient use of marine resources—marine resources, including ocean space, are increasingly in short supply. Those that are available should be used to produce goods and services in a sustainable manner;
- To set priorities—to enable significant inroads to be made into meeting the development objectives of the marine management area in an equitable way, it is necessary to provide a rational basis for setting priorities, and to manage and direct resources to where and when they are needed most;
- To create and stimulate opportunities for new users of marine areas;
- To coordinate actions and investments in space and time to ensure positive effects from those investments, both public and private, and to facilitate complementarity among jurisdictions;
- To avoid duplication of effort by different public agencies and levels of government in MSP activities, including planning, monitoring, and permitting; and
- To achieve a higher quality of service at all levels of government, e.g., by ensuring that permitting of human activities is stream- lined when proposed development is consistent with a comprehensive spatial management plan.

The main policy drivers for MSP in the EU fall into four main categories (Qiu W and Jones PJS, 2013):

- Environmental legislation, which includes the Birds Directive (2009/147/EC), Habitats Directive (92/43/EEC), Environmental Impact Assessment Directive (85/337/EEC), Strategic Environmental Assessment Directive (2001/42/EC), and the Marine Strategy Framework Directive (MSFD, 2008/56/EC).
- Legislation on marine renewable energy, which includes the EU Climate and Energy Pack (2008) and the Renewable Energy Directive (Directive 2009/28/EC).
- Fisheries regulation, particularly the Basic Regulation on the Common Fisheries Policy (CFP), which is currently undergoing a reform (COM(2011) 425 final).
- The Integrated Maritime Policy (IMP) (Regulation (EU) No 1255/2011).

Several authors have developed criteria or principles that MSP should fulfil in order to be effective. In table 1 below the characteristics of effective MSP as developed by the European Commission (Commission of the European Communities, 2008), Ehler and Douvre (2009), Dickinson and colleagues (2010) and Jay (2010) are presented. The attributes of existing MSPs are quite heterogeneous. Most plans have objectives, government authority, and use data, but they differ in degree of stakeholder participation, use of decision support tools, and inclusion of monitoring and performance measures (Collie *et al.*, 2013).

Table 1: Characteristics of effective Marine Spatial Planning

European Commission	Ehler & Douvre	Dickinson *et al.*	Jay
1. Using MSP according to area and type of activity 2. Defining objectives to guide MSP 3. Developing MSP in a transparent manner 4. Stakeholder participation 5. Coordination within Member States – simplifying decision processes 6. Ensuring the legal effect of national MSP 7. Cross-border cooperation and consultation 8. Incorporating monitoring and evaluation in the planning process 9. Achieving coherence between terrestrial and maritime spatial planning –ICZM 10. Strong data and knowledge base.	• Ecosystem-based, balancing ecological, economic, and social goals and objectives toward sustainable development • Integrated, across sectors and agencies, and among levels of government • Place-based or area-based • Adaptive, capable of learning from experience • Strategic and anticipatory, focused on the long-term • Participatory, stakeholders actively involved in the process	• inclusive stakeholder participation, • high level government leadership with clear accountability, • a legal and policy framework that provides clear direction, • comprehensive goals with measurable targets, • effective strategies for achieving goals and targets (which in marine planning include comprehensive zoning to specify acceptable uses and activities), • regular progress monitoring and evaluation, • adaptive management to assess relationships between management actions and outcomes and modify plans as required, • adequate scientific information, • adaption of planning to take account of unique characteristics of the context, and • integration of spatial, jurisdictional, and sectoral dimensions.	• Ecosystem-based • Primacy of scientific knowledge • Conservation/environmental imperative • Area-based • Acceptance of development needs • Integration of sectors and of the land and sea • Stakeholder involvement • Underlying traditions

Source: (Commission of the European Communities, 2008; Douvere and Ehler, 2009; Dickinson *et al.*, 2010; Jay, 2010).

Foley *et al.*(2010) state that the basic principle of MSP lies in the declining health of marine ecosystems around the world which is caused by the fact that current piecemeal governance is inadequate to successfully support healthy coastal and ocean ecosystems and sustain human uses of the ocean. Because a key goal of ecosystem-based MSP is to maintain the delivery of ecosystem services that humans want and need, it must be based on ecological principles that articulate the scientifically recognized attributes of healthy, functioning ecosystems. These principles should be incorporated into a decision-making framework with clearly defined targets for these ecological attributes. The proposed four main ecological principles to guide MSP—maintaining or restoring: native species diversity, habitat diversity and heterogeneity, key species, and connectivity—and two additional guidelines, the need to account for context and uncertainty, must be explicitly taken into account in the planning process. When applied in concert with social, economic, and governance principles, these ecological principles can inform the designation and siting of ocean uses and the management of activities in the ocean to maintain or restore healthy ecosystems, allow delivery of marine ecosystem services, and ensure sustainable economic and social benefits (Foley *et al.*, 2010).

On the other side of the spectrum one could find for example the EU approach for Blue Growth: the long term strategy to support sustainable growth in the marine and maritime sectors as a whole (Commission of the European Communities, 2014a). In this view the cornerstone of policy should be on how innovation can help develop the blue economy in a way that not only fuels EU growth and job creation but also maintains public support for the commercial use of marine resources while ensuring the protection of the marine environment. As we are standing at the dawn of a century that will be largely affected by how we are able to manage our oceans and their resources, it is important to take concrete steps to develop our understanding of the seas and advance technology so that we can develop their economic potential in a sustainable manner (Commission of the European Communities, 2014b). MSP can enhance sustainable growth as it provides legal certainty, predictability and transparency, thus reducing costs for investors and operators, promoting investments and creating growth and jobs. In times of changing framework conditions and economic challenges it might offer a way to smart ocean management, aiding investment and development that is in line with healthy ecosystems (Schaefer and Barale, 2011).

Challenges for Marine Spatial Planning

Following Smith *et al.* (2011) there are three main themes portraying challenges in Marine Spatial Planning. An issue is inclusion and integration of activities; a current trend is quite the opposite and is the exclusion of offshore oil and gas and military activities from MSP (Smith *et al.*, 2011; Steendam, 2014); and the incipient loss of influence of fishing industries and policies at European level, as these become more closely linked to marine conservation objectives and practice principally through the upcoming re-structuring of the Common Fisheries Policy. Secondly, there is a requirement to link land and sea use planning. Finally it is especially necessary to be aware of the contributory roles of information management— such as the planning of environmental monitoring and surveillance of uses—with spatial planning in mind (Smith *et al.*, 2011). One may add that an important theme is that marine spatial planning is a process, not a single plan or outcome (Collie *et al.*, 2013).

According to Kannen (2012), a challenge for MSP is the ability to take into account interactions at different scales, affecting the institutional and social, as well as the ecological domains. As a consequence, new approaches to assessment as well as new forms of governance are called for. Cooperation mechanisms that stimulate co-use of the same location, such as combining wind farms with marine aquaculture, are needed when there is a high competition for physical space. Alternatively, upscaling of policy targets from national to Regional Sea scales and strong transnational cooperation could be a way to fulfil growing societal demands from sea space. This will require MSP to either develop into a broad and inclusive communication process or to become embedded into such processes. In planning practice, differences in society about the meaning of the sea and different perceptions of pressing issues could probably get better recognised when MSP would be guided by consensus-oriented long-term visions concerning the future of particular sea areas (Kannen, 2012).

Fletcher *et al.*(2013) in evaluating two MSP processes in the UK develop an overview of levers and barriers to effective MSP, presented in figure 1below.

Facilitators	Barriers
• Involvement of a wide variety of stakeholders. • Multiple methods and opportunities for involvement. • Leadership of the pilot processes was effective. • Involvement of existing stakeholder networks through basing the marine planning pilots within a coastal partnership. • Effective two-way communication with stakeholders. • Improvements in marine planning knowledge were significant amongst stakeholders. • Marine planning process provides an additional forum to resolve conflict between stakeholders. • Creates opportunities for enhanced public and stakeholder engagement in marine issues. • Opportunities for coordinated and enhanced marine governance.	• Differences in resource costs associated with involvement. • Lack of public involvement. • A greater range of stakeholders could have been involved. • Lack of clarity over the relationship between how terrestrial and marine planning systems might coordinate. • Personnel change in the organising body can create changed approaches to the process and expectations placed on stakeholders. • Data gaps exist therefore policy decisions need to be taken on limited evidence. • Marine planning is resource heavy for process organisers and participants. • Weak internal communication within stakeholder groups can dilute messages to, and engagement with, the wider marine planning community. • Unknowns due to marine planning being a new discipline. • Lack of resourcing amongst stakeholder bodies to fully engage with marine planning. • Insufficient investment of resources by marine planning organisers to make the process work. • Differing values attached to expert and lay knowledge. • The sheer complexity of marine planning.

Figure 1: Facilitators and barriers to effective MSP identified from the MSP pilot studies in southern England. (Fletcher *et al.*, 2013)

Regionalisation

In recent years a number of Commission initiatives on EU marine policy have seen the light, among which the development of the Marine Strategy Framework Directive (MSFD, 2005), the introduction of the Integrated Maritime Policy (IMP in 2007) and the 2012 revision of the Common Fisheries Policy (van Hoof and van Tatenhove, 2009). Especially the MSFD and the CFP explicitly call for cooperation between Member States in implementing the policy. Also the proposed Directive on Marine Spatial Planning and Coastal Zone Management explicitly calls for Member States to establish appropriate cross border cooperation in planning human uses of maritime space and to ensure the sustainable management of coastal areas (Commission of the European Communities, 2013).

Following Schaeffer and Barale (2011), one of the main reasons for the EU to embark on MSP can be derived from the need of enhanced cross-border cooperation. This could be seen as a specific European issue, given the relatively small seas. Cross-border cooperation for the sake of maritime management becomes increasingly relevant as migratory resources such as fish stocks do not respect national borders and activities on one side of a border have almost certainly effects on activities on the other side. In the marine environment, administrative or jurisdictional borderlines lose their dividing character. A common approach to managing marine space on each side of the border would thus enable efficient and smooth application of MSP, favouring the development of maritime activities and the protection of the marine environment based on a common framework and similar legislative implications (Schaefer and Barale, 2011).

A challenge is how to shape this regional cooperation between Member States. The MSFD suggests Member States to use existing structures such as the Regional Sea Conventions, the CFP suggests to use the (Regional) Advisory Councils, yet both remain silent on how to organize regional coordination and integration (van Leeuwen *et al.*, 2014). Following van Leeuwen *et al.* (2014) even trying to use existing institutions to shape regional cooperation, from the perspective of implementation of the MSFD, this may pose some intrinsic challenges. First and foremost of course is the fact that the European Treaty does not recognise the regional level as such; it concerns Member States and the EU institutional level, but not the regional seas and/or regional institutions. In fact there are no supranational institutions with formal competence in European spatial planning (Moisio and Luukkonen, 2014). In addition, achieving coordination and integration of policies requires political will of all parties, including non-EU Member States. Second, not all Regional Sea Conventions have the broad scope required for integration of all relevant policy domains. For example, the OSPAR Convention has always refrained from addressing fisheries and shipping, as other international institutions deal with these sectors (van Leeuwen *et al.*, 2014).

The interconnectedness of adjacent ocean spaces, the cross-boundary impact of ocean uses, and the broader scale needed to be ecologically meaningful require that marine spatial plans developed at the national level are embedded in a broader, international context and integrate, or at least address, the dynamics of the system as a whole. National marine spatial plans should be translated into international spatial policies in which sea uses and biodiversity protection measures are planned to complement one another on an international, or regional scale (Douvere and Ehler, 2009). As mentioned above, this poses a multi-level governance challenge; this multi-level governance is primarily concerned with decision-making competencies of actors on different levels (van Hoof *et al.*, 2012). It relates to both the structure of a multi-level system and the interaction among levels of governance (Newig and Koontz, 2013) and reflects that decision making in the EU is neither exclusively in the hands of Member States (intergovernmental) nor in the hands of European institutions (supranational) (Jordan, 2001).

One of the most important steps in an MSP process will be that of boundary demarcation. Natural system interdependencies underscore the need for MSP to reach across boundaries. If plans are too constrained in scale or limited in scope, and do not consider how ecosystems function, it will be difficult to achieve integration and, in turn, conservation and environmental protection goals. The interconnectedness of neighbouring ocean space and the cross-boundary impacts of ocean uses between countries, at different levels of government, between sectors and between land and seascape units, encourage ever-broader scale and scope for MSP (Portman, 2011).

The governance of marine spatial planning

According to Kidd and Shaw (2013) there is a rapid evolution in marine governance throughout the world in which a complex pattern of overlapping territorial regimes is emerging in which “hard” governance arrangements mainly at a national level (including some with both land and sea interests) are intermeshing with other governance frameworks which tend to be much “softer” in character (Kidd and Shaw, 2013). One of the challenges facing large countries with diverse coastal economies (e.g. US, Canada, Australia) is finding the correct balance between “top down” prescriptive planning frameworks and the “bottom up” development of regional plans that are more likely to be tailored to the local socio-economic and ecological conditions (Collie *et al.*, 2013).

Following Collie *et al.*(2013), government leadership is essential for getting MSP implemented. Although planning efforts led by scientists can make faster initial progress, at some point there must be government buy-in or implementation will not occur. Stakeholder engagement is important for getting subsequent acceptance of the plan. The ability of stakeholders to submit their own plans for consideration can be a main contributor to success (Collie *et al.*, 2013). In order to devise successful and thus accepted plans the sensitivities of different stakeholders need some consideration at an early stage and engagement needs to be tailored to the needs of different socio-economic groups so that trust and the full participation of all stakeholders is captured (Hull, 2013).

As much as in the current suite of EU legislation regulating the use of our seas and oceans there is a call for increased regional cooperation, yet the institutional modus is not further detailed, a similar case can be found for stakeholder participation. In general participation is deemed a necessity, yet the modes of including meaningful public participation in the decision-making process for MSP remain undetermined. As we move towards a more inclusive governance model, building greater public participation into processes such as MSP, it is important to ensure the participation of all sectors that will be affected by and involved in MSP both nationally and regionally within European Member States and regional seas (De Santo, 2011).

As marine spatial planning is a process that often entails multiple levels of government and has to address the needs of multiple users, questions on the governance of the planning process, the way decision-making and the implementation process are organised, are of main importance. Ehler and Douvere (2009) have highlighted six characteristics of effective marine spatial planning, which indicate the importance of governance aspects such as participation, transparency and legitimacy in marine spatial planning processes (Kraan *et al.*, 2013).

Kraan *et al.* (2013) argue that principles and values shape the MSP process as they guide stakeholders’ assessment of the state of the marine ecosystem and in particular in defining problems and opportunities. As governance becomes increasingly participative, with more stakeholders taking part in the process, developing a shared understanding of the state of the marine ecosystem and its uses and the need for change (thus defining the problem) becomes increasingly challenging. Elucidating the underlying principles and values held by the different stakeholder groups may contribute to a mutual understanding and development of a shared vision (thus an explicit and agreed frame of principles and values).

In analysing the case of implementation of the European Natura 2000 policy on the North Sea Dogger Bank, an area where European Union policy, national policies and several stakeholder groups’ interests come together in determining the spatial dimension of implementation of the Natura 2000 policy framework Kraan *et al.*(2013) come to the following conclusions. Structuring a process around a rather formal government institution, and having government rulemaking in implementation of Natura 2000 as main governance arrangement, shapes the planning process in such a way that decision making remains firmly in the hands of the governors. Where stakeholder participation was sought, the form of participation is not a type of co-decision making but rather one of informing the decision making process. The governors use information derived from the system to govern, be it from the science community or stakeholder community, to arrive at a decision, yet the process remains strongly a hierarchal mode of governance.

This matches the underlying perception of policy implementation as being a rather straight forward implementation process in which goals and indicators have been pre-defined, and only need to be operationalised. Responsibility for implementation is claimed by a single actor (government). Although to a certain extent this process can be open and transparent, stakeholders do not participate in the actual decision making process. Focus is on implementation rather than on deliberation.

In a process led by stakeholders (in this particular case the North Sea Regional Advisory Council) the process strongly hinged on the shared views of both industry and NGOs on principles for fisheries management in relation to nature conservation on the Dogger Bank. In addition, although implemented under the auspices of an existing institution (NSRAC) the specific working group (NSRAC FG) started out by discussing scope and procedure, and addressed the difficult task of agreeing on which issues could be dealt with within the group and the resources available.

Having these two separate processes, one operating a hierarchical mode of governance, the other a more participatory mode, the intrinsic different modes of governance of the two processes result in ambiguity on the second level governance (institution). Although principles related to the content of fisheries management were openly discussed, the underlying institutional principles, relating to the second level of governance, were not. As a result there was ambiguity as to the roles, responsibilities, timelines, and rules of the game. It should be clear which process and/or institution has decision power and at what point decisions will be taken. In addition, especially when based on different guiding principles, the success of the planning process is highly dependent on the degree of transparency and trust between participants. In addition it is essential that all parties involved in the process have commitment and resources available to play the agreed on role in the process (Kraan *et al.*, 2013; Hull, 2013).

Competing *c*laims

In the southern part of the North sea, in the coastal waters of Denmark, Germany and the Netherlands, a diversity of user interests exist in the marine area including increasing claims for space for wind turbine parks, protection of ecologically valuable areas, shell fish production, fishing, tourism, recreation, shipping and sand extraction. A main challenge to marine spatial planning is how to allocate specific areas, or zones, to specific activities. Moreover, an important questions is to what extent are these different activities competing for resources and/or space or could multiple uses be implemented simultaneously, or at least at the same place consecutively?

Traditional uses of the sea and sea bed, such as fisheries and transportation, have mostly been performed with ships. These uses are mobile and usually only stay within a given area for a relatively short period of time. The occurring user conflicts could often be resolved by steering a slightly different course to avoid a collision. Yet space is required for shipping lanes, and anchorages (where ships wait outside a harbour, until a berth is available).

Newer, but presently well established and accepted, uses such as the offshore oil and gas platforms have been relatively unproblematic because they are widely spread out in space and at least for ships have small safety zones (500-1000 m.) associated with them. Pipelines and cables also have the benefit of a laying only a small claim on the available space at sea (narrow corridors) and are of no concern to ships, with the exception of fishing vessels that use bottom-touching gears.

The most recent additions such as Offshore Wind Parks that are already in production, but which may be extended to other methods of extracting renewable energy from marine environment (e.g. wave and tidal energy generation) require a larger and (semi-)permanent area to be specifically set aside for these purposes. Or at the very least they are of consequence for ships in the fact that they limit the options that ships have on how they can safely pass an area. Presently wave and tidal energy have not matured beyond the (temporary) installation of pilots, but further development in suitable locations is to be expected.

Not only the space at sea is of importance but also the nearness of infrastructure on land has to be considered. Availability of ports and harbours are of importance to commercial vessels importing and exporting cargo, fishermen selling their catch. Also offshore wind farms and aquaculture require the vicinity of ports both in terms of markets but also as location for maintenance of vessels. Especially for the latter, the distance between ports and production platforms influences production costs in terms of fuel cost as well as in time spent travelling. As a result the preferred locations for specific activities are not equally distributed around the marine ecosystem but are dependent on availability of resources (fish, oil, gas, sand) and on availability of preferred conditions (wind, tides, nearness to shore). All and all this leads at the North Sea to a concentration of competition in the coastal zone.

Proposed co-location of marine activities is therefore an attractive option for marine planners and stakeholders seeking to reduce the conflicts in use of the sea (Christie *et al.*, 2014). Question is whether co-location is legally feasible and how biology, ecology and hydrology of the site as well as consideration of important commercial and economic factors will determine success (Christie *et al.*, 2014). To plan and govern overlapping activities in seas that are shared by several countries is demanding. Also reconciling 'new' and 'old' uses of the sea, and as marine space gets more and more congested by the day, users find themselves in a situation where more space for one means less for others. Marine governance in the form of multi-scale MSP is about trying to reconcile these conflicting demands (Jentoft and Knol, 2014).

Using the principle of Ecosystem Based Management may be seen as an essential means to work towards innovative new Eco-Dynamic Designs (EDDs) of combinations of offshore activities. EDDs integrate multiple disciplines and therefore have multiple aims. Due to these increasing number of aims, the number of relevant stakeholders is likely to increase as well (Van den Hoek *et al.*, 2012). Key to Eco-Dynamic Design is that stakeholders from science, policy and practice are involved in the co-creation of an innovative design from the early stages of project development (van Slobbe and Lulofs, 2011; Van den Hoek *et al.*, 2012; van Slobbe, 2010). Stakeholder participation with the aim of co-creation often occurs in so-called Communities of Practice (CoP) (Wenger, 1998). A CoP can be characterised by mutual commitment on the part of participants by a common aim which is decided upon by all the participants. A shared repertoire is created in the process to create knowledge such as routines, words, instruments, ways of acting, stories, symbols and gestures. Knowledge development is then seen as a process in which knowledge, communication and behaviour are inseparably linked; they create one another (Wenger 1998). The advantage of participatory approaches such as CoP focussing on co-creation is that the potential for conflicts at later stages in the project is likely to be reduced. The legitimacy or acceptance of the process increases, creating the idea or assumption that co-created actions are desirable, proper or appropriate within a socially constructed system of norms, values, beliefs and definitions (Suchman, 1995). By involving stakeholders in a process, it is argued that the quality and durability of decisions is likely to be greater (Reed, 2008).

The need for integration

The EU Integrated Maritime Policy initiative explicitly states that the policy requires a governance framework that applies the integrated approach at every level, as well as horizontal and cross- cutting policy tools. Hence, not only fisheries but also maritime transport, energy, surveillance and policing of the seas, tourism, the marine environment, and marine research are brought under one umbrella (Commission of the European Communities, 2007b).

Although the need for integration in marine spatial planning can be quite straight forward, the way to reach this integration might be more complex. Eggenberger and Partidário (2000) distinguish between integration shaped as substantive integration, methodological integration, procedural integration, institutional integration and policy integration (Eggenberger and Partidário, 2000). Dickinson *et al.* (2010) distinguish between inter-sectoral integration – bringing together user groups and sectoral organizations; intergovernmental integration – bringing together government bodies that have an interest in, or authority over, marine areas; spatial integration – examining marine ecosystems holistically, taking into consideration all factors that impact marine space (e.g., terrestrial-based pollution); science-management integration – utilizing natural, spatial and social sciences to enable better decision-making; international integration – taking into consideration the transboundary nature of the marine environment, its resources and pollutants; and Sustainable development integration – incorporating environmental, social, and economic dimensions in marine planning (Dickinson *et al.*, 2010). Kidd (2013) distinguishes between several categories of integration, see figure 2 below.

Integrated Coastal and Ocean Management dimensions of integration [11]	Categories of integration in integrated water resource management [24]	Categories/dimensions of integration in terrestrial spatial planning [40]
	The Human System	*Sectoral Integration*
Inter-sectoral integration	Cross-sectoral integration	Cross-sectoral integration
		Inter-agency integration
		Territorial integration
International integration	Integration across management levels	Vertical integration
Intergovernmental integration		
Spatial integration		Horizontal integration
		Organisational integration
		Strategic integration
	Matching responsibilities with authority and capacities for action	Operational integration
Science management integration	Involvement of all stakeholders	Disciplinary/ stakeholder integration
	Natural system	
	integration of land and water management, integration of surface water and groundwater management; integration of quantity and quality considerations (including drinking water and waste water); integration of upstream and downstream water related interests; integration of freshwater and coastal zone management.	

Figure 2: Identifying categories and dimensions of integration that may relate to Marine Spatial Planning. (Kidd, 2013)

The main challenge will be to link data on human activities, with ecosystem, social and economic data, and integrate these data in a spatial planning process (Maes, 2008). The latter would require all of the three above introduced perspectives on integration. Not only policy aims and sector objectives, but also the actors and institutions involved and the underlying objective of the specific planning exercise at hand. In this it should be noted that in order to align with notions of the ecosystem approach, marine plans should of course be integrated to match the level of the larger marine ecosystem it is part of. In addition it should integrate over old and new uses and in this realise that certain policy objectives (such as renewable energy production and resource conservation) are not uncontested and that especially the spatial component of activities may portray conflicting demands.

The role of knowledge in marine spatial planning

Marine management to a large extent is embedded in a tradition of founding decisions on scientific advice. Rather fundamental questions in such policy processes focus on the role of science, knowledge and actors within the marine governance set-up and how the advice rendered fits the policy cycle and the process of decision making. Science for policy usually takes place within a context of high stakes, substantial uncertainty and the need to take decisions.

A first step to understand the role of knowledge and information is to understand the difference between data, information and knowledge. Bellinger *et al.* (2004) in siting Russell Ackoff state that data are symbols. Data is raw. It simply exists and has no significance beyond its existence (in and of itself). It can exist in any form, usable or not. It does not have meaning of itself. Information is data that are processed to be useful. It is data that has been given meaning by way of relational connection. This "meaning" can be useful, but does not have to be. Knowledge is the application of data and information. It is the appropriate collection of information, such that it's intent is to be useful. Knowledge is a deterministic process. Understanding is an interpolative and probabilistic process. It is cognitive and analytical. It is the process by which knowledge can synthesize new knowledge from the previously held knowledge. The difference between understanding and knowledge is the difference between "learning" and "memorizing". People who have understanding can undertake useful actions because they can synthesize new knowledge, or in some cases, at least new information, from what is previously known (and understood). That is, understanding can build upon currently held information, knowledge and understanding itself. Wisdom is evaluated understanding. It is an extrapolative and non-deterministic, non-probabilistic process. It calls upon all the previous levels of consciousness, and specifically upon special types of human programming (e.g. moral, ethical codes). It beckons to give us understanding about which there has previously been no understanding, and in doing so, goes far beyond understanding itself. It is the essence of philosophical probing. Wisdom is the process by which discern, or judge, between right and wrong, good and bad. Understanding relations will transform data into information. Understanding patterns will transform information into knowledge. Understanding principles will transform knowledge into wisdom (Bellinger *et al.*, 2004).

So, crucial for the marine spatial planning exercise is to have data, information and knowledge that relate to the issue or problem at hand. Hence the circumstances determine whether available data and information is relevant. In addition there is a need to be aware, as mentioned above in section 3.2, that the principles and values, or wisdom of the stakeholders shape their appreciation of the issue at hand, and in particular in defining problems and opportunities.

In addition, scientific information is likely to be more effective in a process when the information is perceived by relevant stakeholders to be not only credible, but also salient and legitimate. Following Cash *et al.* (2003) *credibility* involves the scientific adequacy of the technical evidence and arguments. *Salience* deals with the relevance of the assessment to the needs of decision makers. *Legitimacy* reflects the perception that the production of information and technology has been respectful of stakeholders' divergent values and beliefs, unbiased in its conduct, and fair in its treatment of opposing views and interests (Cash *et al.*, 2003). So hence again the perception of the information by the stakeholders, or users of the information, determines the usefulness of this knowledge in the process.

This leads to a major challenge in spatial planning. As the entire process is goal oriented, and different groups involved in the process may well have a different perception of the defined problems and opportunities, they all bring different goals to the table. One of the challenges of researching European spatial planning as an art of governing is the task of inquiring into this issue of subjectivity. Policy makers are not only 'mediators' of political rationalities but also subjects of these political rationalities (Moisio and Luukkonen, 2014).

Decision support in marine spatial planning

Decision Support Systems (DSS) or Decision Support Tools are immensely popular. Bolman *et al.* (2014) indicate that more than one hundred DSS can be found designed for MSP decision makers for the North Sea (Bolman *et al.*, 2014). The reasons for the popularity of such tools can partly be found in technological development, which makes it possible to install and use DSS related software systems on PCs, and partly in the need to manage a large amount of often complicated data that play a role in the decision-making processes (Uran and Janssen, 2003).

Despite the large number of DSS developed, the uptake and the use of these models is rather limited. According to Bolman *et al.* (2014) this can be attributed to a number of factors. The involvement of stakeholders and end-users in the development of DSS is not yet common practice. Only few examples were found where stakeholders and end-users were identified and were subsequently actively engaged throughout the process of design and development. However at the same time it remains unclear how the input of stakeholders and end-users is actually incorporated in the DSS. In addition, in the participatory approaches it is not clear how scientific information is being applied in the DSS, or how information contributes to the valuation process by stakeholders.

In addition quite often the way in which the output of a DSS could be utilised in the decision making process has not been taken into account during the design or development of the DSS. Nor is the involvement of decision makers or end-users in the formulation of the objective of the DSS. Hence in these instances the DSS generated does not link up with the particular decision making process.

Most DSS are approached very technically, being disconnected from the human or social context in which it should be used. This results in a disconnection between the system and its utilisation in the decision making process. What is evident is that in some cases participatory approaches have been developed in alignment with DSS development. In these approaches stakeholders and/or end-users were involved in the development process of DSS. Taken from the general literature on DSS, in order to facilitate the intended utilisation of DSS, stakeholders' input should actually be integrated in the design of the DSS. In doing so special attention should be given to the decision makers' problems, needs and input.

In order to generate a successful DSS the first step has to be the development of a clear understanding of what the decision is that the DSS is supposed to be supportive of. This requires the active involvement of the end-users in this process. In addition the development of a DSS can benefit from the input of other groups of stakeholders in order to enhance the decision making by generating additional information and increasing the legitimacy of the input and output of the process a DSS is more likely to be utilised in the end-user or problem owner is explicitly responsible for the aim of the DSS and its effect, and the DSS developers responsible for the outcomes as defined by the needs of the end-user; i.e. the deliverables that jointly form the DSS. End-users and developers should be in continuous interaction. A prerequisite of usable output of the DSS is when output data becomes information that is relevant for decision making.

Noting that data only will become information (Alter, 1998) when the data assists the user in taking a decision it is important to analyse the decision to be taken and to get agreement on how the DSS is constructed (knowledge rules), which problems can/should be solved, which data is used as input and how the output is utilised in the decision making process. Taking the end-users' needs into account before designing the DSS is one step in developing more useful DSS, another step is to make the end-user/ problem owner explicitly responsible for the aim of the DSS and its output. This would call for a more continuous interaction between end-user and DSS developer.

2. The tenet of ordering claims at sea

Marloes Kraan, David Goldsborough and Luc van Hoof

The use of Europe's seas and oceans is changing rapidly. We see an increased use of the marine waters and its resources both in traditional uses (such as shipping, fisheries and tourism) as in more novel functions such as renewable energy production and aquaculture. Also we notice a rapid development of the European Union (EU) policy framework for the marine waters, which today encompasses among others the Birds- and Habitat directive, Natura 2000, the Water Framework Directive, the Marine Strategy Framework Directive, the Common Fisheries Policy and the Integrated Maritime Policy.

The increased utilization of the seas and the strong call for conservation measures in the marine environment evoke increased competing claims over its natural resources and unveil a need for ordering the different functions [1,2]. Marine spatial planning is a process to allocate space for specific uses, which can help to avoid user conflicts, to improve the management of marine spatial claims, and to sustain an ecosystem-based management of ocean and seas [3].

According to Maes [3] marine spatial planning (MSP) is a public process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives that are usually specified through a political process. Ehler and Douvere (2009) have identified six characteristics of effective marine spatial planning, presented in figure 1 below [4]. These characteristics indicate the importance of governance aspects such as participation, transparency and legitimacy in marine spatial planning processes.

- Ecosystem-based, balancing ecological, economic, and social goals and objectives toward sustainable development
- Integrated, across sectors and agencies, and among levels of government
- Place-based or area-based
- Adaptive, capable of learning from experience
- Strategic and anticipatory, focused on the long-term
- Participatory, stakeholders actively involved in the process

Commission published the "Roadmap on Maritime Spatial Planning: Achieving Common Principles in the EU" in 2008 [2]. This document describes 10 key principles for Maritime Spatial Planning (MSP):

1. Using MSP according to area and type of activity
2. Defining objectives to guide MSP
3. Developing MSP in a transparent manner
4. Stakeholder participation
5. Coordination within Member States — Simplifying decision processes
6. Ensuring the legal effect of national MSP
7. Cross-border cooperation and consultation
8. Incorporating monitoring and evaluation in the planning process
9. Achieving coherence between terrestrial and maritime spatial planning — relation with Inter Coastal Zone Management (ICZM)
10. A strong data and knowledge base

In both literature and planning practices usually less attention is being rendered to the underlying principles and world views that shape the aspiration and process of marine spatial planning. In order to unravel the, perhaps tacit, assumptions shaping MSP processes we will in our analysis use the three orders of governance as defined by Kooiman and Bavinck: the day-to day operations where people and their organisations meet, the institutional arrangements in which these interactions take place and the level of meta-governance; the visions, principles and values that underline the governance process [5]. We will use these three orders of governance to illustrate how the underlying governance principles, or tenets (beliefs and opinions) play a role, and hence can also be put to use, in an MSP process. We will use the case of implementation of the European Natura 2000 policy framework on the North Sea Dogger Bank, an area where EU policy, national policies and several stakeholder groups' interests come together, to illustrate how these tenets can facilitate the ordering of claims at sea.

In section two we will present the analytical framework which we will use to analyse the tenets of marine spatial planning and its governance aspects. In section three we will describe and explore the process that took place on the Dogger Bank in the implementation process of Natura 2000. In section four we will discuss our findings and draw conclusions.

Governance principles: an analytical framework

As marine spatial planning is a process that often entails multiple levels of government and has to address the needs of multiple users, questions on the governance of the planning process, the way decision-making and the implementation process are organised, are of main importance. The governance concept implies more integrated approaches: 'governance goes beyond the problems at hand to consider longer-term societal trends and needs' [6]. An example of how governance can take form is the interactive governance approach as developed by Kooiman *et al.* [5]. Focusing on fisheries, they developed an analytical perspective to analyse the fisheries system – from ecosystem to the plate of the consumer. The analytical distinction they made between the 'system to be governed' the 'governing system', and the interactions between them, may well be used in understanding marine governance as a whole [5].

Their definition of governance thus is: "the whole of public as well as private interactions that are initiated to solve societal problems and create societal opportunities. It includes the formulation and application of principles guiding those interactions and care for institutions that enable them [7]. 'When governors try to solve problems or create opportunities, they inevitably bring to surface fundamental assumptions, world views and ethical values for discussion and examination' [8].

Kooiman *et al.* (2005) distinguish between three orders of governance. The first order of governance is about those activities that are about solving problems and undertaking day-to-day management. The second order of governance comprises the maintenance and design of institutions; developing the capacity to undertake first order governance by providing the guiding rules, or the way things are done. In the third order, also called meta-governance, the main normative principles and values are articulated, guiding the behaviour of first- and second-order governing [5]. Especially this meta-governance level is of analytical value as it brings to the fore the importance of underlying, often implicit world views and strongly held ideas of those involved in governance. In day to day operations the values, norms and concerns of the several stakeholder groups (including scientists, policymakers, Non-Governmental Organisations (NGOs) and industry) are often concealed. However as they fundamentally shape the debate and structure the governance arrangement, understanding these tenets and the way they are intertwined in the debate may assist in unravelling the first and second orders of marine governance and hence the goals and means articulated in the MSP process. These tenets also bear on the overall mode of governance that will evolve. Kooiman and Bavinck distinguish three ideal types of modes of governance: hierarchical governance, self-governance and co-governance [6]. Often mixes of these modes can be recognised in societies.

Principles and values shape the MSP process as they guide stakeholders' assessment of the state of the marine ecosystem and in particular in defining problems and opportunities. As governance becomes increasingly participative, with more stakeholders taking part in the process, developing a *shared* understanding of the state of the marine ecosystem and its uses and the need for change (thus defining the problem) becomes increasingly challenging. However as Mahon *et al.* (2011) state: 'As principles may vary with the perspectives of different stakeholders, explicit articulation is essential in order to ensure that actors operate from a common or agreed-upon set. At the very least, all stakeholders should have a common understanding of the base from which each set of actors will negotiate' [9]. Elucidating the underlying principles and values held by the different stakeholder groups may contribute to a mutual understanding and development of a shared vision (thus an explicit and *agreed* frame of principles and values). Shared principles increase the governability of the system [10].

Already in 1998 Constanza *et al.* recognized the need for a new shared principle, or paradigm, for governance of ocean resources in the face of growing uncertainty. 'The key to achieving sustainable governance of the oceans is an integrated (across disciplines, stakeholder groups, and generations) approach based on the paradigm of "adaptive management", whereby policy making is an iterative experiment acknowledging uncertainty, rather than a static "answer"' [11]. Six principles, the so-called Lisbon principles, underpin this paradigm (see figure 2 below).

Principles	From Constanza *et al.*
Responsibility	Access to environmental resources carries attendant responsibilities to use them in an ecologically sustainable, economically efficient, and socially fair manner. Individual and corporate responsibilities and incentives should be aligned with each other and with broad social and ecological goals.
Scale-matching	Ecological problems are rarely confined to a single scale. Decision making on environmental resources should (i) be assigned to institutional levels that maximize ecological input, (ii) ensure the flow of ecological information between institutional levels, (iii) take ownership and actors into account, and (iv) internalize costs and benefits. Appropriate scales of governance will be those that have the most relevant information, can respond quickly and efficiently, and are able to integrate across scale boundaries.
Precaution	In the face of uncertainty about potentially irreversible environmental impacts, decisions concerning their use should err on the side of caution. The burden of proof should shift to those whose activities potentially damage the environment.
Adaptive management	Given that some level of uncertainty always exists in environmental resource management, decision makers should continuously gather and integrate appropriate ecological, social, and economic information with the goal of adaptive improvement.
Full cost allocation	All of the internal and external costs and benefits, including social and ecological, of alternative decisions concerning the use of environmental resources should be identified and allocated. When appropriate, markets should be adjusted to reflect full costs.
Participation	All stakeholders should be engaged in the formulation and implementation of decisions concerning environmental resources. Full stakeholder awareness and participation contributes to credible, accepted rules that identify and assign the corresponding responsibilities appropriately.

Table 1: The Lisbon Principles of Sustainable Governance; [11]

Kooiman *et al*. (2005) discuss underlying principles in fisheries governance in three ways. Firstly they describe the current principles underlying the international laws and agreements that have developed since World War II such as the Code of Conduct for Responsible Fisheries, the Convention on Biological Diversity, the United Nation Convention Law of the Sea, the Universal Declaration of Human Rights, International Labour Organisation, World Trade Organisation [12].They have structured the discussion around what has been recognised in Kooiman *et al.* as the fundamental concerns in contemporary fisheries and aquaculture: ecosystem health, social justice, livelihood & employment and food security & safety [13].

Secondly Kooiman *et al.* discuss principles at the meta- level that should guide fisheries governance [14]. As the meta-level is normative by its definition, the authors become normative themselves, listing principles they feel should guide fisheries governance. This is valuable as an example, yet debatable as a choice, which they admit at the end of the chapter: 'these principles, either practical or distanced, should be the subjects of governance debates' [15]. In that sense the approach of Mahon *et al*. (2011) is more impressive, as they describe in their volume the process of arriving at a principles-based vision for Caribbean marine ecosystem based management and ways of achieving this vision. First of all the process was stakeholder based instead of driven by the thoughts of governance and fisheries specialists themselves, secondly because it shows how the choices were made. The whole point of taking principles into account in marine governance processes, being fisheries related or ecosystem based, is that there is no one set of principles for all processes but merely that the principles that underlie the visions of stakeholders and choices made are unveiled and discussed [16]. Mahon *et al.* (2011) provide a useful method of how such an exercise can be undertaken [16].

We will now turn to the case of MSP at the Dogger Bank. We will look at the different orders of governance and in particular focus on the way the underlying principles, values and norms as held by the different stakeholder groups played a role and were put to use in the planning process.

Ordering the Dogger Bank

The Dogger Bank, see figure 3 below, is the largest sandbank in the North Sea. It falls within the Exclusive Economic Zones of the United Kingdom, the Netherlands, Germany and Denmark. The overall surface area of the Dogger Bank is about 17,600 square kilometres and the distance to the nearest shore, the UK coastline, is a 100 kilometres.

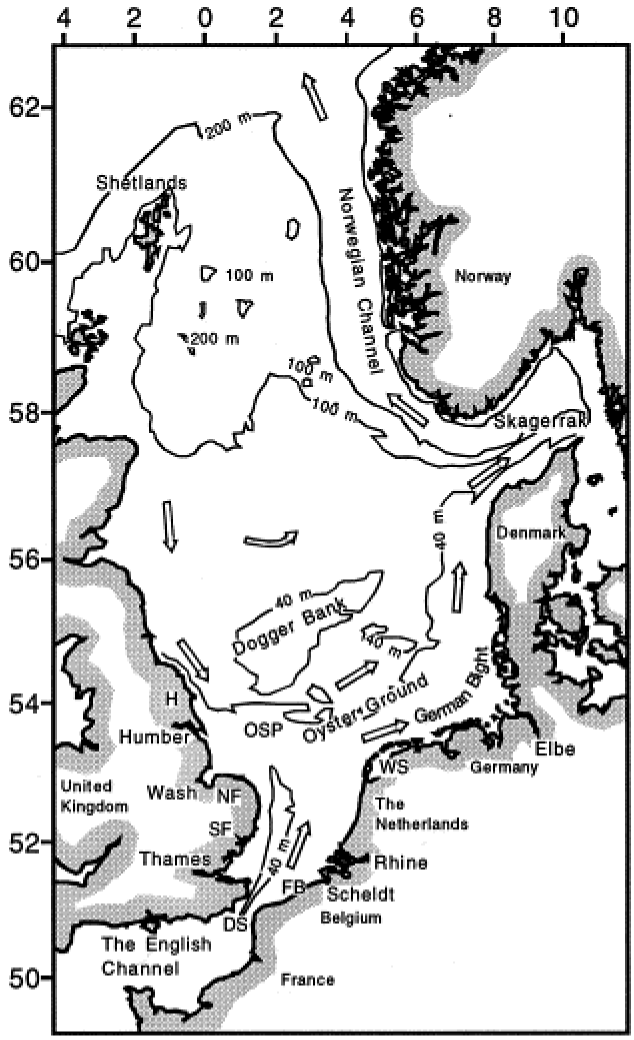

Figure 2: Map of the North Sea with geographic names which appear in the text. H = Holderness; NF = Norfolk; SF = Suffolk; DS = Dover Strait; FB = Flemish Banks; WS = Wadden Sea; OSP = Outer Silverpit. Arrows indicate the directions of residual currents of the surface water [17](Otto et al., 1990).

The Dogger Bank has a year round high production due to the clear water and the presence of fronts and provides food for fish, birds and marine mammals. Sand is the dominant sediment on the bank but muddy and stony patches can also be found. Five benthic communities are found on the Dogger Bank: (1) Bank community (most of the top of the sandbank), (2) North-eastern community on the northern slopes, (3) Southern community on the southern slopes, (4) Western community on the slopes in the west, and (5) South west patch [18].

The Dogger Bank has been nominated as a special area for nature protection under the EU Natura 2000 policy. Natura 2000 is the central EU nature and biodiversity policy combining the EU Birds- and Habitats Directive. Under the Habitats Directive Member States are required to propose Sites of Community Importance (SCIs) with habitat types and species that are listed in the Directive. Formal designation of proposed sites as Special Areas of Conservation (SACs) is the responsibility of the EC. For the Dogger Bank Habitat 1110 in Annex I, 'Sandbanks which are slightly covered by seawater all the time', is the qualifying feature, and this has led to the nomination of the Dogger Bank as an SCI by

Germany in 2004, the Netherlands in 2008 and the United Kingdom (UK) in 2011. Early on Denmark concluded that their part of the Dogger Bank does not qualify as an SCI under the Habitats Directive.

Historically the very rich fishing grounds on the Dogger Bank have been very important for fisheries and till date that is still the case. Other uses of the Dogger Bank include shipping, oil and gas extraction, cables and pipes lines, and preparations are under way to construct the largest wind farm in the world on the northern part of the UK Dogger Bank. The main challenge in implementing Natura 2000 on the Dogger Bank is to manage in particular the fisheries in such a way that defined Habitats Directive conservation and restoration objectives are met without having large detrimental effects on current commercial fisheries. In addition this Marine Spatial Planning process of combining different uses for certain areas at sea, requires cooperation between several EU member states.

As part of this MSP process the Dutch government initiated in 2010 the FIMPAS initiative. In order to ensure that fisheries measures would apply to all EU fishermen in Dutch marine protected areas (MPAs)1, including the Dogger Bank, the Netherlands initiated the FIsheries Measures in Protected AreaS (FIMPAS) project. This international project involved Member States, environmental NGOs, fisheries organizations and scientists in a process to identify fisheries management options for the Dutch MPAs in the North Sea. In January of 2011 the cross boundary nature of the Dogger Bank SACs and their fisheries was recognized by FIMPAS, and an inter-governmental Dogger Bank Steering Group (DBSG) was set up [19].

The main objective of this DBSG was to develop a fisheries management plan in relation to nature conservation, including a zoning proposal, for the combined area covered by the 3 national Natura 2000 sites (SACs of the UK, the Netherlands and Germany) of the Dogger Bank. This joint Member State proposal, including an integrated advice from the International Council for the Exploration of the Sea (ICES), would then be submitted to the European Commission (EC) for approval. As a first step in this process the North Sea Regional Advisory Council (NSRAC) was invited in March of 2011 by the DBSG to propose fisheries management zoning proposals for the Dogger Bank Natura 2000 areas. The NSRAC Spatial Planning Working Group (SPWG) discussed how to respond to this request. As they envisioned this to be a complex and time and money consuming process they, after consultation with the chair of the DBSG, asked the Centre for Marine Policy to facilitate and support the NSRAC through their MASPNOSE project (see box 1). With facilitation and support by the MASPNOSE project guaranteed, the SPWG formed a NSRAC Focus Group (NSRAC FG) to carry out this stakeholder driven process. This NSRAC FG consisted of 8 participants: 3 from the fishing industry (UK, the Netherlands and Denmark), 3 from NGOs, 1 FOREWIND consortium liaison, and 1 from the MASPNOSE Dogger Bank case study team.

MASPNOSE

With their Roadmap for Maritime Spatial Planning the EC aimed to facilitate the development of MSP by Member States and encourage the implementation at national and EU level. As practical experience with MSP was limited, the Directorate-General for Maritime Affairs and Fisheries (DG MARE) called for proposals (MARE/2009/17) "Preparatory action on Maritime Spatial Planning in the North East Atlantic/North Sea /Channel area". This preparatory action on MSP aimed to gather practical knowledge and experience in the implementation of MSP in a cross-border context, and aimed to stimulate the development of a common model, cross-border, ecosystem based approach towards MSP in the North East Atlantic/North Sea/Channel area. This preparatory action was granted to MASPNOSE; a project proposed by a small international (the Netherlands, Germany, Denmark and Belgium) consortium with involvement and support from national authorities and a number of key stakeholder groups including the NSRAC. The MASPNOSE project aimed to facilitate concrete, cross-border cooperation among European countries on ecosystem-based MSP. In this hands-on project the Dogger Bank was one of the two case studies. The objective of the Dogger Bank case study was to encourage cross-border cooperation for the area of three national SACs on the Dogger Bank, to test the 10 key-principles from the EU Roadmap on MSP, to identify gaps and barriers in the implementation of MSP, but also to identify opportunities. A combination of case study findings and other MASPNOSE results were used to formulate best practices on cross border MSP in EU setting. Detailed results from the MASPNOSE project can be found in the deliverables from this project and resulting papers.

Box 1: The MASPNOSE project

[1] Fisheries measures sanctioned by Member States in marine protected areas (MPAs) only apply to *all* European fishermen if they are issued by the European Union.

Four Dogger Bank stakeholder processes

In the period March 2011 till April 2012 the NSRAC Focus Group was involved in four stakeholder processes, all aimed at producing a fisheries management plan, including a zoning proposal, for the Dogger Bank, see table 2.

Period	Participants	Owner	Outcome
May - October 2011	NSRAC Focus Group	NSRAC FG	NSRAC Position Paper submitted to DBSG (October 2011) [20]
October - November 2011	DBSG, NSRAC FG and other invited stakeholders	DBSG	NSRAC to continue to develop a zoning proposal within strict terms of reference set by the DBSG. NSRAC FG to include DBSG observers [
December – February 2012	NSRAC FG and DBSG observers	NSRAC	NSRAC could not agree on joint zoning proposal as elaborated in February, 2012 NSRAC SPWG report [21]
March – April 2012	NSRAC FG and chair NSRAC	NSRAC	Final position paper on fisheries management in relation to nature conservation for the combined area of 3 national Natura 2000 sites (SACs) on the Dogger Bank, including two annexes explaining the rationale behind the NGO and industry zoning proposals. [22]

Table 2: Four Dogger Bank stakeholder processes

May - October 2011

In this process NSRAC FG members, invited stakeholders, experts and observers worked together at two 2-day meetings sharing and discussing data, knowledge, views and opinions on conservation and fisheries on the Dogger Bank. The terms of reference (TOR) for this NSRAC-owned process were set and agreed on by the NSRAC FG at the start of the process. The TOR detailed roles, responsibilities, procedures and deadlines and enabled a timely completion of the process. Although the produced position paper did not include a quantified zoning proposal it did include elements of a zoning proposal, constraints regarding the DBSG process and detailed guiding principles for future management of the Dogger Bank [20]. The described principles were related to responsibility, adaptive management, full cost allocation, and participation.

October - November 2011

The second Dogger Bank process was owned by the DBSG, facilitated by ICES, and concluded with a two day stakeholder meeting in Dublin in November 2011. The NSRAC was invited to this meeting to represent the stakeholders. At this Dublin meeting the NSRAC stated that they were not happy with the presented (ICES prepared) material, including three zoning scenarios. They expressed that if more time were available they would most likely be able to produce a joint zoning proposal for the Dogger Bank. As a result the DBSG returned the assignment to the NSRAC including detailed TORs.

December – February 2012

Initially these new Terms of Reference were not accepted by the NSRAC. In the end the NSRAC agreed to work with the set of TORs provided that the NSRAC would not at all cost stick to the letter of the TOR. This second NSRAC-owned process, including -for the first time- government DBSG members as active observers, started in December of 2011 and ended February 2012 with the failure of the NSRAC to produce a final joint zoning proposal: the main disagreement was on locations of areas to be closed and total percentage of the Bank to be closed. A key issue in the failure by the NSRAC appeared to be the wide range that was set in the TOR for the conservation zone: 25 to 55 % of the Bank.

As the process failed to produce an end result an extension with an April 2012 deadline was granted. DBSG included in this extension the requirement of involvement of the chair of the NSRAC and ICES in the process.

March – April 2012

In a scoping meeting, at the start of this third NSRAC process, the NSRAC FG and the chair and vice-chair of the NSRAC discussed the conditions of the extension and debated options for producing a joint fisheries management plan for the Dogger Bank, including a joint zoning proposal. During this meeting it became clear that the differences of opinion between the industry and the NGOs on the location and size of the area to be protected could not be resolved in the available time (less than a month) for this process. But at the same time these discussions unveiled several of the shared views of both industry and NGOs on principles for fisheries management in relation to nature conservation on the Dogger Bank.

The outcome of this scoping meeting was that the NSRAC FG agreed to produce a joint position paper for fisheries management in relation to nature conservation for the Dogger Bank with the addition that the disagreement between industry and NGOs would be described and detailed. During this meeting an outline of the document, including a table of contents, was also drafted and a procedure for the whole process was agreed on. To produce the position paper within the set deadline the NSRAC FG selected a small working group with stakeholder representation and decided that the remainder of the process would only involve the NSRAC FG. This was a deviation from the initially proposed process that also included the involvement of DBSG members. This new procedure was also communicated at the end of this meeting to the DBSG via a jointly drafted email.

The NSRAC succeeded in meeting the DBSG set deadline and the NSRAC Executive Commity adopted position paper “Fisheries management in relation to nature conservation for the combined area of 3 national Natura 2000 sites (SACs) on the Dogger Bank” was submitted to the DBSG on April the 10th 2012 [22](NSRAC , 2012). Crucial for the success of this process was that the NSRAC FG detailed and approved the procedure and the content of the process at the beginning.

Apart from the NSRAC final position paper both NSRAC stakeholder groups drafted a position paper detailing their view on fisheries management in relation to nature conservation on the Dogger Bank. These position papers were also submitted to the DBSG before the April 19th Dogger Bank steering group meeting in Brussels. The NSRAC FG participated in this meeting with three representatives: the chair of the NSRAC FG (=chair NSRAC SPWG), one industry representative and one NGO representative.

Principles and planning, discussion and conclusions

We will now use the three levels of governance to analyse the Dogger bank case and illustrate how principles play a role in the governance in Marine Spatial Planning. In the Dogger Bank case of MSP two processes developed: an intergovernmental EU Member States driven process and a stakeholder driven process around the NSRAC. The two processes were closely intertwined whereby the stakeholder process was to contribute to the more formal decision making process. Although linked, they developed as two distinct tracks.

The goal of the DBSG process was the EU member states’ implementation of the Natura 2000 obligation. Hence a focus on a formal governmental decision making process involving several member states as spindle around which advise from the science and stakeholder community was collected. In the process the institution of a Steering Group was created, yet the decision making process remained with the individual member states and their individual task of implementing Natura 2000.

Structuring the process around a rather formal institution such as the DBSG, and having government rulemaking in implementation of Natura 2000 as main governance arrangement, shaped the planning process. In such a configuration decision making remains firmly in the hands of the governors. Stakeholder participation was sought, yet this form of participation is not a type of co-decision making but rather one of informing the decision making process. The governors use information derived from the system to govern, be it from the science community or stakeholder community, to arrive at a decision. In governance terms the process relates strongly with the hierarchal mode of governance.

This governance mode fits with the set-up of EU marine policy, from which Natura 2000 derives. The task defined is perceived as being a rather straight forward implementation process in which goals and indicators have been defined, and only need to be operationalized. Responsibility for implementation is claimed by a single actor (government). Although to a certain extent this process can be open and transparent, stakeholders do not participate in the actual decision making process. Focus is on implementation rather than on deliberation.

The stakeholder driven process around the NSRAC was shaped by a different set of tenets. The process was initiated to inform a governmental decision making process on location and size of areas to be closed for fisheries on the Dogger Bank, for which stakeholder participation and knowledge was actively sought. Therefore the NSRAC was chosen as it is the platform were several stakeholder groups meet and functions as advisory bodies towards the Commission and on request to member states.

Although the two main factions in the NSRAC (the fishing industry and the environmental NGOs) in the end did not arrive at a single RAC advise, the process strongly hinged on the shared views of both industry and NGOs on principles for fisheries management in relation to nature conservation on the Dogger Bank. In addition, although implemented under the auspices of an existing institution (NSRAC) the specific working group (NSRAC FG) started out by discussing scope and procedure, and addressed the difficult task of agreeing on which issues could be dealt with within the group and the resources available.

The NSRAC FG governance mode of co-governance was shaped around agreement on task and scope and, more importantly, around a shared understanding of the goal of nature conservation on the Dogger Bank. This resulted in an advice from the NSRAC FG to the DBSG. It is in this interface were the differences in ordering principles of the two tracks become more evident. The DBSG principles lay with policy implementation and hence political interpretations of policy. The NSRAC process was more focussed on practical implementation rather than on interpretation. This resulted in two different fora; a DBSG built on policy interpretation and negotiations and a NSRAC advice built on practical implementation. This lead the two tracks to be incongruent: one focussed on content mater the other on politics. An important success factor of the first tack of the NSRAC FG was to be able to steer away from negotiations and focus on getting a better understanding of the issue at hand. This was done by from the start discussing and unveiling the underlying principles for fisheries management in relation to nature conservation, related to the first level of governance. In contrast, with involvement of the DBSG the second and third NSRAC process were dominated by negotiations on location and size of conservation zones.

In the NSRAC process the principle of participation was central, whereas the DBSG process focused on a decision making process institutionalised in a hierarchical mode of governance. These intrinsic different modes of governance of the two processes resulted in ambiguity on the second level governance (institution) of the Dogger Bank Natura 2000 process. Although principles related to the content of fisheries management were openly discussed, the underlying institutional principles, relating to the second level of governance, were not. As a result there was ambiguity as to the roles, responsibilities, timelines, and rules of the game. It should be clear which process and/or institution has decision power and at what point decisions will be taken. In addition, especially when based on different guiding principles, the success of the planning process is highly dependent on the degree of transparency and trust between participants. In addition it is essential that all parties involved in the process have commitment and resources available to play the agreed on role in the process.

In the Dogger Bank Natura 2000 case the two governance modes, the intergovernmental DBSG and the participatory NSRAC FG, never evolved into a single institution. As a result ownership of the process remained obscure, the legal framing and mandate of parties involved stakeholders was not always clear and disputed issues could easily be pushed around between the two fora. In addition the rules of the game were not always clear and changed during the process with new Terms of Reference being developed and pushed forward. On the upside, this first ever attempt at developing fisheries management measures on a large cross-border scale involving several EU Member States and stakeholders has shown that such a cooperation is a viable and realistic option.

As for the underlying principles of MSP and the questions on the governance of the planning process the Dogger Bank case demonstrates two important issues. First, the NSRAC process clearly demonstrated that by agreeing on the guiding principles of the working group, both in terms of a fundamental understanding of the conservation task as on the details of the work ahead, a stalemate between industry and ENGOs was reverted into cooperation towards a shared advise (be it not unanimous but with different opinions). Hence, following Constanza *et al.* (1998), Kooiman *et al.* (2005) and Mahon *et al.* (2011) by agreeing on basic high level norms and values at the third level order of governance, operations at the first order (the day to day operations) can be stimulated [11, 5, 16].

Secondly, the interaction between the DBSG and the NSRAC process illustrates that also the underlying principles of the second order (the institutional setting) need to be made transparent, discussed and agreed upon, as shared vision operations related to the first level can easily get derailed. This especially becomes evident when principles of responsibility and participation are oblique. Interpretation drift in mandate between institutions obscures the planning process.

Noting the amount of lists being produced to foster the principles of Marine Spatial Planning, the discussion on these principles is currently at centre stage. What we have illustrated here is that next to guiding principles to design an MSP process, such as e.g. ecosystem-based, integrated and participatory [4], or guidelines for implementation such as e.g. coordination within Member States, ensuring the legal effect of national MSP and cross-border cooperation and consultation [2] there are overarching views of the world, the tenets, that shape the governance of the MSP process. Being aware of these tenets can assist in facilitating a multi-stakeholder MSP process and moreover these tenets can be put to use in such an MSP process.

So to the principles defined for Marine Spatial Planning such as by Ehler and Douvre (2009) and the EC (2008), especially when it pertains to participation and stakeholder involvement, we would like to add the necessity of taking the third order level governance principles in consideration [2,4]. By agreeing on mandate and paradigm sustainable governance of the oceans can be achieved.

References

[1] Commission of the European Communities. An integrated maritime policy for the European Union. Commission Staff Working Document accompanying document to the Communication from the Commission to the European Parliament, The Council, The European Economic and Social Committee and the Committee of the Regions Brussels, 10.10.2007. SEC (2007)1278.

[2] Commission of the European Communities. Communication from the Commission. Roadmap for Maritime Spatial Planning: achieving common principles in the EU Brussels, 25.11.2008. COM (2008) 791 final.

[3] Maes F. The international legal framework for marine spatial planning. Marine Policy 2008; 32: 797-810.

[4] Ehler C. Douvere F. Marine spatial planning: A step-by-step approach toward ecosystem-based management. Paris, UNESCO. Intergovernmental Oceanographic Commission and Man and the Biosphere Programme. IOC Manual and Guides No. 53, IOCAM Dosier No. 6; 2009.

[5] Kooiman J, Bavinck M, Jentoft S, Pulin R. Fish for life. Interactive governance for fisheries. MARE Publication Series. Amsterdam: Amsterdam University Press; 2005.

[6] Kooiman J, Bavinck M. The governance perspective. In: Kooiman J, Bavinck M, Jentoft S, Pulin R. Fish for life. Interactive governance for fisheries. MARE Publication Series. Amsterdam: Amsterdam University Press; 2005. p16.

[7] Kooiman J, Bavinck M. The governance perspective. In: Kooiman J, Bavinck M, Jentoft S, Pulin R. Fish for life. Interactive governance for fisheries. MARE Publication Series. Amsterdam: Amsterdam University Press; 2005. p17.

[8] Chuenpagdee R, Degnbol P, Bavinck M, Jentoft S, Johnson D, Pullin R, Williams S. Challenges and concerns in capture fisheries and aquaculture. In: Kooiman J, Bavinck M, Jentoft S, Pulin R. Fish for life. Interactive governance for fisheries. MARE Publication Series. Amsterdam: Amsterdam University Press; 2005. p30.

[9] Mahon R, Fanning L, McConney P. Principled ocean governance for the wider Caribbean region. In: Fanning L, Mahon R, McConnney P. Towards marine ecosystem-based management in the wider Caribbean. MARE Publication Series. Amsterdam: Amsterdam University Press; 2011. p29.

[10] Bavinck M, Chuenpagdee R, Diallo M, Van der Heijden P, Kooiman J, Mahon R and Williams S. Interactive fisheries governance – A guide to better practice. Delft: Eburon Academic Publishers; 2005. p51.

[11] Constanza *et al.* Principles for sustainable governance of the oceans. Science 1998; 281; 5374:198-199.

[12] Bavinck M, Chuenpagdee R. Current principles. In: Kooiman J, Bavinck M, Jentoft S, Pulin R. Fish for life. Interactive governance for fisheries. MARE Publication Series. Amsterdam: Amsterdam University Press; 2005. p.245-263.

[13] Kooiman J, Bavinck M. The governance perspective. In: Kooiman J, Bavinck M, Jentoft S, Pulin R. Fish for life. Interactive governance for fisheries. MARE Publication Series. Amsterdam: Amsterdam University Press; 2005. p25-37

[14] Kooiman J, Jentoft S, Bavinck M, Chuenpagdee R, Sumaila UR. Meta-principles. In: Kooiman J, Bavinck M, Jentoft S, Pulin R. Fish for life. Interactive governance for fisheries. MARE Publication Series. Amsterdam: Amsterdam University Press; 2005. p265-283

[15] Kooiman J, Jentoft S, Bavinck M, Chuenpagdee R, Sumaila UR. Meta-principles. In: Kooiman J, Bavinck M, Jentoft S, Pulin R. Fish for life. Interactive governance for fisheries. MARE Publication Series. Amsterdam: Amsterdam University Press; 2005. p283

[16] Fanning L, Mahon R, McConnney P. Towards marine ecosystem-based management in the wider Caribbean. MARE Publication Series. Amsterdam: Amsterdam University Press; 2011.

[17] Otto

[18] Wieking G, Kröncke I. Macrofauna communities of the Dogger Bank (central North Sea) in the late 1990s: spatial distribution, species composition and trophic structure. Helgol Mar Res 2003; 57:34–46

[19] ICES. Report of the FIMPAS Workshop 3. Management proposals for Dogger Bank, Cleaver Bank and Frisian Front, 24-26 January 2011. Den Helder, the Netherlands. ICES Advisory Committee.

[20] NSRAC. Position paper on fisheries management in relation to nature conservation for the combined area of 3 national Natura 2000 sites (SACs) on the Dogger Bank. October 2011.

[21] NSRAC could not agree on joint zoning proposal as elaborated in February, 2012 NSRAC SPWG report

[22] Final position paper on fisheries management in relation to nature conservation for the combined area of 3 national Natura 2000 sites (SACs) on the Dogger Bank, including two annexes explaining the rationale behind the NGO and industry zoning proposals

3. A multitude of opportunities: competing claims and the potential for multiple use of the sea

Luc van Hoof with Jan Tjalling van der Wal, Robbert Jak, Katrine Soma, Christine Röckmann and Josien Steenbergen

Ongoing population growth, technological change, and shifting consumer demands all have considerably increased the need for more food, more energy and more trade. An increasingly larger share of goods and services comes from coastal and marine resources (Douvere and Ehler, 2009). The North Sea has a diversity of user interests including increasing claims for space for wind turbine parks, protection of ecologically valuable areas, shell fish production, fishing, tourism, recreation, shipping and sand extraction. A main challenge to marine spatial planning is how to allocate specific areas, or zones, to specific activities. Moreover, an important question is to what extent are these different activities competing for resources and/or space or could multiple uses be implemented simultaneously, or at least at the same place consecutively?

Traditional uses of the sea and sea bed, such as fisheries and transportation, have mostly been performed with ships. These uses are mobile and usually only stay within a given area for a relatively short period of time. The occurring user conflicts could often be resolved by steering a slightly different course to avoid a collision. Space is required for shipping lanes, and anchorages (where ships wait outside a harbour, until a berth is available).

Newer, but presently well established and accepted, uses such as the offshore oil and gas platforms, have been fitted in relatively unproblematic as the platforms are widely distributed in space and at least for ships have relatively small safety zones (500-1000 m.) associated with them. Pipelines and cables also have the benefit of exerting only a small claim on the available space at sea (narrow corridors) and are of no concern to ships, with the exception of fishing vessels that use bottom-touching gears.

The most recent additions such as Offshore Wind Parks and other methods of extracting renewable energy from the marine environment (e.g. wave and tidal energy generation) require quite a larger and (semi-)permanent area to be specifically set aside for these purposes. Or at the very least they are of consequence for ships in the fact that they limit the options that ships have on how they can safely pass an area. Presently wave and tidal energy have not matured beyond the (temporary) installation of pilots, but further development in suitable locations is to be expected.

Not only the space at sea is of importance but also the nearness of infrastructure on land has to be considered. Availability of ports and harbours are of importance to commercial vessels importing and exporting cargo and fishermen selling their catch. Also offshore wind farms and aquaculture require the vicinity of ports both in terms of markets but also as location for maintenance of equipment. Especially for the latter, the distance between ports and production platforms influences production costs in terms of fuel cost as well as in time spent travelling. As a result the preferred locations for specific activities are not equally distributed around the marine ecosystem but are dependent on availability of resources (fish, oil, gas, sand), on availability of preferred conditions (wind, tides, nearness to shore) and on the costs for construction and operation associated with a specific location. All and all this leads at the North Sea to a concentration of competition between activities in the coastal zone.

Proposed co-location of marine activities is therefore an attractive option for marine planners and stakeholders seeking to reduce the conflicts in use of the sea (Christie *et al.*, 2014). Question is whether co-location is legally feasible and how biology, ecology and hydrology of the site as well as commercial and economic factors will determine success (Christie *et al.*, 2014). To plan and govern overlapping activities in seas that are shared by several countries is demanding. Reconciling ‘new’ and ‘old’ uses of the sea is a challenge next to the fact that users find themselves in a situation where more space for one means less space for others. Relocating activities to other areas may not always be an option. For example closing an area for fishing, although in principle granting the individual fishermen using this are to go fish elsewhere, may due to a lack of knowledge about the new areas prohibit the fishermen to actually fish in a new location. Next to the fact that it will increase competition between fishermen in the remaining areas.

When two or more activities are operating in the same area this is referred to as ‘multiuse’, which implicit will include many operators in the same area who are referred to as ‘multiusers’. Multiuse is seen as a solution to increase overall benefit of space at sea, on the one hand by increased economic activities, and on the other hand by releasing opportunities for nature conservation elsewhere. Multiuse can provide opportunities by facilitating entry of new developments in scarce areas. Particularly, opportunities for developing aquaculture (shell fish, fish and algae) at offshore locations have been looked at. For such multiuse, the existing activities (e.g. an OWP or oil platform) are envisioning possible benefit, as their presence already limits shipping activities in given areas, which also could be used for aquaculture installations.

Arriving at multiuse would require a form of integrated management, in which all relevant sectors, interests and values, should be considered jointly during a process of distributing rights to access the marine natural resources, as for instance illustrated by the Dutch integrated management plan for the North Sea 2015 (IDON 2011), suggesting a strategy including analyses of respective spatial claims and of values in terms of utility and necessity.

We will use the experiences in the North Sea to examine the competing claims made on the seas and explore the potential for different groups of users to integrate specific uses. In this we will consider the role Marine Spatial Planning can play in facilitating this process. If an analysis of the management of human activities in the marine environment is called for, then the North Sea presents an ideal case study because from a global perspective the North Sea is one of the areas where human impact is highest (Halpern et al., 2008). In chapter two we will look at the potential use of our seas and oceans, the current competing claims that are exerted and the possibilities for multiuse. In chapter three we will examine the constraints that exist on multiple usage. In chapter four we will explore the role Marine Spatial Planning can play in multiuse. Finally in chapter five we will draw some conclusions and reflect on the potential for multiuse at the North Sea.

The potential for multiple use: user groups and competing claims in the North Sea

According to the European Commission, in their Blue Growth strategy, the sea and the coasts are drivers of the economy. The EU's blue economy represents 5.4 million jobs and a gross added value of just under €500 billion per year. In all, 75% of Europe’s external trade and 37% of trade within the EU is seaborne (Commission of the European Communities, 2012). In addition there is a potential of the seas and oceans yet untapped. So in its strategy for Blue Growth the EU Commission seeks to tap this potential. First, there has been rapid technological progress in working offshore in ever deeper waters. Robotics, video-surveillance and submersible technology are now routinely packaged into machinery for operations that were not feasible ten years ago. Second, we need to look how the 71% of the planet that is ocean can deliver human necessities such as food and energy in a way that is more sustainable. Third, the need to reduce greenhouse gas emissions has not only driven the deployment of offshore renewable energy installations, but has also provided a further impetus for energy saving and an additional reason to favour seaborne transport over land transport due to its lower emissions per tonne-kilometre (Commission of the European Communities, 2012). In order to develop the potential of the blue economy in Europe, Member States need to put in place policies and local solutions that effectively address existing barriers to tap this potential (Commission of the European Communities, 2014).

Tapping the potential of the sea also comes with restrictions. According to Christie *et al* (2014) worldwide demand for energy is growing and predicted to increase by up to three times by 2050. Renewable energy will play a vital role in meeting this demand whilst maintaining global climate change targets. Such developments place additional pressure on existing sea space and may result in conflicts with other marine activities and users. Co-location of certain activities, marine protected areas, aquaculture and commercial fishing in particular, has therefore been proposed as an option to ease demands on space (Christie et al., 2014).

This increased competition for resources and, moreover, for space is not a recent development. In 1965 Young described offshore claims and problems in the North Sea as the presence of petroleum and natural gas reserves could raise legal problems of considerable interest and complexity. “For the North

Sea is not merely an oilfield covered by water: for centuries it has been one of the world's major fishery regions and the avenue to and from the world's busiest seaports. Thus all three of the present principal uses of the sea – fishing, navigation, and the exploitation of submarine resources- promise to meet for the first time on a large scale in an area where all are of major importance."(Young, 1965 p. 505).

As described in the introduction, the competition between uses over resources is to a large extent a mere competition over space. Traditional uses of the sea such as fisheries and transportation are mobile and usually only stay within a given area for a relatively short period of time. The offshore oil and gas platforms are relatively widely spread out in space. Pipelines and cables also have a relative limited claim on the available space.

The most recent additions in the field of renewal energy production, such as offshore wind parks and wave and tidal energy require quite a larger and (semi-)permanent area to be specifically allocated for these purposes. Also the implementation of the EU Natura 2000 network, allocating zones for nature conservation do exert a spatial claim on available sea space.

As most uses seek the nearness of land based infrastructure in order to limit costs in terms of fuel cost as well as in time spent travelling a relatively large part of competing claims is exerted in the coastal zone. Also as available resources or conditions (fish, oil, gas, sand, wind, tides) are not equally distributed around the marine ecosystem competition can become locally concentrated.

In general we can see a tendency that traditional uses have to give up space to accommodate the newer uses. Hence give up fishing grounds to accommodate nature conservation and wind parks and relocate shipping lanes. Especially for fisheries from a historical perspective a lot of formally available space had to be given up to accommodate new uses. Already in 2004 the Dutch Fish Produce Board (Productschap Vis) issued a communication which stated that in today's spatial allocation at the North Sea fishing had been pushed to the extremities resulting to fishing to take only place on a 'post stamp' size space left (Productschap Vis, 2004). In figure 1 below the remaining space for fishing activities in the Dutch EEZ is illustrated by defining space claimed for by other activities.

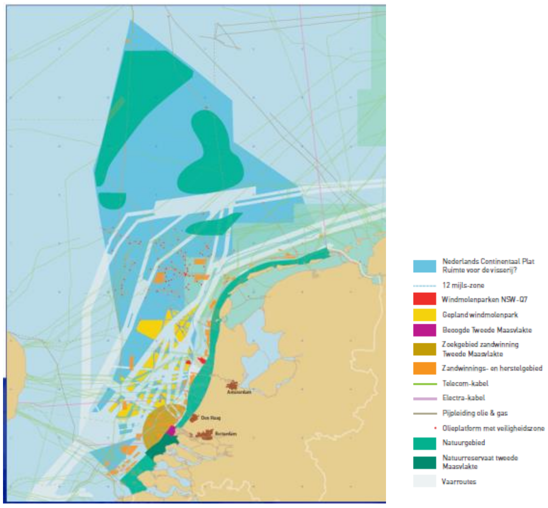

Figure 3: Space for fishing activities

Relating to this it is equally interesting that the Dutch government in its policy document on the use of the North Sea allocates quite a number of areas and zones for specific activities (especially for the national priorities of sand extraction for coastal defence and renewable energy production), yet when it comes to fisheries there is no specific area allocated for this activity (ministerie van Verkeer en Waterstaat et al., 2009). In fact it is stated that fishing activities can take place throughout the Dutch EEZ as so far as these are compatible with (other) activities of national importance being shipping, oil and gas extraction, military activities, sand extraction and wind energy production. In its 2011 revision of its policy document on the use of the North Sea the Dutch Government moves towards what appears to be a first step towards multiuse. The revision document states that the possibility for exploratory research into prospects of sustainable fisheries within the perimeter of wind farms will be created (IDON, 2011).

So with an increased pressure on available sea space and a desire to realise a Blue Growth agenda at sea, hence a further intensification of sea use, finding potential multiuse applications would provide leeway in a set of competing claims. Like in the marine ecosystem organisms and activities may interact in various ways in overlapping time and space. Enterprises or sectors compete for resources, or may find benefit from each other. In Table 1 the possible types of interaction between individuals, based on an ecological classification are summarized, and also extrapolated to describe interactions for human activities.

Table 1. Types of interactions in ecology, extrapolated to human activities (in italics between brackets)

Effect on X	**Effect on Y**	**Type of interaction**	**description**
-	-	Competition	mutually detrimental interaction between individuals, populations or species (*individuals, enterprises, sectors*)
0	**0**	Neutralism	describes the relationship between two species (*activities*) which interact but do not affect each other. Since true neutralism is rare or non-existent, its usage is often extended to situations where interactions are merely insignificant or negligible.
0	-	Amensalism	is a relationship in which a product of one organism (*activity*) has a negative effect on another organism (activity), in which one organism (*activity*) is harmed, while the other is neither affected nor benefited.
+	-	Antagonism	one species (*activity*) benefits at the expense of another (including predation and parasitism)
+	**0**	Commensalism	benefits one organism (*activity*) and the other organism (*activity*) is neither benefited nor harmed.
+	+ or **0**	Ecological / Economic facilitation	describes species (*activities*) interactions that benefit at least one of the participants and cause no harm to either. Facilitations can be categorized as mutualisms, in which both species (*activities*) benefit, or commensalisms, in which one species (*activity*) benefits and the other is unaffected.
+	+	Mutualism	an interaction between two or more species (*activities*), where species (*activities*) derive a mutual benefit, for example an increased carrying capacity.

It is obvious that a combination of human activities is most effective in the following cases;

Commensalism, Facilitation, Mutualism. Synergies are reached in case there is a mutual benefit for both (or all) activities, and none of them is harmed by the other(s). In the case of facilitation, the presence of one or more species may create conditions that makes it possible for another species to enter a habitat. This is originally described for the ecological process of succession, where an early successional species may so alter conditions or the availability of resources in a habitat that the entry of new species is made possible (Connell & Slatyer, 1977 in Begon et al., 1986). When extrapolated to human activities, it would mean that already established activities in an area (habitat) may have created an environment where new activities are made possible. These new activities can benefit from the ‘facilities’ created by other activities. In the concomitant development of (new) activities, sectors may pursue synergies by looking for possibilities for facilitation, e.g. by making use of existing facilities, or by coordinating (sub)activities, such as maintenance and supplies.

In theory quite an array of potential co-location possibilities, or multiuse opportunities exist. For example aquaculture activities could be easily shared with activities such as oil and gas extraction or with wind parks. In turn wind parks could be easily associated with activities such as marine protected areas or Natura 2000 zones. Also fishing activities could be co-located with other activities. For example alternative fishing methods could be applied in Natura 2000 areas; static gears could be used in combination with wind farms.

Constraints on multiple usage

As mentioned above, competing claims tend to especially materialise in the coastal zone and towards land-based facilities. Areas closer to ports and harbours, near large cities, are attractive to commercial vessels importing and exporting cargo, fishermen selling their catch and aquaculture producers selling their harvest. Also for renewable energy production and aquaculture the vicinity of suitable ports has a direct influence on the costs involved for construction and installation activities. This near-harbour-space is also required for shipping lanes and anchorages, where ships wait outside a harbour until a berth is available. Also when anchored in areas close by harbours, vessels needs a certain space to ensure safety related with water movements of tides and wind, as well as during strong weather conditions (storm, swell) when an anchor may not hold and a ship slowly move away from its intend anchoring position (crabbing).

Next to direct competition for space related to the location vis-a-vis land based infrastructure such as markets and harbours, hence nearness to shore, there is also competition for space in the coastal zone based on the physical characteristics. The relatively shallower waters of the coastal zone imply lower costs for construction for e.g. wind parks and other fixed infrastructure.

In addition there is also competition over time. A clear example of this are military zones that are used only part of the year for fleet manoeuvres and exercises. The remaining time of the year the area could be used by other users. This follow up in time can also be witnessed in other user, such as for example the renewed use of redundant production platforms for aquaculture activities.

Direct competition in time can occur when activities have to take place at the same place at the same time. For example harvesting of products from aquaculture installations can be time-critical to avoid damage and loss in quality. At the same time construction and maintenance of equipment for generating renewable energy can be time critical. Especially towards the end of summer a clash may occur, as the sea and weather conditions are favourable to each party's activities.

This highlights another phenomenon associated with multiple use. Currently most activities at sea are exerted by distinct user groups: fishermen fish, energy companies construct and operate renewable energy installations and aquaculturists farm fish. Each professional group brings a distinct set of practices, knowledge and know-how to the sea. In case of multiuse one of the conflicts that arises easily is not only the challenge to combine two or more uses in space and time but also to bring together the different practitioners. One solution could be that a single operator exploits both uses, hence the wind farm operator starting aquaculture activities or the aquaculturist starting a wind mill farm. Quite often these types of multiuse do not materialise out of a lack of knowledge and know-how about the new activity. In that case co-location of activities implies also the cooperation between users. This in itself can be a challenge to organise with issues such as are both operators operating under one organisational structure (company) or are the separate activities organised disjointedly in which case coordination of activities can become problematic.

Polices, laws, rules and regulations can be facilitating or hindering factor in developing multiuse. Policies in the Netherlands tend to not be favourable for developing multiuse as licenses for e.g. offshore wind farms and oil and gas grant exclusive rights to develop a given area, with no incentives to promote multiuse. This results in the practice of no fishing and no shipping being allowed within wind parks in the Netherlands. In the UK the policy appears to be slightly more open to multiuse possibilities, as consortia are granting licenses to develop wind parks with no policy excluding shipping and fishing from these areas. Whereas this is similar to the situation in Denmark, in Germany the situation is similar to the Netherlands with less flexibility towards multiuse. Belgium on the contrary actively searches for multiuse, in this case investigating possibilities for developing aquaculture activities in or near wind parks.

In this it should also be realised that policies and regulations materialise in differing institutional settings. For example shipping activities are organised at the international level by the International Maritime Organization IMO, fisheries activities within the EU are regulated by the Common Fisheries Policy and the allocation of space for wind farms is a national prerogative. Implementation of nature conservation at sea takes shape under the Marine Strategy Framework Directive and the Bird- and Habitat Directives in the Natura 2000 programme. As these are all directives it is up to the individual

Member States to further shape the policy by putting the directive into national rules. In this process, and within the limits of Commission oversight, domestic actors can adopt an interpretation that somewhat deviates from the directive. In this vein, the mechanisms of a directive are seen by the Commission as preferable to that of a regulation or a decision that would be too detailed and restrictive, have a character of a 'one size fits all' approach, and thus, would be inappropriate to address the varied problems in each region (Juda, 2007).

Providing this leeway for individual Member States indeed provides the Member States with the opportunity to devise a policy that best fits local circumstances. However, this may also easily lead to a situation in which different adjacent Member States develop different policies for a shared area. Case in point in this respect is the Doggerbank of which the Natura 2000 interpretation and the allowing of activities within the area differs between the UK, Denmark, Germany and the Netherlands.

This also brings to the fore that not only within a national EEZ a demand for coordination between users and between policies is required. As the sea does not stop at national borders it also requires from the riparian states to coordinate policies and policy implementation.

Even if countries have policies favouring multiuse, co-location of activities may not develop into a common arrangement because of other structural barriers. One such a barrier can be the issue of insurance. Insurance companies can set contract conditions which are limiting, or even obstructing, opportunities for multiuse. An example is the increase in insurance fee when an operator of a wind farm seeks to co-locate aquaculture activities. The increased fee prohibiting the co-location.

All in all from a technical and practical perspective quite some multiuse and co-location of activities at sea is possible. And the multi-dimensional aspects of the sea render ample opportunities to create multiuse both in place and in time. Also from an economic and (business) financial perspective multiuse creates (new) opportunities that may render individual activities to become more viable. For example the co-location of aquaculture activities, algae reactors and wind farms could increase the overall viability of each of the individual activities.

However there are also quite some barriers that can hinder the development of effective multiuse of the seas. Policies and laws need to facilitate and not obstruct multiuse. This is quite challenging in a multi-level governance setting in which at different levels (national, local, regional, international, supranational) policies are being made and implemented. Coordination is hence needed at all of these levels and an appropriate institutional setting needs to be devised in order to facilitate the process of co-location.

Also having multiple users cooperate may provide a challenge. The benefits of co-location may not be that easily reaped. Yet in a situation of increased competition and a (policy) strive for even increasing use of the seas and oceans not considering multiuse may not even be an option.

The potential role of Marine Spatial Planning and multiple users

From the above we may conclude that facilitating multiuse at sea faces three challenges. The first challenge is to bring the operators of different activities together to seek for benefits in co-locating activities. The second challenge lies in the development of a policy and planning framework for the sea that actively caters for co-location. Thirdly there is a need for devising an institutional setting that will allow for facilitation and coordination of multiuse at the scale of the ecosystem.

Marine Spatial Planning may have a role as mechanism of co-ordination of different activities and sector policies. Marine spatial plans have often been motivated by the emergence of a new use of the ocean that threatens to displace existing uses (Collie et al., 2013; Young, 1965). Planning is to be understood not only as a legal instrument or a public investment plan, but also as an operational and programmatic tool for the development of public policies as well as of private investment strategies and local initiatives (Commission of the European Communities, 2000). In this way Marine Spatial Planning is a process that can enhance sustainable growth as it provides legal certainty, predictability and transparency, thus reducing costs for investors and operators (Schaefer and Barale, 2011).

Starting within the context of Marine Protect Areas, Marine Spatial Planning is often associated with comprehensive zoning to specify acceptable uses and activities. In the case of multiuse allocating specific zones to single activities does not cater for the need for co-location. Then the main issue is where and how to allocate marine space to different activities?

A rather simple way of allocating space for activities is to base the allocation on profitability of activities and give sectors scoring highest the priority to use the largest share of the marine resources. A problem with this approach is that this is a rather short term approach which tends to overlook other -environmental and social- values, values which are not directly captured in monetary market values. For instance, damage to marine ecology has a risk of reducing future use possibilities, in terms of buffer mechanisms to climate change and acidification, but also in terms of depleting possibilities for future products, such as medicine. Also aesthetic and ethical values – in terms of 'warm glows' gained by seeing or knowing that marine biodiversity exist, as well as considerations about damaging biodiversity, which is judged as 'a bad thing to do' given the long time these systems needed to develop complex functions and interactions among sub-systems as well as resilience, i.e. the ability to recover from different degrees of impacts. As for aesthetic considerations, wind parks are generally not appreciated to be located close to shore, disturbing the unobstructed ocean view which, among others, may have a direct effect on the tourist industry.

In order to reach acceptable solutions to the resource allocation and support for spatial allocation of the seas, stakeholder involvement has been suggested a priority. Again, there are problems related with stakeholder processes, as they tend to take shape as negotiations with a focus on distributional aspects only. In such processes, the strongest actors tend to gain the largest access possibility, which is not very different from just estimating the largest profitability.

Thus multiuse would not be a logical outcome of the two strategies above. The challenge is thus to design a process that can ensure public backing and support providing actors with opportunities to explore solutions with mutual gains and benefits. In this way, multiuse would emerge as a relevant alternative. How to incorporate this in a process of Marine Spatial Planning?

Marine spatial management involves policy issues with different value dimensions, which are characterized by incommensurability. This implies that trade-offs cannot solve the conflict by replacing a loss of one aspect with a gain of another; for example, compensation in money of a loss in biodiversity may not be considered a sufficient or adequate solution. Possibilities to incorporate incommensurable values are necessary when looking for best alternative ways of allocating marine space among interested parties.

Alternative multiuse options can be seen as relevant win-win situations where more than one sector can benefit from a given area. In addition to the need of incorporating incommensurable values, relevant process-oriented criteria have been identified in processes looking for win-win situations. They include: 1) Legitimacy, 2) Information management, 3) Social dynamics and 4) Costs of implementation. (Varjopuro et al 2008, Rauschmayer et al 2008, Berghöfer et al 2008).

Legitimacy refers to the degree to which a policy decision is considered to be respected, obeyed and in concordance with accepted rules by the people affected. While a decision is legitimate if its outcome is considered in accordance with substantial rules, it might be considered not legitimate if it contradicts accepted procedural rules of decision-making (Varjopuro et al 2008).

The mapping of the diversity of preferences of the different stakeholder groups can increase the legitimacy during the process. Linked to the issue of legitimacy is the issue of representation. As it is not possible to involve every one, a central question is related to how the different views should be represented during the process and by whom.

Interactive processes in the form of dialogues allow for the development of new solutions which can benefit many more than only the most profitable sectors (Giller et al 2008). During the dialogue based interactive processes, while developing understanding through processes of mutual learning of the different values, goals and interests as a starting point, the possibilities for creative thinking of future win-win solutions for resource allocation becomes appropriate. Hence, based on identifying marine ecological, economic, social and spatial dimensions as a starting point to find relative importance to different objectives, scenario analysis to assess win-win situations constitutes a useful tool to arrive at best possible solutions (Giller et al 2008). As pure objectivity is not achievable during processes of conflict management, as even the definition of research questions involve value driven influence (Giller et al 2008), the aim must be to balance the multi-level multi actor interests and values (Giller et al 2008).

Using the principle of Ecosystem Based Management may be seen as an essential means to work towards innovative new Eco-Dynamic Designs (EDDs) of combinations of offshore activities. EDDs integrate multiple disciplines and therefore have multiple aims. Due to these increasing number of aims, the number of relevant stakeholders is likely to increase as well (Van den Hoek et al., 2012). Key to Eco-Dynamic Design is that stakeholders from science, policy and practice are involved in the co-creation of an innovative design from the early stages of project development (van Slobbe and Lulofs, 2011; Van den Hoek et al., 2012; van Slobbe, 2010). Stakeholder participation with the aim of co-creation often occurs in so-called Communities of Practice (CoP) (Wenger, 1998). A CoP can be characterised by mutual commitment on the part of participants by a common aim which is decided upon by all the participants. A shared repertoire is created in the process to create knowledge such as routines, words, instruments, ways of acting, stories, symbols and gestures. Knowledge development is then seen as a process in which knowledge, communication and behaviour are inseparably linked; they create one another (Wenger 1998). The advantage of participatory approaches such as CoP focussing on co-creation is that the potential for conflicts at later stages in the project is likely to be reduced. The legitimacy or acceptance of the process increases, creating the idea or assumption that co-created actions are desirable, proper or appropriate within a socially constructed system of norms, values, beliefs and definitions (Suchman, 1995). By involving stakeholders in the process, it is argued that the quality and durability of decisions is likely to be greater (Reed, 2008).

Marine Spatial Planning involves complex situations where uncertainty is high and where different values and interests are at stake. Consequentially, there is a need for interdisciplinary approaches to understand resource use and problems in achieving synergies during participatory processes (Giller et al 2008). Interactive processes may be made in the form of negotiation with merely distributive focus, or they can be interactive in the form of dialogues (Habermas 1970).

Concluding reflection

The North Sea is one of the most crowded and intensely used marine areas around the globe. The pressure on the North Sea to facilitate expanding existing uses and to accommodate new uses is growing. On the one hand this growth is perceived to tap the yet un- and underused potential of the seas. On the other hand it is to cater for the scarcity of space on land.

The sea has a lot of resources to offer. And, more than on land, the multi-dimensional configuration could potentially allow for more than one activity to take place in a specific place and in time. The search is for how to optimise the use of the sea and accommodate potential co-location and multiuse of the seas.

The preferred locations for specific activities are not equally distributed around the marine ecosystem but are dependent on availability of resources (fish, oil, gas, sand) and on availability of preferred conditions (wind, tides, nearness to shore). Especially a number of new uses have a clear preference to be located close to ports and land based facilities. This results in increased competing claims especially in the coastal zone.

From a technical and practical perspective quite some multiuse and co-location of activities at sea is possible. And the multi-dimensional aspects of the sea render ample opportunities to create multiuse both in place and in time. Also from an economic and (business) financial perspective multiuse creates (new) opportunities that may render individual activities to become more viable. For example the co-location of aquaculture activities, algae reactors and wind farms could increase the overall viability of each of the individual activities.

However there are also quite some barriers that can hinder the development of effective multiuse of the seas. Policies and laws need to facilitate and not obstruct multiuse. This is quite challenging in a multi-level governance setting in which at different levels (national, local, regional, international, supranational) policies are being made and implemented.

In allocating space for activities three main challenges need to be addressed. The first challenge is to bring the operators of different activities together to seek for benefits in co-locating activities. The second challenge lies in the development of a policy and planning framework for the sea that actively caters for co-location. Thirdly there is a need for devising an institutional setting that will allow for facilitation and coordination of multiuse at the scale of the ecosystem.

Distributing scarce marine space is an interplay between uses but also its users. Whereas Marine Spatial Planning, especially when it relates to zoning of the seas and hence allocating areas for specific activities, may assist in providing a legal instrument or a public investment plan providing legal certainty, predictability and transparency, in itself it does not cater for multiuse. In addition, in optimising the allocation of zoning from the perspective of single uses there may well be no one optimal solution for all.

Multiuse may not be a logical outcome of a planning process as it involves practitioners form different sectors bringing different experiences knowledge and know-how to the table. The challenge is thus to design a process that can ensure public backing and support providing actors with opportunities to explore solutions with mutual gains and benefits. In this way, multiuse would emerge as a relevant alternative.

Coordination is hence needed at all of these levels and an appropriate institutional setting needs to be devised in order to facilitate the process of co-location. The benefits of co-location may not be that easily reaped. Yet in a situation of increased competition and a (policy) strive for even increasing use of the seas and oceans not considering multiuse may not even be an option.

Hence, while potentially multiuse options are available and can be perceived as possible win-win situations, they would need to be addressed in a proper design of marine spatial strategies to arrive at best options for policy making on marine spatial planning.

References

Christie, N., Smyth, K., Barnes, R., and Elliott, M. 2014. Co-location of activities and designations: A means of solving or creating problems in marine spatial planning? Marine Policy, 43: 254-261.

Collie, J. S., Adamowicz, W. L., Beck, M. W., Craig, B., Essington, T. E., Fluharty, D., Rice, J., et al. 2013. Marine spatial planning in practice. Estuarine, Coastal and Shelf Science, 117: 1-11.

Commission of the European Communities 2000. TERRA – AN EXPERIMENTAL LABORATORY IN SPATIAL PLANNING chapter 2 Towards a new system of spatial planning. Office for Official Publications of the European Communities.

Commission of the European Communities 2012. Communication from the Commission to the European Parliament, the Council, the European Economic And Social Committee and the Committee of the Regions. Blue Growth opportunities for marine and maritime sustainable growth. COM(2012) 494 final. Brussels.

Commission of the European Communities 2014. Innovation in the Blue Economy: realising the potential of our seas and oceans for jobs and growth. COM(2014) 254 final/2. Commission of the European Communities,, Brussels.

Douvere, F., and Ehler, C. N. 2009. New perspectives on sea use management: Initial findings from European experience with marine spatial planning. Journal of Environmental Management, 90: 77-88.

Halpern, B., Walbridge, S., Selkoe, K. A., Kappel, C. V., Micheli, F., D’Agrosa, C., Bruno, J. F., et al. 2008. A global Map of Human Impact on Marine Ecosystems. Science, 319: 948-952.

IDON 2011. integraal beheerplan Noordzee 2015; herziening 11 november 2011. Ed. by ministerie van Infrastructuur en Milieu, ministerie van Defensie, ministerie van Economische Zaken, Landbouw en Innovatie,, and Rijkswaterstaat. den Haag.

Jentoft, S., and Knol, M. 2014. Marine spatial planning: risk or opportunity for fisheries in the North Sea? 12: 1-16.

Juda, L. 2007. The European Union and Ocean Use Managament: The Marine Stratgey and the Maritime Policy. Ocean Development and International Law, 38: 259-282.

ministerie van Verkeer en Waterstaat, het ministerie van Volkshuisvesting Ruimtelijke Ordening en Milieubeheer, and het ministerie van Landbouw Natuur en Voedselkwaliteit 2009. Beleidsnota Noordzee 2009 - 2015. den Haag.

Productschap Vis. 2004. Nota Ruimte voor Visserij. Vissen op een Postzegel.

Schaefer, N., and Barale, V. 2011. Maritime spatial planning: opportunities & challenges in the framework of the EU integrated maritime policy. 15: 237-245.

Young, R. 1965. Offshore Claims and Problems in the North Sea. The American Journal of International Law, 59: 505-522.

4. The role of science in Marine Policy making: Reflecting on the role of IMARES as boundary organisation in applied marine research projects.

Marloes Kraan and Martin Pastoors

IMARES as boundary organisation

IMARES can be seen as a boundary organisation, it is an applied scientific research institute which implicates that it does research that needs to be relevant for policy. IMARES often operates in a boundary area with policy officers where science and policy overlap. In the boundary area a variety of activities take place between scientists and policy makers; the translation of policy questions into research questions, the translation of scientific knowledge into usable knowledge and in some cases also joint knowledge production (Turnhout et al 2007: 221). These activities have been called boundary work (Gieryn 1983) and comprises all processes and negotiations that take place at the science-policy interface. Both scientists and policy makers try to keep the distinction between science and policy but how that works out in practice depends on the context (see also Rockmann et al 2014).

Not all actors are always aware of this boundary work, for many the demarcations between policy and science are real and sharp. Science deals with facts and rationality and policy deals with values and emotions. The borders between the two domains are often normatively valued: 'while facts are allowed, values are not, and while rational is good, emotional is bad' (Turnhout et al 2007:221). The boundaries are functional; it is valued as important to protect science from the biasing influence of politics (Cash et al 2002:1). However the boundaries also act as barriers to communication, cooperation and integrated assessment and action (Cash et al 2002:1).

Traditionally scientists have focused on credibility; how to create authoritative, believable and trusted information, thereby prioritizing methods development, and creating a system in which peer review served as the main guardian of quality. This is a very powerful driver of science; working on interesting studies in the field of interest and getting them accepted in the scientific community. For many applied scientists this in fact still is the main driver. Implicitly, the authors hypothesise, that many scientists assume that their work and their products are taken up in the policy domain and accepted in society as long as it is credible. However research has shown that for science to be effective in policy it should also be viewed as salient (relevant) and legitimate by the clients and stakeholders.

Science for policy usually takes place within a context of high stakes, substantial uncertainty and the need to take decisions, a situation which has been described as post normal science (Ravetz 1993). Especially so when the topics of research are related to complex problems, which has also been called 'wicked problems' (Rittel and Webber 1973). Wicked problems are problems which are difficult to define and to view them separately from other and bigger problems. Wicked problems are not solved once and for all but pose a constant challenge, partly because it is not known for sure when or if they are solved (Jentoft and Chuenpagdee 2009). Jentoft and Chuenpagdee (2009) describe many fisheries problems as wicked and discusses implications for governance. Marine spatial planning, sustainability or an ecosystem based management also deal with complex problems in complex and dynamic systems. In this paper we focus on the implications of wicked problems for the role of science in the wider governance setting.

Turnhout et al (2007) have differentiated between 4 types of policy problems: structured, unstructured, badly structured and moderately structured (Turnhout et al 2007). They claimed that depending on the type of policy problem, 'science takes on a different role and knowledge takes a different shape' (Turnhout et al 2007:225). It is only in well-structured problems that there is consensus on the goals and means and methods of reaching the goals. Only in well-structured policy problems, science' role is clear; the role of problem solver and with knowledge often taking the form of data. With all the other forms of policy problems, which can be seen as different gradients of wicked problems, the role of science is not that of a problem solver but can take the form of accommodator, advocate or problem signaller; knowledge will not be solely data but can take the form of ideas, concepts and arguments (Turnhout et al 2007:224). Following Cash et al (2003) we pose that applied science (aiming to be useful in policy), especially when it deals with wicked problems, needs to be held credible, salient and legitimate by the actors in the field (researchers, policy officers and stakeholders).

This is however not often explicitly assessed. It is not part and parcel of scientists to reflect after the work is done with stakeholders on how they have valued the work (process) done. In the Zee op Zicht (Sea sight) project we have used a post-hoc evaluation methodology assessing the scientific work / activities in a number of recent or ongoing projects by interviewing involved actors. The projects were selected as cases to highlight different aspects of the role of knowledge in the policy-related research, it does not have the ambition to be comprehensive:

1. MASPNOSE - A preparatory action for Marine Spatial Planning in the North Sea; this is a tender project funded by the Directorate-General for Marine Affairs and Fisheries (DG MARE) that fits closely to the European Union (EU) MSP policy process.
2. MEFEPO - Making European Fisheries Ecosystem Plan Operational; an EU FP7 funded project.
3. MSFD - Implementation of the Marine Strategy Framework Directive; a project funded by the Dutch government, which looks at the science-policy interface on how to support policy makers.

In this article we focus on the analyses of the MASPNOSE project, with the intention to do a comparative analysis with the other projects in a later stage.

Theoretical framework

Marine science is one of the research domains that clearly is meant to produce knowledge for action; action which needs to be decided upon in an arena in which different actor groups contest policy decisions and also question underlying information (see also Cash et al 2002: 13-15; Wilson 2009). The actor groups are: managers (policy makers and politicians), scientists, fishers and NGOs. In order to apply scientific results in a policy process, boundary work needs to be performed (Clark et al 2010). The uptake of knowledge in policy depends on the effectiveness of boundary work. SCL literature has shown that advise is more likely to be taken up if the knowledge is perceived by stakeholders as salient, credible and legitimate.

Boundary work, originally coined by Gieryn (1983), refers to the activities to overcome tensions on 'the interface between actors with different views of what constitutes reliable or useful knowledge' (Clark et al 2010). Although the concept of boundary work may seem intuitive, the operationalization into concrete factors that can be evaluated is a challenge. The approach taken in this paper follows the three criteria identified by Clark et al (2010): Saliency, Credibility and Legitimacy (or SCL criteria) and has been operationalised further (see table 1).

Criterion	Operationalization
Saliency	1. Is it relevant or valuable for the decision or policy in question? 2. Does the knowledge provided fit into the policy challenge behind the question? 3. Was the knowledge presented at the scale useable for policy-making? 4. Was the timing of the knowledge product in line with the requirement for policy-making?
Credibility	1. It is technically adequate in its handling of evidence? 2. Has the knowledge been produced according to the scientific standards? 3. Has the knowledge been adequately (peer) reviewed? 4. Did the researchers carrying out the research have the expertise to do the analyses? 5. Has the knowledge produced (results) included the needed expertise? (Different disciplines) 6. Quality of data & information, transparency of procedures. 7. Quality of data & information
Legitimacy	1. It is fair, unbiased, and respectful of stakeholders? 2. Has the knowledge been derived while considering all relevant sources of information? 3. Has the knowledge process been open to perspectives from different stakeholders? 4. Does the knowledge produced show a preference for certain types of data or information? 5. Did all stakeholders have an equal/balance amount of resources (a. time/ b. budget/ c. access to information/d. others) during the knowledge production process? 6. In case of conflict of interest was a strategy used to reconcile those different interests?

Table 1. Three criteria of knowledge, modified, with key questions and issues to consider. (based on Mitchell et al. 2006 and Clark et al., 2010, Wilson 2009)

Saliency, credibility and legitimacy should be seen as attributions because they are not objective; they are 'actor-specific judgements using different criteria and standards' (Cash et al 2002). They differ between stakeholders, stakeholder groups, and between different cases or contexts. There are also variations of boundary work dependent on different uses of knowledge in policy: enlightenment, decision, negotiation; and on different sources of knowledge; knowledge that is seen by users as originating from a single authoritative source or knowledge originating from multiple possibly conflicting sources (Clark et al 2010). The more politicized the context and the more users involved as well as sources of knowledge the more boundary work needs to include not only credibility but also saliency and legitimacy. Furthermore White et al (2010) have also assessed how the responses could be qualified; as positive (about the SCL), negative or neutral.

In this theoretical framework we bring three approaches together:

- How is the knowledge / knowledge process evaluated?
    - As salient, credible and or legitimate?
    - How can these responses be qualified? As positive, negative or neutral?
- What is the knowledge used for; to enlighten, to make a decision or for a negotiation?
- What are the trade-offs (Cash et al 2002) and what can we learn from them?

As in this paper we only assess the MASPNOSE project, we will only discuss the outcomes of the first question: How has the knowledge / knowledge process of the MASPNOSE project been evaluated by the actors involved in the project?

Study Methods

In this project IMARES was interested in evaluating its own role in research projects. As an applied institute IMARES seeks to make an impact with the research projects in policy, in the Zee op Zicht (Sea sight) project we found the room to do such a reflective project, focusing on the role of science and the uptake of science. It was decided that better insight could be gained by an evaluation of the salience, credibility and legitimacy of the knowledge of projects IMARES was involved in, by interviewing stakeholders involved in the projects. In order to maintain some distance, we found a masters student from the Wageningen University (Sara Gonzalez de Uzqueta de Lorza) to do the interviews during her research internship at IMARES. To allow for comparability a common theoretical framework was developed, and as well as an extensive interview protocol, allowing for a thorough operationalization of the concepts (see Gonzalez de Uzqueta de Lorza 2013).

The MASPNOSE project

The MASPNOSE project was funded in 2009 and was based on a call for proposals from DG MARE (MARE/2009/17) "Preparatory action on Maritime Spatial Planning in the North East Atlantic/North Sea /Channel area". This preparatory action on Maritime Spatial Planning (MSP) aimed to gather practical knowledge and experience in the implementation of MSP in a cross-border context, and aimed to stimulate the development of a common model, cross-border, ecosystem based approach towards MSP in the North East Atlantic/North Sea/Channel area. All of this followed the Roadmap for Maritime Spatial Planning by the EC (Commission of the European Communities 2008) which set down some common guidelines for MSP directed at Member States. The MASPNOSE project was proposed by a small international (the Netherlands, Germany, Denmark and Belgium) consortium of research institutes with letters of support from national authorities and a number of key stakeholder groups including the NSRAC. The MASPNOSE project aimed to facilitate concrete, cross border cooperation among European countries on MSP. Two case studies were taken on the Thornton bank and the Dogger Bank.

- Thornton Bank: an area comprised between Belgium and The Netherlands, partly on sand banks located on both sites of the border.
- Dogger Bank: an area between the United Kingdom, The Netherlands, Germany and Denmark where cross-border MSP could aid to address the issue of fisheries management, nature conservation and sustainable energy production.

A combination of case study findings and other MASPNOSE results were used to formulate best practices on cross border MSP in EU setting. Detailed results from the MASPNOSE project can be found in the deliverables from this project and resulting papers.

Methodology

For the MASPNOSE case we have interviewed 10 people; 2 researchers who were involved in the project, 4 government officials; of which 3 were related to involved member states (The Netherlands and Belgium), 1 worked at the EU; and 3 stakeholders (one member of the NSRAC (working at an NGO) and two fisher representatives) and an external advisor to the project. The respondents were interviewed via semi-structured interviews based on an interview protocol, either face to face or via skype by Sara Gonzalez de Uzqueta de Lorza. By using a semi-structured methodology we could allow for comparisons between the cases but we would also leave room for the interviewees to steer the direction of the interview. The interviews were transcribed and coded according to table 1. S1, C1, L1 were the codes used for saliency, credibility and legitimacy in general; the subsequent codes (S2-S4, C2-C6, L2-L6) were further specifications in relation to saliency, credibility and legitimacy (see the table). The interview guide was set-up broader than only dealing with SCL, so not all parts of the interviews were coded (see also Gonzalez de Uzqueta de Lorza 2013). The second round of coding was to evaluate whether the interviewees had spoken about SCL in a positive, negative or neutral way. In total of 141 codes had been allocated to the 10 interviews (SCL1-6, pos, neg and neutral and some free coding).

Results

When asked directly, all stakeholders are generally mildly positive about the MASPNOSE project; when asking more and more in detail, more differentiation can be seen. We will discuss these in this section, first we will use the number of codes used as a proxy for a general impression of which attributes were used most, then we will look at the qualification of the quotes and finally we will discuss the attributes 1 by 1. In the discussion we will reflect on how the interviewees spoke about the role of knowledge (process) in MASPNOSE and discuss the trade-offs.

Number of codes

As a proxy for understanding whether saliency, credibility or legitimacy have been commented on most, we can count the number or times that the codes have been attributed to the different quotations. Saliency was the most used code (55), followed by legitimacy (41) and then credibility (32). Most codes SCL(1-6) have 1 or 2 citations assigned to it; yet saliency is coded in 7 interviews with rather high numbers (at least 2 steps more than another code – minimum of 3 max 7). This is an indication that overall the actors related to the MASPNOSE project found the uptake of knowledge in policy the most important topic to discuss.

	Researcher 1	Government 1	Researcher 2	EU represent	SH 1 NSRAC	Advisor	Government 2	SH 2 NSRAC (Fisher	SH 3 NSRAC (Fisher	Government 3	TOTALS:
	all	DB	all	all	DB	all	TB	DB	DB	TB	
C	6	1	1	1	5	2	3	7	1	5	32
L	5	7	2	2	5	7	2	5	4	2	41
S	11	7	2	7	5	8	9	2	0	4	55
TOTALS:	22	15	5	10	15	17	14	14	5	11	128

Table 2. Showing the number of coded quotations (SCL) per respondent. (S=saliency, C=credibility and L=legitimacy).The colour indicates higher numbers, giving a quick insight in the dominant topics and the balance between the topics. (TB=Thornton Bank, DB=Dogger Bank)

Looking at the difference between the two cases in MASPNOSE we see that legitimacy has been used more often as a code in the Dogger Bank interviews than in the Thornton bank interviews (table 3).

	Researcher 1	Government 1	Researcher 2	EU represent	SH 1 NSRAC	Advisor	Government 2	SH 2 NSRAC (Fisher	SH 3 NSRAC (Fisher	Government 3	TOTALS:
	all	DB	all	all	DB	all	TB	DB	DB	TB	
C	6	1	1	1	5	2	3	7	1	5	32
L	5	7	2	2	5	7	2	5	4	2	41
S	11	7	2	7	5	8	9	2	0	4	55
TOTALS:	22	15	5	10	15	17	14	14	5	11	128

Table 3. Showing the number of coded quotations (SCL) per respondent. (S=saliency, C=credibility and L=legitimacy).The green columns are with actors related to the DB and the blue to the TB. (TB=Thornton Bank, DB=Dogger Bank)

Qualification of the attributes

Looking at the qualification of the quotes, as positive, negative or neutral in relation to saliency, credibility or legitimacy (table 3) it becomes clear that 3 interviews balanced out as generally neutral (positive and negative comments are in balance); 2 positive (more positive comments than negative) and 5 negative (more negative comments than positive).

	Researcher 1	Government 1	Researcher 2	EU representative	SH 1 NSRAC (NGO)	Advisor	Government 2	SH 2 NSRAC (Fisher rep)	SH 3 NSRAC (Fisher rep)	Government 3	TOTALS:
	all	DB	all	all	DB	all	TB	DB	DB	TB	
negative	11	10	4	0	5	8	11	7	3	10	69
neutral	5	2	0	1	3	4	0	0	1	0	16
positive	11	5	3	8	9	6	4	2	1	2	51
TOTALS:	27	17	7	9	17	18	15	9	5	12	136
	Neutral	NEG 58%	Neutral	POS 89%	POS 53%	Neutral	NEG 73%	NEG 77%	NEG 60%	NEG 83%	

Table 3. Showing the number of coded SCL quotations as positive, negative or neutral per respondent. (TB=Thornton Bank, DB=Dogger Bank)

Assessed per role, it becomes clear that the interviews in which positive and negative remarks are in balance are the ones with researchers (i.e. project managers) and the advisor to the project; the interviews with a more negative qualification of SCL were with the government officials and the fisher representatives and the more positive ones with the EU officer (who had co-funded the project) and the NSRAC stakeholder with an NGO background. Assessing the tone per case within MASPNOSE, the impression is that the interviews with actors related to the Thornton Bank case generally express a more negative qualification of SCL (78%). The Dogger Bank case interviews are also using more negative qualifications but less than in the Thornton bank case (65% overaged over 4 people, of with 3 negative and 1 positive). The actors whom were interviewed in relation to the whole MASPNOSE project (2 researchers, advisor and client) generally balanced out neutral (with 1 positive).

Saliency

The stakeholders interviewed (all involved in the Dogger Bank case) are all positive about the role that the MASPNOSE researchers played as process facilitators in helping the NSRAC: *"we would have never been able to do it on our own, because we simple did not have the resources to engage all the right stakeholders, conducting meetings in a well-managed way, so it was a very important initiative from MASPNOSE"* (SH 1). The government actors involved (both in the Dogger Bank case as in the Thornton bank case) were much less positive about the MASPNOSE project, they thought the role of science was unclear, and appreciated the outcomes of the Dogger Bank case less positive than the stakeholders. In general quite some reserves could be seen as to why science was treading in to their domain:

- Government 1: '*(...)in the beginning we were not very happy that MASPNOSE started as it started, because its involvement or potential involvement in the Dogger Bank situation. (...) In that period we were in the start of the international cooperation with the Dogger Bank, and we didn´t want the researchers to get involved in that process, because we wanted to put a cooperation structure first and we wanted to admit researchers in a later stage. At the beginning we wanted to hold the development of the Dogger Bank cooperation in our own hands'.* And

- Government 1: "*you want to have a complete control of what is happening within your competence, and once you have a research institution also going through the process, then you do not have control on that research institute, and they may say all kind of things that do not help in our process*".

- Government 3 (related to the Thornton Bank case): *'but I don´t need anybody to tell me how this job should be done. Especially since nobody has done it before, and I want to get the feet in the water, and start doing and by doing it learning together maybe we can reflect on it on the governance setting, but not on the way from the governance theory we should do it like this'*.

The scientists involved in the project also commented on this:
Researcher 1: *'When we set up the project we found out that it is very difficult to (...) really get the governments on board in the project because they said we will not commit to a project that we cannot oversee or control'.*
This has been recognised also by the EU representative: '*If there was anything that was maybe more challenging with the implementation of the project, was the involvement of the governmental authorities'.* The external advisor to the project suggested that the EU Commission should have stepped in: '*What I am saying here is that if the EU Commission is considering this as one of the formal ways of managing activities, at the commission level, you would need a kind of an agreement for countries that work together to achieve a common goal'* (Advisor).
Both quoted government officials work at the member state level and apparently they felt that the fact that the EU had asked for this research, was also seen as interference from the EU: *'From governmental perspectives, the whole idea of this test projects, was to help the European commission to draft a directive on how do we need to do our job, given the development at that time within the EC'*(Gov 3).

Both government officers stress the difference between governance in theory, and guiding principles on paper and political processes in practice:

Government 1: '*but MSP you should not forget that this decision making there is an important political context in that. For an international situation you negotiate with other states, which is a political action'.*
Government 3: '*For instance one of the principles says: 'use a strong knowledge data base underlying your policy decisions'; I´d never put it in law, because I don´t know so much about the sea, if I would have new activities which haven´t been done in sea before, I can´t in advance proof that it will not affect the ecosystem. If I would have a directive for it, which would force into the Dutch law, I will set myself stuck in the middle, ... because I can´t proof in front of the judge that the new activity I allow, will for 100% be safe for the ecosystem'.*

Thus in terms of saliency, it has become clear that the concept can be hybrid. A research topic can be very salient, as it deals with what is actual and happening in the political domain. However making political processes at the heart of a study might not always be appreciated. Policy makers value to have and keep room to manoeuvre and control of their processes. Researchers stepping in, intervening in their processes is not always welcomed.

Interestingly researcher 1 discusses the other side of the medal; apparently he had had a hard time to convince researchers in the MASPNOSE project that marine spatial planning is more than an academic exercise: *'There were also researchers in the project that were thinking that spatial planning is essentially a scientific activity, so you should make all the scientific knowledge and how to generate all the types of maps that you need to make decisions and to think about how you would approach your objectives, so there it becomes almost a tool in itself that can be done from research perspective only' (Res1).* He thought otherwise though: *'I was aware of the political sensitivity of the project, and I was seeing this as an applied project, to me it was not necessary about research, we should involve research and some researchers to put in some knowledge but it was more about talks, and negotiating, and legal aspects of spatial planning and all kind of other things' (Res1)*. He mentioned that this differential insight lead to tensions in the project team, that some of the researchers thought that he was compromising science too much.

One of the big differences between the two cases was that the Dogger Bank case was a 'real' case, the discussions that the MASPNOSE researchers facilitated were relevant for the stakeholders involved (it helped them in their political process) and was relevant for government actors (active in the Dogger Bank Steering group). This also had as implication that much of the learning was done in the Dogger bank case. Researcher 2 about this: '*later on the results from MASPNOSE…almost all the conclusions came from the Dogger Bank case; transparency, clear rules from differentiation and no from the other case study. It would have been nice if the 2nd case study had provided inputs for the outputs of the project. The Thornton case was not a real case study'.* The two government officers involved in the Thornton bank case express that the research was not of much relevance to them, the case was mainly a test without a real policy link and timing was bad (as they were caught up in developing national MSP plans). The conclusions on the case also remained quite general and were too vague (Gov3). Gov 3 furthermore commented on the fact that the questions had not been formulated by them, policy makers.

Nevertheless the appreciation of the role of the MASPNOSE scientists was different between the stakeholders and the government actors. The stakeholders were happy with the neutral platform that the MASPNOSE researchers had provided for them to have their discussions, carefully steering away from negotiation and having as much as possible knowledge sharing: '*there were no chance that we could have done it without the resources and expertise and sort of honest brokers, the neutral platform that MASPNOSE brought to the table. No way that we could have done it without MASPNOSE'* (SH1).

Whereas the government actor mainly commented on the failure of the process as it had not lead to one shared vision of the stakeholders for a management plan of the Dogger Bank: *'Well the scientists didn´t manage to formulate a proposal which was good enough for both parties'* (Gov1).

Credibility

The evaluation of credibility has in the MASPNOSE case been more about the role of the scientists than about the scientific knowledge. MASPNOSE was an action research type of project, in which the scientists involved were mainly facilitating processes between governing actors from different member states (Thornton bank) and between stakeholder groups (Dogger Bank). This action research as we saw in the previous paragraph was appreciated by the stakeholders in the Dogger Bank case were it also served a role in a real process, whereas it worked less well in the Thornton Bank case were the case didn't really link up to the need of the government actors involved.

Map-tables as boundary objects

In the Dogger Bank case the use of map-tables as boundary objects particularly worked well. The map-tables functioned as a tool to invite the stakeholders to share knowledge and perspectives.

Scientist 1: *'What I learnt from that session is that a tool such as the map table can be very powerful because they are very inviting for sharing information. I had the session where people were standing around the table, and then people would say this is an area where you have such and such biodiversity, and this is an area where you would do such and such fishing, and this is very important for this type of fishing…. (...) And then in the evening session we were going to finish that, and then people were sitting behind their desks for a meeting arrangement, and then the same people would start to negotiate. So we first had the session were they shared information all standing next to the table, and the next session all siting behind the tables and then they started negotiating instead of sharing. (...) So I learnt from that, that my role as facilitator is not just talking about the topic and things on the map, but even the arrangement in the room, how do you engage people in the process is very important, even the physical location where you are makes a difference in how you can facilitate such a process.*

As without it, when sitting around the table talking about management measures for the Dogger Bank, NGO's and fisheries quickly end up negotiating and arguing about the underlying information:

SH2: *'When we were discussing, the environmental NGOs and the fisheries were at the opposite sides of the table. And the ENGOs said 'we think, we believe that we need to close this % because we have this report'…and the fisheries said 'we have a light impact'...'*

SH1 echoes the importance between negotiating and dialogue: *'it is very, very easy in a process as such where stakeholder groups are quite diametrically opposed, maybe it is putting too strongly, but where NGOs want to protect as much as the area as possible and the fishery industry where they want to fish as much as possible, they have very different aspirations, and it is very easy in a process like this to dive straight into negotiation without having gone through a proper discussion and dialogue, (...) and [Researcher 2] (...) was very very anxious to steer away from the negotiating mode for as long as possible.*

'Real' scientists

When assessing the comments made by all actors involved in the Dogger Bank about credibility, it becomes clear that many have missed the availability of 'real scientists': *'and the whole discussion was made much more difficult by there being very little scientific understanding of how much is the area that you would need to protect to achieve the conservation objectives'(*SH1). SH2 commented that it would have been better if MASPNOSE would have also provided direct interaction with specialists to be consulted on the spot: *'we need the real scientists in that process, they should have been sitting with us in that meeting*' (SH2) and later: *'we had some reports but many when they read those reports, they are not sure 100% what the report actually says, that is why it is very important to have the real experts in the meeting'* (SH2).

SH2: '(...) *but actually no one knows, we are talking on things we know anything about, and different scientists have been doing different investigations on sand banks, even on the Dogger Bank. I believe that if different experts (1 or 2 persons every time) could have in the meetings, it would have helped'.*

Legitimacy

All actors have been asked about process of stakeholder involvement in MASPNOSE. The challenge however was that as MASPNOSE in fact studied processes of ongoing marine spatial planning, many actors answered in relation to these real political processes, so the answers do not necessarily reflect the legitimacy of the knowledge process and or outcomes of MASPNOSE itself. At a general level most actors agree to the principle that stakeholder involvement (at some point) is valuable; as the EU official said it: *'the added value of this project is that it involves multiple actors, multiple players and it generates information that is available and shared'*. But there are however different ideas on how to do it, when to do it, who to invite and what can be expected from it. The advisor to the project talked for long about stakeholder participation: '*The whole stakeholder engagement has to be managed onto itself as much as the government...., it is not by simply bringing a bunch of people to the table, and saying we are going to do this together. If there is not a clear focus on to what is going to be achieved, and why are different stakeholders at the table, …there is a whole variety of stakeholders here (...)...if you don´t structure that, the whole thing turns into a conflict and a conflicting discussion which is very difficult to manage and slide into a negotiating style thing rather than an implementing activity'.*

In the Dogger Bank case the stakeholders had been asked by the Dogger Bank Steering Group to come up with one proposal. That eventually failed, something that the government actor interpreted as a failure of the process and which according to him resulted in the fact that the stakeholder perspective could not be taken on board: 'because we always said: '*if you come up with a good proposal which responds to the Terms of Reference then we will take it on board'. But since they did not reach an agreement, we have never received a joint proposal from the stakeholders. So the stakeholders were present during the whole process, they were given the opportunity to discuss among themselves and with MASPNOSE people but they didn´t yielded a result'*. The stakeholders and scientists however appreciated the process nevertheless:

Researcher 2: '*it didn´t happen. but at the end they produced much more than they thought, and in that sense, this has made a difference to the way NGOs and fisheries have been working together in the previous years'.*

SH2: *'Maybe we didn´t reach consensus but a lot of work was done and in the end we were pretty close to each other, it was about the area closure, how much percentage of the Dogger Bank do we need to close to achieve conservation measures…the industry found 25% and the NGO said that they wanted 35%, so it was only 10% in between us, but it took a long way to come there and a lot of investigations.'*

SH3: *'Yes absolutely, they did, if the MASPNOSE project wouldn´t have been there, we wouldn´t had the institutional and financial arrangements to achieve what we did'.*

In the Thornton Bank case there was no stakeholder participation. According to Researcher 1 the governments involved were against the involvement of non-government participants: *'Because they [the government participants] said 'what we are doing here is trying to get to know each other and we are trying to learn how MSP happens in other countries, and this is not the spatial planning process, so we cannot involve the other stakeholders in this stage of the process when we are trying to get to know each other'. According to Government official 3 his Belgian colleagues were against stakeholder participation 'because they were in a kind of sensitive debate with some of their stakeholders in the planning process, and they didn´t feel like that it would be helpful at that point in time to also involve them in the MASPNOSE study'.*

Discussion

By interviewing 10 actors involved in the MASPNOSE project, from different actor groups (science, policy and stakeholders) it has become clear in most of the interviews actors had commented on the saliency of the project. That makes sense because the project was asked for by the EU, and member states played an active role in the project. In the Dogger Bank case the work done with the stakeholders served in a real political process. Nevertheless differences can be seen between the two cases and between the different actor groups. This underlies the finding of Cash et al (2002) that the evaluation of saliency, credibility and legitimacy are actor-specific and context specific. It has also become clear that MASPNOSE as a project really encompassed two totally different cases, with different political realities and in a different stage. Although the MASPNOSE project as a whole served as *enlightenment* in the policy context; the reality of the Dogger Bank case, helping the NSRAC to come up with a shared zonation proposal as part of the DBSG process, made that it served as a process for *negotiation* at the same time. That means that different types of boundary work were needed in the project.

The scientific knowledge in MASPNOSE also had different sources. The main activities of the scientists interviewed were to facilitate processes between member states (TB) or between stakeholders (Dogger Bank). The facilitation could be seen as action science; facilitating based on the what is known from interactive governance theory. But there was also the science about and contributing to marine spatial planning and ecosystem based management, such as the ICES scientists that shared their knowledge in the Dogger Bank case with the stakeholders.

The action research methodology applied was evaluated differently by the government actors and the stakeholders. The first felt that the scientists were treading on their territory, thus grossly overstepping the boundary between science and policy. The government actors also expressed that there was a difference between governance theory and political reality. Some of the scientists involved in the MASPNOSE project also had difficulties with the boundary work that was done – they felt that it should have been more academic and less linked to policy. Boundary work can be seen as a balancing act whereby too much movement to either one of the sides comprises a risk to fall off.

The stakeholders involved in the Dogger Bank case appreciated the action research. They happily made use of the resources the project provided and the boundary work that was done. The map-tables that were used as boundary objects made that they could share knowledge instead of negotiate immediately. Although the Dogger Bank case did not result in the intended shared zonation plan, the stakeholders still valued the process.

At the other hand the stakeholders expressed that they had missed the scientific input from experts. They would have appreciated that the scientific information could be explained by scientific experts in the meeting. They expressed the expectation that chances for disagreement between fisheries and NGO's would be less if it would have been framed through science. Probably it would have helped a bit, if people are unsure how to understand what is written in scientific texts, or understand the methods that were used. But whether it then would have been accepted by both 'sides' remains a question as we know from research that actors prefer information from their own network to external information and that 'information will only be perceived as authoritative if it is supported by sources of knowledge that are already present in the actors mind' (Turnhout et al 2007, referring to Lindblom and Cohen (1979)). It seems the stakeholders somehow longed for what can be seen as a 'traditional image' of science; working independent of values and political preferences, with 'real' scientists who can without doubt say what the situation really is.

A number of trade-offs have become apparent. First of all trying to be really salient, and to connect to real ongoing processes can have consequences for legitimacy. For instance in the Thornton bank case, the member states did not accept the inclusion of stakeholders in the case as it could possibly interfere with their ongoing political process. Secondly having a legitimate process, whereby the knowledge process is open to perspectives from different stakeholders might interfere with saliency. For instance in the Dogger Bank case the stakeholders didn't manage to come up with one shared plan, but with two different plans which resulted in the fact that their perspectives were put aside in the political process. The third trade off that manifested itself was that of credibility versus saliency. Both from the science side as from the policy side the credibility of the researchers doing the action research was questioned. At the other side of the spectrum the credibility of the action scientists was valued because they managed to improve the legitimacy of the process.

This main lesson from this study is that it is valuable to evaluate research projects afterwards by interviewing involved actors. The reflexivity can contribute to a better understanding of the role of boundary organisations such as IMARES. As increasingly research questions posed to IMARES are related to wicked problems, it becomes necessary to contemplate about the saliency and legitimacy of the knowledge (process) whilst maintaining credibility. The discussion shows that trade-offs are involved. Perhaps the way forward for applied institutes is to build in explicit checks and balances in the project management process where questions are asked about the saliency and legitimacy of the knowledge produced. Often systems of peer review are in place focussing on the credibility of science, but explicit evaluation – preferably also with involved non-science actors – will help in the learning process.

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References

Cash, D., W. Clark, F. Alcock, N.Dickson, N.Eckley, J. Jäger (2002) *Salience, credibility, legitimacy and boundaries: Linking research, assessment and decision making.* John F. Kennedy School of Government Harvard University. Faculty research working paper series.

Clark, W., T. Tomich, M. van Noordwijk, N. Dickson, D. Catacutan, D. Guston, E. McNie (2010). *Toward a general theory of boundary work: Insights from the CGIAR's Natural Resource Management Programs*. Faculty research working paper series.

Commission of the European Communities (2008). Communication from the Commission: Roadmap for Maritime Spatial Planning: Achieving Common Principles in the EU. COM(2008) 791.

Gieryn, T. (1983). Boundary work and the demarcation of science from non-science, strains and interests in professional interests of scientists. *Am. Sociol. Rev*. 48:781-795.

González de Uzqueta de Lorza, S. (2013). *The role of science in the policy cycle in marine governance settings: Development of the fisheries management Plan for the Dogger Bank in MASPNOSE and The challenges for the regionalization of the Fisheries Ecosystem Plans in MEFEPO.* Internship at the Institute of Marine Research for Ecosystem Studies (IMARES)-IJmuiden M.Sc.: Aquaculture production and Marine Resource Management (MAM) Wageningen University

Jentoft, S. and R. Chuenpagdee (2009). Fisheries and coastal governance as a wicked problem. *Marine Policy* 33(4): 553-560.

Ravetz, J. (1990). *The merger of knowledge with power. Essays in critical science*. Mansell Publishing Limited, London.

Rittel, H. and Webber, M. (1973). Dilemmas in a general theory of planning. Policy Sciences 4:155-169

Röckmann, C., J.van Leeuwen D. Goldsborough, M. Kraan, G. Piet (forthcoming). The interaction triangle as a tool for understanding stakeholder interactions in marine ecosystem based management. *Marine Policy.*

Turnhout, E., M. Hisschemöller, H. Eijsackers (2007). Ecological indicators: Between the two fires of science and policy. *Ecological Indicators* 7: 215-228.

White, D., A. Wutich, K. Larson, P. Gober, T. Lant and C. Senneville (2010). Credibility, salience and legitimacy of boundary objects: water managers' assessment of a simulation model in an immersive decision theater. *Science and Public Policy*, 37(3):219-232.

Wilson, D. (2009). *The Paradoxes of Transparency: Science and the Ecosystem Approach to Fisheries Management in Europe*. MARE Publication Series No. 5. Amsterdam: Amsterdam University Press.

5. Unravelling the myth – The use of Decisions Support Systems in marine management

Bas C. Bolman, Robbert G. Jak and Luc van Hoof

Decision Support Systems (DSS) or Decision Support Tools are immensely popular. An inventory implemented by the EU FP7 funded MESMA project1 identified some 78 tools developed to assist in Marine Spatial Planning (MSP) (Cronin, van der Meulen et al. 2013). Krueger & Schouten-De Groot (2011) identified more than one hundred DSS designed for MSP decision makers for the North Sea. The reasons for the popularity of such tools can partly be found in technological development, which makes it possible to install and use DSS related software systems on PCs, and partly in the need to manage a large amount of often complicated data that play a role in the decision-making processes (Uran & Janssen 2003).

DSS are defined broadly as interactive (computer-based) systems that help people use (computer) communication, data, documents, knowledge, and models to solve problems and make decisions (cf. Power & Sharda 2009). According to Power (2002), DSS are ancillary or auxiliary systems; they are not intended to replace skilled decision-makers. DSS do not intent to automate decision making; they should facilitate the decision making process. Rothschild et al (1996) developed a more elaborate definition, taking into account the socio-economic setting in which DSS are placed. They define DSS as a functionally integrated and automated computer-system which allows managers to examine the expected effects of different management strategies, incorporate multiple objectives and concerns of stakeholders, determine the relative influence of various sources of uncertainty, and estimate the marginal value of collecting additional data.

For the purpose of this paper, the brief definition given by Sprague and Carlson (1982) was elaborated: “A DSS is an interactive system, usually based on a computer system, that processes unstructured input data into structured output data”. Output data becomes information when it is relevant and utilised by decision makers (Alter 1998). Not all DSS utilise computer-systems. A DSS may also consider approaches of dealing with expert opinions, involve graphic presentation methods, and use of paper work. Over the last decade, DSS in marine management have been developed towards spatial applications. Spatial DSS focus on decision making in Marine Spatial Planning in order to manage interactions between multiple activities and ecosystems in marine areas.

Te Brömmelstroet (2009) states that the implementation of DSS is still problematic after three decades of developing DSS: “every time designers come up with new generations of models and modern names, using advanced techniques [….]. But every time it appears that planners are not excited about their creations”. And so it seems that the issue of spatial DSS being rarely used in the decision making process is almost as old as the DSS itself. Based on a literature study, Uran & Janssen (2003) found a series of explanations for the lack of success of DSS. These explanations relate to the level of details, time and costs for development and maintenance, complexity of the system and uncertainty of the output (Ubbels & Verhallen 2000; Jones et al. 1998). Another explanation is the limited involvement of users in the development phase, which can lead to unsuccessful DSS (Aschoug et al. 1998). Other fields of application of DSS include the utilisation for evaluating the efficiency and effectiveness of marine management policy measures as occurs in several EU financed research projects such as COEXIST (e.g. Soma et al. 2013) and MESMA (Stelzenmüller et al. 2013). The recent trend in marine management is to incorporate stakeholder processes into the development of DSS. Often stakeholders are involved to increase the legitimacy of the decisions that need to be taken.

Following the observation by Aschoug et al. (1998) and Uran & Janssen (2003) on the consequences of not involving users in the development phase of DSS, the question arises what the current status quo is in the utilisation of DSS in marine management. The main question addressed in this paper is: do DSS developed over the past years in fact contribute to the decision making process in marine management? The question is answered by examining the expected effects of different management strategies, incorporate multiple objectives and concerns of stakeholders, determine the relative influence of various sources of uncertainty, and estimate the marginal value of collecting additional data. In the next paragraph an overview is provided of current approaches used to assess DSS. The useful elements of these approaches are combined in the third paragraph, where a theoretical framework is developed which is used to evaluate the contribution of an individual DSS to a given decision making process. In the fourth paragraph this framework is applied to a suite of DSS for marine management. In the fifth paragraph the findings are discussed and conclusions are drawn.

Current evaluation approaches

This paragraph examines which evaluation methods exist for assessing contributions of DSS to decision making processes in marine management. First an overview is provided of existing methods, using the domain of marine management as a premier source. Frameworks from other domains such as urban planning, regional planning and policy making have also been used where applicable.

Uran & Janssen (2003) introduced five steps to search for explanations for success or failure in the utilisation of DSS. The first step concentrates on the specification of alternatives, i.e. the possibility to test alternative solutions such as the incorporation of ideas and knowledge of the users. The second step, user guidance, is about how well a user is guided when using the DSS and in how far the different steps to be taken are self-explanatory. The third step focusses on the presentation of output and looks at the degree in which users are able to understand output such as tables, graphs or maps. The amount of output is also relevant; in case of an overload of information the user will find it difficult to utilise the right output. The fourth step is the support in evaluation of results. It analyses in how far the output of a DSS is useful for evaluation in case the output is not directly suitable for decision making. The fifth step is the achievement of functionality objectives. It examines in how far the DSS does what is was meant to do by identifying if the final DSS product meets the functional specifications as defined in the initial stage of the DSS project (Uran & Janssen 2003).

Te Brömmelstroet (2009) identified four mechanisms for assessing the success of (computer) planning instruments in urban planning. The first mechanism focuses on the designer of the DSS being present during the decision making process. This enables the designer to learn which output data is needed by the decision makers. The second mechanism is about a formal and explicit dialogue between designers and decision makers during the design and utilisation of the DSS. It is also about the importance of understanding what specific role the DSS is going to play in the decision making process. The third mechanism concentrates on how the DSS actually connects to existing decision making problems. The fourth mechanism identifies how the lessons from the interactions between designers and decision makers are captured into documents in order to enable them to deal with the dynamics of the decision making process (Te Brömmelstroet 2009).

Van Delden (2009) studied the use of DSS in the domain of integrated planning and policy making. The study illustrates that few DSS are actually used to support policy preparation and analysis. Based on academic literature she finds that explanations relate to a lack of transparency, inflexibility and a focus on technical capabilities rather than on real planning problems (Uran and Janssen, 2003; Vonk et al., 2005; Geertman, 2006). Van Delden identifies eight factors determining the success or failure of DSS. The factor 'Strategic value' defines to what extent the DSS adds value to the decision making process. It should be the end-users of the DSS, hence the main stakeholders, who define the strategic value and to give direction to the design of the DSS. The factor 'availability of data, knowledge and models' relates to the easiness of accessing and using the information. The awareness of available input for the DSS helps to manage expectations of the different groups involved and avoids misunderstanding of what the system can and cannot do. The credibility of the system refers to the belief of the users in the functionality of the DSS. Domain language of the system is the degree to which the DSS fits into the worldviews and perceptions of the users. This is achieved mainly by the interactions between designers and end-users. The institutional embedment refers to the way in which a DSS is positioned in the organisation that utilises the DSS. The disciplines within the departments that use the DSS should connect to the disciplines that relate to the input of the DSS. The culture aspect is a crucial factor in the analysis of Van Delden. It assesses in how far people are actually committed to use the DSS and to integrate it into their decision making process. Easiness of use is another import factor, due to its focus on interface usage, easy access to functionalities and the amount of training that is needed to use the DSS efficiently. The last factor is 'maintenance and support', focussing on the degree to which the input data and processing models are updated and the assistance of experts to facilitate this (Van Delden 2009).

Rhee and Rao (2008) discuss three different approaches for DSS evaluation. The three-faceted approach focuses on evaluating technical, empirical and subjective aspects. A technical evaluation looks primarily at the system itself, by its logic, algorithm and data flow. An empirical evaluation concentrates on the effectiveness and how DSS can be improved. The subjective evaluation considers how DSS influence the relations among the involved users, organisations and environment (Rhee & Rao 2008).

All four approaches for the evaluation of DSS take the DSS as a starting point and then look at the degree to which they were used in the decision making process. Although the focus on user-requirements and -needs is present in all four approaches, none of the approaches put the decision making process central and then assess the degree in which the DSS contributed to this process. Thus, the question of which decisions are taken and which information is deemed crucial by the participants of the participation process remains unanswered. In the next paragraph a framework is proposed that aims at addressing the identified gap.

Framework for analysing DSS

Following the elaborated definition of Sprague and Carlson (1982) and the insights gained from other approaches, a framework is proposed to analyse the degree in which a DSS contributed to the decision making process in marine management. The framework consists of five elements (Figure 1), listed here in random order:

- Stakeholders
- Utilisation
- Objectives
- Data
- Outcome

A first element of analysing a DSS is stakeholder mapping. Stakeholders are defined here as those groups of people that are potentially affected by the decision to be taken and hence have an interest in influencing the decision; participation in this context can be defined as the process in which stakeholders take part in a decision making process, ranging from being informed, being consulted to as much as having an active role in taking the decision. By involving stakeholders in a process, it is argued that the quality and durability of decisions is likely to be greater (derived from Reed 2008). The early participation of stakeholders in the development of a DSS creates the opportunity to align their user requirements in order to design a tailor-made DSS that actually serves their needs. There might be "hidden actors", i.e. those actors who provide input data and those who build the DSS might also be regarded as a stakeholder. A crucial stakeholder is the end-user of the DSS, most probably being a decision maker. The analysis should make clear whether the end-user and his problems and needs have been identified. In addition it is important to identify the degree to which the end-user has been involved in the development, testing and implementation of the DSS. Another relevant factor is whether the end- user is the same person as the problem owner, and if the problem owner is the same person as the client who finances the DSS. The analysis should also assess in how far other stakeholder' problems and needs have been incorporated in the process and how the DSS is addressing them.

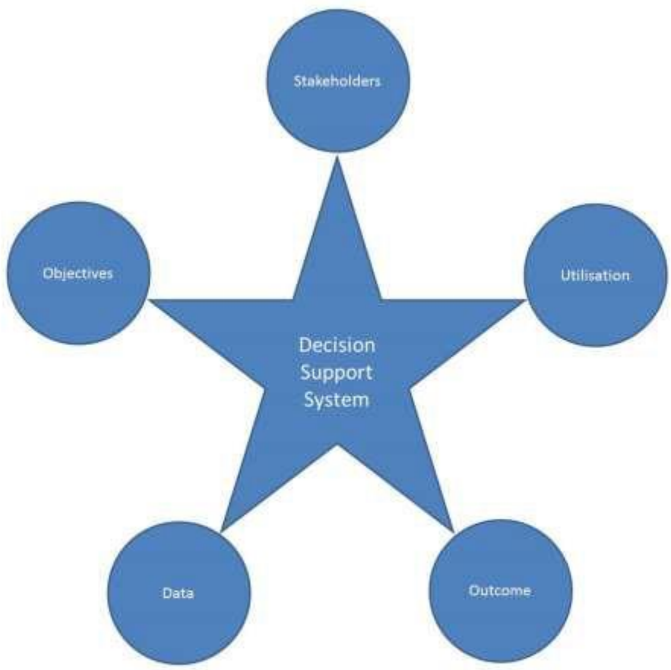
A second element in the analysis is utilisation. This step analyses how the DSS is planned to be utilised in the decision making process, whether or not these plans are documented and whether or not they are incorporated in the design of the DSS. The utilisation element explains how the end-users think they will utilise the output of the DSS, how the output supports their decision making process, and how the output data becomes information in the process through its use and application.

A third element consists of unravelling the objectives of the DSS itself. This part of the analysis makes clear in how far elements one and two – stakeholders problems and needs – in combination with the way in which the end-user plans to utilise the DSS, actually resulted in documented objectives as defined in interaction by the end-users and developers of the DSS. Again, the link with the decision making process is crucial here. To what extend were end-users involved in defining the objectives of the DSS? Does the objective actually connects with the decision making process? Did the objectives change throughout the development of the DSS? If yes, why and what has been done to address these changes in objectives?

A fourth element identifies what the DSS is intended to do in terms of processing unstructured input data into structured output data. The quality of the output can never be higher that the quality of the input. In the analysis it should become clear what kind of data is needed as input for the DSS. Is the data qualitative, semi-quantitative or quantitative by nature? Who provides the input data and where do the data derive from? Can the necessary input data easily be identified and accessed? Is the quality of the input data checked regularly? Considering output data the end-user is again of crucial importance, since output data needs to be aligned with the utilisation needs in the decision making process. In how far is the output data actually being used in the decision making process? Did the output actually become information, hence did the data made available address the issue at hand, through its use in the decision making process?

A fifth element analyses the outcomes of the DSS with respect to the objectives as defined in the third element. A first step in this analysis is to determine whether the objectives of the decision making process have been achieved. However, by focussing only on the degree to which objectives are achieved one might run the risk of missing the connection with the decision making process which the system should support. Thus, outcome relates also to utilisation as mentioned in the second element. Here the critical answer should be provided to assess if and how the DSS contributes to the decision making process in marine management.

Figure 4: Schematic overview of the proposed framework. As all elements and aspects of the DSS interact and mutually determine the accomplishment of the DSS they are presented here rather as a star than as a sequence of steps.



Evaluating marine DSS

For the evaluation DSS were selected from a literature search. This search was carried out in Scopus (www.scopus.com) on June 26th 2013, in the Life Sciences section from 2000 till present, and by applying search terms in the title, abstract or keywords of the documents. A number of 7979 documents were found including the search term “decision support system” OR “decision support tool”, and a further selection was applied by using the keyword “marine” resulting in 424 documents. Only “articles” were considered (323). Since the aim of the current analysis in this article is to test the application of DSS in decision making, the selection was further narrowed down using “management” as search term. This resulted in 302 articles that formed the basis for further selection by checking the contents of the articles, starting with the newest documents. For this search, several criteria were used. The peer reviewed paper should:

- focus on decision makers/managers, not on sectors;
- describe a completed DSS;
- be developed for European seas and/or coastal zones;
- consider one or more of the following topics: fisheries, nature, spatial management, wind farms, climate change;
- contain enough information to perform an analysis.

The most recent articles were checked (2013) and 6 relevant publications on DSS were selected based on the criteria mentioned above. In some articles the concept of DSS is not explicitly used. If the definition of a model, framework or tool in an article aligned with the definition of DSS in this paper and fulfilled the above mentioned criteria, the article was selected.

The first selected article focuses on a DSS called The Integrated Development of Applied Systems for Coastal Management (IDeASyCoM). The DSS aims to structure and systematise the cognitive process involved in modelling decisions to facilitate their specification, valorisation and transfer and to enhance their pertinence and completeness based on the need (Doré et al. 2012). The authors found three challenges while developing models for coastal management. These challenges include the possibility to reduce the number of loops back to modelling decisions during the modelling process, finding a way to formalise and qualify pre-modelling analysis and how modelling decisions can be taken in accordance with constraints involved in the coastal management problem (Doré et al. 2012). The focus of this paper is not on the decision-makers in coastal management, but on the decision-makers in modelling itself. The first phase and starting point of this DSS is the identified need, which is defined by a task group of modelling experts. Subsequently the DSS has four other phases. The second phase is a functional analysis to prioritise a set of functions that the model has to accomplish to satisfy the demand. The third and fourth phase, the systemic and physical approach, aim to complete the functional specifications. The fifth phase consist of modelling decisions to sort the multiple potential solutions found along the sequence (Doré et al. 2012).

Applying the evaluation framework to this DSS, the first element considered is stakeholder mapping. From the paper one stakeholder was identified, namely the modellers, which are at the same time the end-users of the DSS. The needs or challenges of these end-users have been defined, however it is not clear if the authors have identified these needs themselves or that they have been formulated by the end-users. No evidence could be found in the paper that the end-users are identical to the funders of the DSS. The same goes for the involvement of the end-users throughout the development of the DSS; no evidence could be found, assumed that the authors are not identical to the end-users. Problems and needs of the end-user are addressed in the beginning of the DSS process. The input of end-users is primarily used to translate the need into a calculation formula. The process of how the task group of modelling experts actually identifies its need is not addressed in the paper. The second element, consisting of utilisation, describes how the DSS is planned to be utilised in the decision making process. No evidence could be found of how the DSS is going to be used in the decision making process. In fact, the paper does not describe the actual application of the DSS. The third element focuses on the objectives of the DSS, namely to structure and systematise the cognitive process involved in modelling decisions. Although there is a clear connection between the objective and the decision making process in modelling, the paper does not address if and how the end-users are involved in the formulation of the objectives of the DSS. For the fourth element, consisting of the input and output data, the paper primarily describes what the DSS does, but not what kind of data should be used as input. It also does not address the kind of data serving as output of the DSS to facilitate the decision making process in modelling. For the fifth and final element, the outcome of the DSS, it was determined that the paper does not describe the application of the DSS. It can therefore not be assessed if the DSS has been used by the end-user.

The second selected article is by Parravicini et al. (2012) describing a DSS aiming at visualizing the expected outcomes of alternative management scenarios for a case study from coastal Italy. To visualise these outcomes a geospatial approach for modelling the relations between human pressures and coastal ecosystem status was developed. The paper starts from the notion that mapping the relationships between multiple human activities and the status of the ecosystem is difficult for two main reasons. The first reason is that multiple pressures may interact in complex non-additive manners. The second reason is that spatial information on both ecosystem status and potential sources of impact is scarce (Shears and Ross, 2010; Halpern et al., 2008a; Fraschetti et al., 2009). The geospatial modelling tool follows four steps. The first step is GIS mapping of human pressures and their intensities. The second step is GIS mapping of the marine ecosystem status. The third step is modelling of the relationships between human pressures distribution and marine ecosystem status. The fourth step is the use of the model calibrated in step 3 to build maps of expected ecosystem status according to different management alternatives (Parravicini et al. 2012).

Applying the evaluation framework results in the following observations. Although the developed scenarios are supposed to be used by managers, it was not possible to trace whether they were actually involved in the development of this DSS. The DSS involves multiple activities such as a harbour expansion, finfish fishing, mussel harvesting and SCUBA diving, but evidence for their involvement in the DSS could not be found. Science – perceived a stakeholder in this model – was involved by consulting 12 environmental scientist to assess the intensity of each pressure. Experts were also involved to visualise the effects of the harbour expansion; at the same it was not possible to determine whether these experts were scientists or stakeholders. With respect to the degree of utilisation of the DSS, it could not be traced how the DSS was going to be used by the managers. The objectives of the DSS are to visualize the expected outcomes of alternative management scenarios. The involvement of managers as the end-users of the DSS could not be found in the paper. For the input and output data, the paper describes that marine ecosystem data was scarce; field studies were used to collect data. The origins of the data on pressures could not be found. Specific types of pressures such as under water noise, abrasion and turbidity, including their data, could not be found. The GIS maps represent a clear output of the DSS; but is not possible to find the specific parameters that were used to construct the maps. For the outcome of the DSS, it was determined that the paper does not specify if the end-users or managers have used the DSS in their decision-making process.

The third selected article describes the development of a participative approach for a Decision support System for Coastal climate change impact assessment (DESYCO). The DSS includes databases, scenarios, models, methodologies and a system to assess and integrate the management of biophysical and socio-economic impacts linked to climate change in coastal zones. All these elements come together in a GIS platform. DESYCO aims to support decision and policy makers in defining the most suitable adaptation strategies in coastal zones (Santoro et al. 2013). This DSS follows three phases. The first phase is the scenario construction, in which future climate change scenarios are defined. The second phase is the integrated impact and risk assessment, which prioritises impacts, targets and areas at risks from climate change. The third and last phase concentrates on risk and impact management. Also a participatory framework parallel to the three DSS phases is part of this DSS. The participative framework uses seven steps, including DSS end-user analysis, introduction of the project to the end- users, selection of risk parameters with end-users, contribution to multi-criteria analysis and the end- users' opinion, explanation of the DSS to the end-users, and finally the step of monitoring and evaluation (Santoro et al. 2013).

Using the framework for the DSS of Santoro et al. (2013) provides us several interesting insights. Stakeholders, governments and authorities, NGOs and economic sectors, are certainly involved through the participatory framework as described above. . The article even states that the involvement of end- users (i.e. public institutions and administration) is fundamental in developing a tool that meets stakeholder needs. Although a participatory approach was connected to the development of the DSS, and stakeholders and end-users were involved throughout the process, no evidence could be found that the DSS was designed to be actually utilised by these end-users. The objectives of the DSS are to assess and manage climate change impacts and risks in a participative approach. Additionally the DSS aims at supporting decision and policy makers in defining the most suitable adaptation strategies in coastal zones. No evidence was found of end-users being involved in formulating these objectives in the initial stages of the DSS development. At the same time the objective of the DSS does indeed connect with the decision making process. The exact type of data that should be used as input for the DSS could not be found. This also applies to the source of the data. How the output data was used in the decision making process is not clear either. Santoro et al. combine the participation process and the development of a DSS in a refreshing new manner. The purpose of the participation process is to make a success of the DESYCO DSS meaning that the end-users are actually using the DSS in practice. Therefore it is surprising that the article does not mention if and how the DSS contributes to the decision making process with the help of the participation process.

The fourth selected article by Stelzenmuller et al. (2011) describes a modelling framework to support the implementation of an ecosystem approach to marine spatial management so that it can be used in decision making processes. The authors do not explicitly use the concept of DSS; however the modelling framework suits the definition of a DSS as used in this paper. The framework aims to quantify in a spatially specific way the ecological and economic risks of management options. The article aims to test the framework's ability to combine the assessment of the ecological and economic risks of spatial management options in relation to 2 scenarios at the resolution of fishing fleets. This spatial DSS consists of a GIS with a 3 by 3 nautical miles grid. The grid is filled with data from a number of variables in order to predict the overall level of vulnerability of plaice to fishing as a function of the total catch and catch per unit effort of plaice. The variables are fishing effort, fishing hours (beam trawling, otter trawling and shrimp trawling), total catches, sediment data, average bottom temperature and salinity, catch per unit effort (CPUE, abundance of species), vulnerability of plaice to beam and otter trawling and depth. With the help of the framework a baseline scenario and two marine management scenarios were defined. The baseline scenario in the article was the current state or "do-nothing" scenario. The first scenario is to identify management targets for fisheries to maintain the current vulnerability of plaice in case of environmental change, meaning an increase in bottom temperature of 0.5°C. The second scenario is to understand how vulnerability of plaice changes in case of the development of offshore wind energy. The allocated areas for wind were applied and fisheries were reallocated. In the next step these scenarios were applied in the framework. The authors conclude that the approach would be a useful tool in facilitating informed decisions because of the spatial approach towards potential risks en to relinquish related uncertainty concerning spatial management options.

Evaluating the DSS of Stelzenmuller et al. (2011) it is clear that the tool is meant to support decision- making in marine spatial management. However it was not possible to find evidence that stakeholders, end-users or decision makers were involved in the development of the DSS. Because it is not clear how the output of the DSS is being used in the decision making process it is not possible to evaluate whether the utility purpose of the DSS was taken into account during the design. No evidence could be found of end-users being involved in the formulation of the objective of the DSS, of quantifying the ecological and economic impact of spatial management measures. Quantitative data has been used as input for the DSS which has been delivered, amongst others, by other research institutes. The output data is also quantitative; but it is not possible to determine whether the output was used as input for decision making processes. The title of the article suggests that the function of the tool is to support decision making in marine spatial management. At the same time it was not possible to evaluate if the tool was used in decision making processes.

The fifth publication deals with a DSS that aims to evaluate different management scenarios for coastal management, by using an ecosystem services approach and steps for environmental valuation and policy assessment (Luisetti et al., 2011). Several analytical steps are proposed that are tested for two case studies on managed coastal realignment, where agricultural land is turned into saltmarshes that are a soft and more sustainable flood defence helping to dissipate wave energy (Luisetti ea, 2011). The proposed framework involves an economic valuation, by making use of a cost-benefit analysis based on equations for cost calculations. Management strategies (scenarios) were scored on the basis of a number of attributes related to ecosystem services, including the size of newly created salt marshes, the number of returning protected bird species, the access to the salt-marsh (yes or no), increase in tax to pay by local people and the distance of these people to the nearest site for realignment.

Although Luisetti et al (2011) state that the DSS could serve management, the authors do not explicitly mention the involvement of policy makers or coastal managers, or other stakeholders in the problem definition and set-up of the DSS. Stakeholders were consulted by means of a questionnaire to answer eight questions in relation to the management options (scenarios). These preferences were used in the cost benefit analysis, however, the stakeholders were not involved in the design of the DSS framework, nor in a decision making process. Also the utilisation of the DSS in a decision making process is not described. The authors conclude that the DSS on the basis of a cost benefit analysis could work in situations not complicated by a social decision making context. The method relies on input data for costs and benefits for several ecosystem services. The output are values of different management scenarios for different time horizons (25, 50 and 100 years). It is not reported if an how the output information is used in a decision making process for the considered case studies.

The sixth selected article by Garmendia et al (2010) describes a participatory process in which a social multi-criteria evaluation is applied as a decision support tool, in contrast to the traditional technocratic approaches. The DSS is applied in a real case study concerning the coastal zone management of an estuary. The emergence of new social values and needs and a new law requiring sustainable management has shifted the management system in the estuary, (Garmendia et al., 2010). The participatory integrated assessment process can be divided into three phases. The first phase involves the identification of relevant social actors involved, understanding the socio-environmental dynamics of the system and definition of the problem to be addressed. The second phase concerns the representation of the problem at hand, i.e. the definition of the decision space and the evaluation criteria. The third phase concerns the evaluation in which the alternative solutions, forming the decision space, are being assessed in social and technical terms.

When applying the framework for evaluation, it is evident that stakeholders have an important contribution to the DSS. In a real case study, a diverse group of stakeholders including scientists, authorities, industries, NGOs and citizens was involved in a participatory integrated assessment process with the aim to develop and evaluate sustainable management options. The identified key issues for the management of the estuary were dredging activities, disposal sites and ecological threats, and the objective of the DSS was to evaluate different management options for these key issues. Stakeholders were involved in the problem definition, the selection of management alternatives, the assessment of their preferences and the evaluation of the results. So, the (semi-quantitative) input of the DSS is completely based on the inputs by all participating stakeholders, involving a valuation of criteria such as employment and environmental disturbance. The valuation is therefore not based on a scientific assessment, but a subjective score. A mathematical model processes the information, where the selection of indicators has an impact on the output of the model. The indicators are selected by the person performing the analysis (a scientist). The outcome of the DSS is a ranking of management options. In addition to the model output, the process in which many stakeholders were involved showed its value by the integration of diverse expertise and values in a mutual learning process. The process also resulted in the identification of common interests amongst the diverse group of stakeholders. As the approach was applied in a real case study, the outcome is applicable for decision making, although no decision(s) on a selected management options have been reported by the authors.

Figure 5: results of the theoretical framework applied to six DSS in marine management

		DSS					
		IDeASyCoM	Geospatial modelling	DESYCO	Modelling framework	Managed realignment	Social multi-criteria evaluation
Element	Stakeholders	No	Limited	Yes	No	Limited	Yes
	Utilisation	No	No	No	Not clear	Not clear	Limited
	Objective	Limited	Limited	Limited	No	Limited	Yes
	Data	Limited	No	No	Limited	Yes	Limited
	Outcome	Not clear	No	Limited	Not clear	Not clear	Limited

Conclusion and discussion

In this paragraph the five elements (stakeholders, utilisation, objective, data, outcome) are combined for the evaluation of DSS of paragraph three with the findings in the paragraph four to give an indication of the current state of the use of DSS in marine management. In general two types of articles are observed. The first type of articles has a strong focus on DSS techniques and natural science. The second type of articles has a strong focus on the participatory approach.

The first element in the framework is the involvement of stakeholders and how their problems and needs are incorporated in the DSS process. From the analysis it becomes clear that the involvement of stakeholders and end-users in the development of DSS is not yet common practice. Paradoxically the same scientists often formulate their ambition as providing input for decision makers in order to make informed decisions. In the analysis only few examples were found where stakeholders and end-users were identified and were subsequently actively engaged throughout the process of design and development. The exception was found in those DSS that have a participatory process integrated with the process of designing and developing (Santoro et al. 2013; Garmendia et al. 2010). However at the same time it remains unclear how the input of stakeholders and end-users is actually incorporated in the DSS. In addition, in the participatory approaches it is not clear how scientific information is being applied in the DSS, or how information contributes to the valuation process by stakeholders.

The next element in the framework is utilisation, with the purpose of unravelling in how far the scientists who develop DSS are in contact with the end-users to define how the output of the DSS should be utilised and support the decision making process, so that output data becomes information to the decision makers. In the analysis it was not possible to find evidence in the DSS articles suggesting that the way in which the output of a DSS should be utilised in the decision making process has been taken into account during the design or development of the DSS.

The involvement of decision makers or end-users in the formulation of the objective of the DSS is the third element in the framework, making clear whether or not the objective is actually connected to the decision making process. In most of the articles no evidence was found that decision makers or end-users were involved in the formulation of the objective in order to align with the decision making process.

The fourth element in the evaluation framework is the input and output data. This should make clear what type of data is needed and used and where it comes from. Most articles describe in detail which variables are required for the DSS to function properly. Stelzenmuller et al. (2011) e.g. describe very precisely what kind of GIS data is used as input and what the source is of the used data sets. On the other hand Stelzenmuller et al. do not explain how their output data is integrated in the decision making process in fisheries management. Other articles are not clear on both the connection between input data, output data and the decision making process. In the analysis it was not possible to indicate if output data has become a source of information in the decision making process by the end-users.

The last element of the framework is the outcome of the DSS, focussing on the evaluation of DSS, the achievement of objectives and the contribution of the DSS in the decision making process. None of the articles have actually made the step towards describing what happened with the DSS after its completion. Has the DSS been used by decision makers? What were the experiences? How did the DSS contribute to the decision making process? These remain unanswered questions because no evaluations were found of DSS and possible feedback of stakeholders, end-users or decision makers.

Most of the DSS studied do not seem to be actually used in decision making, at least there is no clear evidence found of this in the articles that were reviewed. Most DSS are approached very technically, being disconnected from the human or social context in which it should be used. This results in a disconnection between the system and its utilisation in the decision making process. What is evident is that in some cases participatory approaches have been developed in alignment with DSS development. In these approaches stakeholders and/or end-users were involved in the development process of DSS. Taken from the general literature on DSS, in order to facilitate the intended utilisation of DSS, stakeholders' input should actually be integrated in the design of the DSS. In doing so special attention should be given to the decision makers' problems, needs and input. In the current set of DSS that were reviewed, an image arises of the development by scientists of models that in a way could be useful for the decision making process and are therefore in hindsight labelled as being DSS.

In order to generate a successful DSS the first step has to be the development of a clear understanding of what the decision is that the DSS is supposed to be supportive of. This requires the active involvement of the end-users in this process. In addition the development of a DSS can benefit from the input of other groups of stakeholders in order to enhance the decision making by generating additional information and increasing the legitimacy of the input and output of the process a DSS is more likely to be utilised in the end-user or problem owner is explicitly responsible for the aim of the DSS and its effect, and the DSS developers responsible for the outcomes as defined by the needs of the end-user; i.e. the deliverables that jointly form the DSS. End-users and developers should be in continuous interaction. A prerequisite of usable output of the DSS is when output data becomes information that is relevant for decision making.

Hence in short, based on the general literature and the DSS that were examined emphasis should not be so much on the science part of underpinning the decision in marine management but rather on unravelling the decision and the decision making process the DSS is supposed to be supportive of. This entails e.g. questions like: what is the type of decision to be made? What should be the output of the decision? What should be the effect of the decision? Who is taking the decision? What are the problems and needs of the decision maker?

Noting that data only will become information (Alter 1998) when the data assists the user in taking a decision it is important to analyse the decision to be taken and to get agreement on how the

DSS is constructed (knowledge rules), which problems can/should be solved, which data is used as input and how the output is utilised in the decision making process. Taking the end-users' needs into account before designing the DSS is one step in developing more useful DSS, another step is to make the end- user/problem owner explicitly responsible for the aim of the DSS and its output. This would call for a more continuous interaction between end-user and DSS developer.

Increasingly the development of DSS can be noticed in marine management issues, tools that in a very clever way could assist in the decision process. Yet quite a number of the DSS remain idle on the shelf after development. In the evaluation of why DSS work or not work, on the one hand rather technical/methodological scientific analyses can be found and on the other hand participatory analysis, yet there is a lack of integration of these two perspectives. This in fact provides a plea for co-creation: involve social scientist and participatory approaches to co-create a DSS together with GIS, ICT experts and ecologists. But most importantly a co-creation between scientists and decision makers!

The 5 evaluative steps that were elaborated in this article can assist in overcoming these omissions when developing a DSS. Consider the role of stakeholders in the decision making process. Which actors play a role in the process, what are their interests and in which phase(s) of the process are they involved in the process? Secondly analyse the planned role of the DSS in the decision making process. Step three, unravel the objectives of the DSS itself. How does it contribute to the decision making process? The fourth element identifies what the DSS is intended to do in terms of processing unstructured input data into structured output data. Finally analyse the outcomes of the DSS in terms of the objectives of the DSS and its role in the decision making process.

References

Alter, S. (1998). Information Systems, Addison-Wesley Longman Publishing Co., Inc. Boston, MA, USA.

Ascough, J. C., II, Deer-Achough, L. A., Shaffer, M. J., & Hanson, J. D. (1998). Subjective evaluation of decision support systems using multiattribute decision making (MADM). In El-Swaify, S.A, Yakowitz,

D.S. (eds.), Multiple objective decision making for land, water, and environmental management. Boca Raton, FL: Lewis Publishers.

Cronin, K., M. van der Meulen, F. Keppel, A. Christensen, T. Hogaasen, V. Stelzenmuller and K. Deneudt (2013). Final Set of Management Tools: Final set of management tools and recommendations for improvements. MESMA report D4.5. IJmuiden.s

Doré, R., Maron, P., Neves, R. (2012). Toward a qualified process for coastal models: Integrated Development of Applied Systems for Coastal Management (IDeASyCoM). In Ocean & Coastal Management, 69, 307-315.

Garmendia, E., Gamboa, G., Franco, J., Garmendia, J. M., Liria, P., & Olazabal, M. (2010). Social multi- criteria evaluation as a decision support tool for integrated coastal zone management. Ocean & Coastal Management, 53(7), 385-403.

Geertman, S. (2006), Potentials for Planning Support: A Planning-Conceptual Approach, Environment and planning B : Planning and Design, 33(6), 863-880.

IRMA (2011). Green Technologies: Concepts, Methodologies, Tools and Applications. London: Information Science Reference.

Jones, A.C., El-Swaify, S.A., Graham, R., Stonehouse, D.P., Whitehouse, I. (1998). A synthesis of the state-of-the-art on multiple objective decision making for managing land, water, and the environment In: El-Swaify, S. A, & Yakowitz, D.S. (Eds.), Multiple objective decision making for land, water, and environmental management. Boca Raton, FL: Lewis Publishers.

Kirakowski, J., & Corbett, M. (1990). Effective Methodology for the Study of Hci (Human Factors in Information Technology, Vol 5).

Krueger, I. & Schouten-De Groot, P. (2011). KPP Noordzee: Tools. Deltares report 1204375-000.

Luisetti, T., Turner, R. K., Bateman, I. J., Morse-Jones, S., Adams, C., & Fonseca, L. (2011). Coastal and marine ecosystem services valuation for policy and management: Managed realignment case studies in England. Ocean & Coastal Management, 54(3), 212-224.

Parravicini, V., Rovere, A., Vassallo, P., Micheli, F., Montefalcone, M., Morri, C., Paoli, C., Albertelli, G., Fabiano, M. & Bianchi, C. N. (2012). Understanding relationships between conflicting human uses and coastal ecosystems status: a geospatial modeling approach. Ecological Indicators, 19, 253-263.

Power, D.J. (2002). Decision support systems: concepts and resources for managers. Westport: Quorum Books.

Power, D.J. & Sharda, R. (2009). Decision Support Systems. In: Springer Handbook of Automation. Berlin: Springer Berlin Heidelberg.

Reed, M. S. (2008). Stakeholder participation for environmental management: a literature review. Biological conservation, 141(10), 2417-2431.

Rhee, C., & Rao, H. R. (2008). Evaluation of decision support systems. In: Handbook on Decision Support Systems 2 (pp. 313-327). Springer Berlin Heidelberg.

Rothschild, B. J.; Ault, J. S.; Smith, S. G. (1996). A system approach to fisheries stock assessment and management. In V. F. Gallucci, S. B. Saila, D. J. Gustafson, & B. J. Rothschild (Eds.). Stock assessment, quantitative methods and application for small scale fisheries. CRC Press.

Santoro, F., Tonino, M., Torresan, S., Critto, A., & Marcomini, A. (2013). Involve to improve: a participatory approach for a Decision Support System for coastal climate change impacts assessment. The North Adriatic case. Ocean & Coastal Management, 78, 101-111.

Soma, K., Ramos, J., Bergh, Ø., Schulze, T., van Oostenbrugge, H., van Duijn, A. P., ... & Buisman, E. (2013). The “mapping out” approach: effectiveness of marine spatial management options in European coastal waters. ICES Journal of Marine Science: Journal du Conseil, fst193.

Sprague, R.H. & Carlson, E.D. (1982). Building effective decision support systems. Englewood Clifts, N.J: Prentice-Hall Inc.

Stelzenmüller, V., Schulze, T., Fock, H. O., & Berkenhagen, J. (2011). Integrated modelling tools to support risk-based decision-making in marine spatial management. Marine Ecology Progress Series, 441, 197-212.

Stelzenmüller, V., Breen, P., Stamford, T., Thomsen, F., Badalamenti, F., Borja, Á., ... & ter Hofstede, R. (2013). Monitoring and evaluation of spatially managed areas: a generic framework for implementation of ecosystem based marine management and its application. Marine Policy, 37, 149- 164.

Te Brömmelstroet, M. (2009). Hoe maak je modellen meer bruikbaar voor praktijken van planning? Een constructieve dialoog als brug tussen twee werelden. In: Synergie in stedelijke netwerken: tussen competitie en complementariteit, W. Salet and L. Janssen-Jansen, eds., Sdu Uitgevers, Den Haag, 103-112.

Ubbels, A. A., Verhallen, A. J. M. (2000). Suitability of decision support tools for collaborative planning processes in water resource management, Report No. 99.067. The Netherlands: Institute for Water Management and Wastewater Treatment.

Uran, O., & Janssen, R. (2003). Why are spatial decision support systems not used? Some experiences from the Netherlands. Computers, Environment and Urban Systems, 27(5), 511-526.

Van Delden, H. (2009). Lessons learnt in the development, implementation and use of Integrated Spatial Decision Support Systems. In 18th World IMACS/MODSIM Congress, Cairns, Australia.

Vonk, G., S. Geertman, and P. Schot (2005), Bottlenecks Blocking Widespread Usage of Planning Support Systems, Environment and planning A, 37, 909-924.

6. A Framework to weigh up marine activities

Luc van Hoof

Obviously, the need for marine spatial planning is strongly, if not entirely, influenced by the need for a framework that allows management of the increasing demand for ocean space and ecologically responsible decision-making about new uses of the sea (Douvere and Ehler, 2009). The value of marine spatial planning is not just in the development of the product but also in the process. Done well, the planning process can help to clarify management objectives, examine trade-offs among them, involve stakeholders and reduce conflicts among users. The process does not end with the plan, especially since many plans have specified dates for evaluation (Collie *et al.*, 2013).

In this chapter we will first look at ways in which marine planning can be framed. Secondly we will explore the type of information that is required in such a planning process. We will in the third section address the issue of balancing and weighing up alternative and competing activities and interests. Finally in the fourth section we will develop our framework for an informative participatory framework for marine spatial planning.

A framework for marine planning

As illustrated in chapter one, a marine spatial plan can be perceived in different ways. MSP is to be understood not only as a legal instrument or a public investment plan, but also as an operational and programmatic tool for the development of public policies as well as of private investment strategies and local initiatives (Commission of the European Communities, 2000). Also whether the focus is more on the rational use of a shared marine space and integration over activities and sectors, or whether the focus is on the sustenance of fragile ecosystems, determines the feel of the planning process. These different perceptions of the goal and process of MSP also allows for different ways of framing the process. Below we will present some recent examples of providing a framework for MSP from literature. In a fundamental way all these frames are based on the generic policy cycle which typically proceeds through stages of problem identification, intervention planning, adoption and funding, implementation, and evaluation and review (Carneiro, 2013)

Gilliland and Laffoley (2008) present a step by step framework for plan production with specific attention for stakeholder input into the process. Foley *et al.* (2010) present a framework for the key aspects of any marine spatial planning process with an emphasis on how ecological principles can be used throughout the planning and implementation process. Carneiro (2013) and Stelzenmüller *et al.* (2013) both present frameworks with a key focus on evaluation aspects of Marine Spatial Planning. The several frameworks are presented in the figures below.

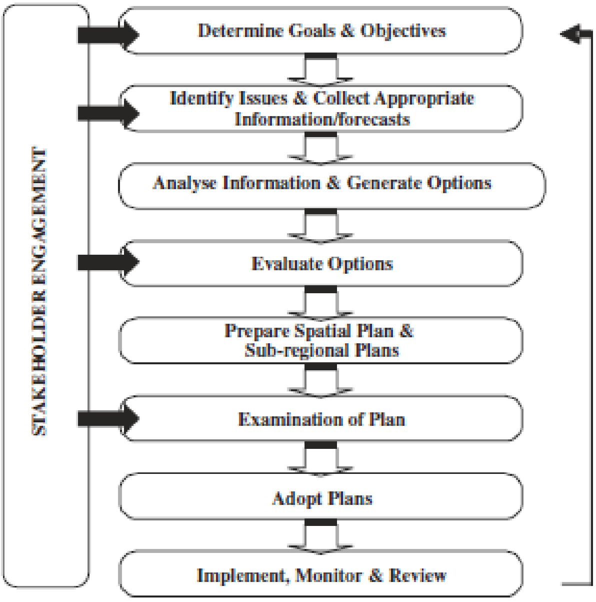


Fig. 3. The plan production process and stakeholder engagement based on work from the Irish Sea (adapted from Ref. [25]).

Figure 6: The plan production process and stakeholder engagement based on work from the Irish sea. (Gilliland and Laffoley, 2008)

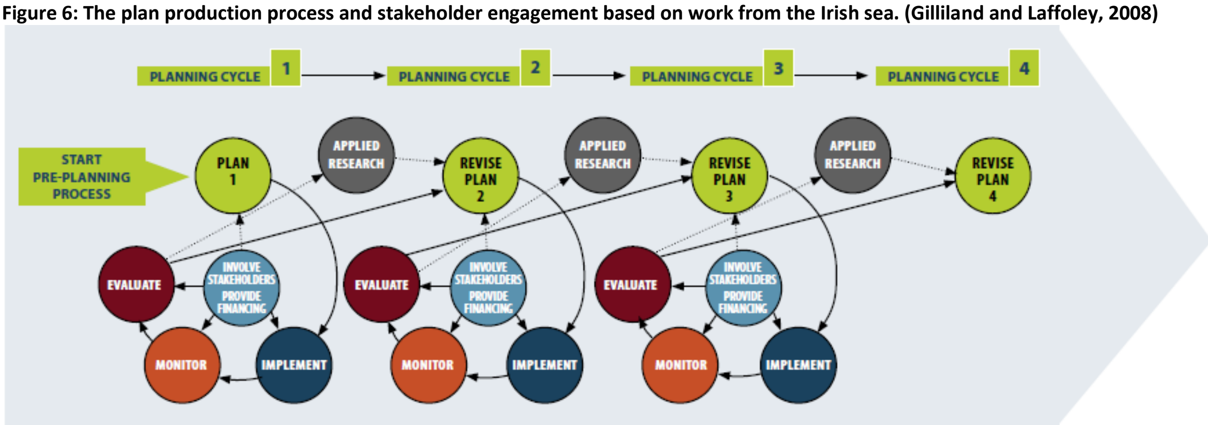


Figure 7: The Continuing MSP Planning Cycle. (Douvere and Ehler, 2009)

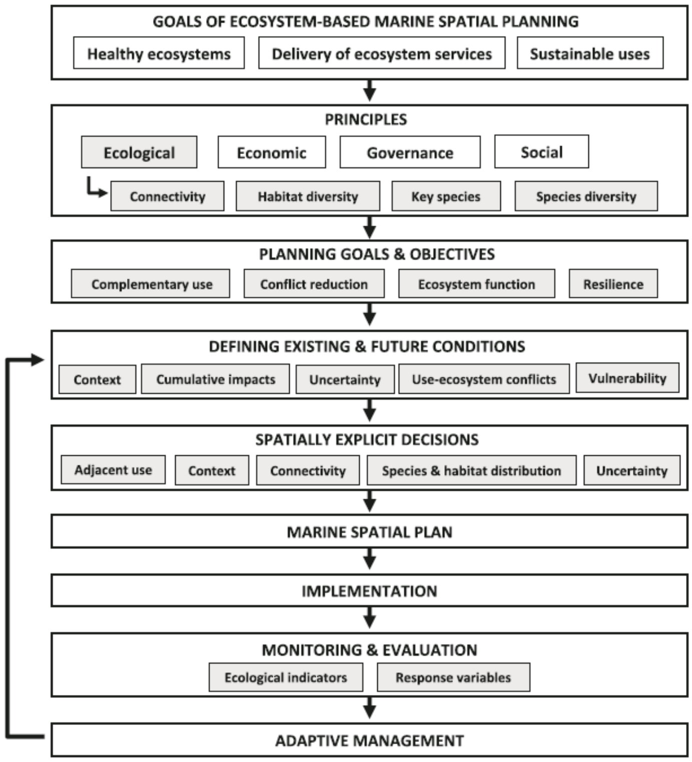


Figure 8: Flow diagram outlining the key aspects of any marine spatial planning process with an emphasis on how ecological principles can be used throughout the planning and implementation process. (Foley *et al.*, 2010)

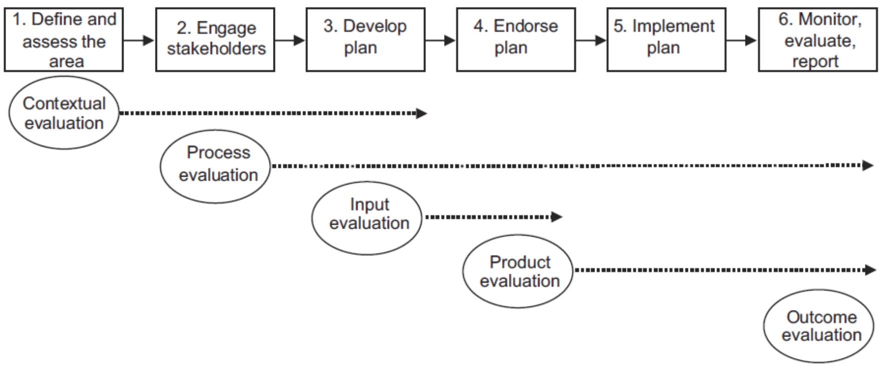


Figure 9: Categories of evaluation for the different stages in the DFO operational framework. (Carneiro, 2013)

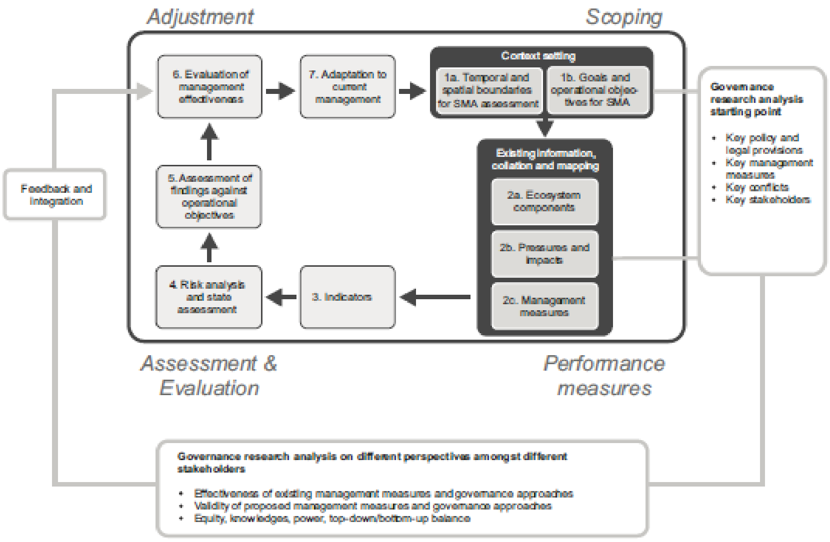


Figure 10: The flowchart shows proposed framework steps and the links to the governance research elements. (Stelzenmüller *et al.*, 2013)

Most planning frameworks will emphasize the rather cyclical nature of planning. Also in many frameworks specific attention is rendered to participation. Noting our analysis in chapter three, in developing a framework we will in addition have to render specific attention to aspects of competing claims, the specifics of the governance and institutional setting of the marine spatial plan, the integration over sectors, users and user groups and, most and for all, the role of knowledge and information in the planning process.

Information and decisions in marine planning

Fletcher *et al.* (2013) recognised that an adequate evidence base is instrumental in providing a sound basis for MSP decision-making. However, as an adequate evidence base is unlikely to exist to support most MSP processes it is important to ensure that the quality of the evidence that does exist and that any gaps in evidence are clearly reported. This will allow stakeholders and decision-makers to incorporate uncertainty into MSP decisions transparently and to ensure that policies are credible given the evidence available (Fletcher *et al.*, 2013). Rather than adopting a traditional instrumental view of rationality, framing knowledge that connects means and goals, our aim is to encourage deeper reflection on the more general epistemological problem of planning and policy-making: on what counts as knowledge (Richardson and Jensen, 2000).

Hence, as analysed in chapter 5, it is crucial for the marine spatial planning exercise is to have data, information and knowledge that relate to the issue or problem at hand. In addition there is a need to be aware, as mentioned above in chapter2, that the principles and values, or wisdom of the stakeholders shape their appreciation of the issue at hand, and in particular in defining problems and opportunities. In addition, scientific information is likely to be more effective in a process when the information is perceived by relevant stakeholders to be not only credible, but also salient and legitimate. And to take into account that the different groups involved in the planning process are all subjects of political rationalities.

A way to address these challenges is for the actors involved in the MSP process to jointly define the issues the process is going to address and which information can be used in order to assist in this process of decision making. Early and continuous engagement can lead to joint learning amongst participants when information is shared and explored together to develop understanding. This specifically works well to address conflicts and devise solutions early on in the process of engagement (Hull, 2013).

Balancing the scale

It is essential through spatial planning to identify development options that ensure compatibility and reinforcement between environment considerations and economic objectives. In this sense the environment becomes a key economic concern for an area that can strengthen its global competitiveness (Commission of the European Communities, 2000).

According to Katsanevakis *et al.* (2011) when it comes to management interventions, the cost and benefits have to be evaluated. The assignment of values to biophysical features of the marine environment allows the assessment of alternatives. The general assumption is that good management should produce a net gain. This is the basis of cost benefit analysis (CBA). The concept of Total Economic Value (TEV) is now widely accepted consisting of the sum of all market and non-market values in the environment. As not all environmental goods and services are traded on markets valuation techniques for non-market environmental goods and services can be used. There is a clear rationale that underpins the desire to place monetary values on environmental change. Monetary values should allow us to compare environmental costs and benefits with market costs and benefits. Methodologies of non-monetary assessment include Environmental Impact Assessment (EIA), Opinion Polling (OP) and Multi- Criteria Analysis (MCA). A development of MCA is Multi-Attribute Decision Analysis, which addresses complex problems characterised by a mix of objectives. The idea of placing monetary values on the environment is not new. Non-monetary valuation techniques attempt to understand the cause, distribution and strength of socioeconomic values. The drive here is to win the widest possible consensus reducing the need for difficult and costly enforcement in the future (Katsanevakis *et al.*, 2011).

Grafton *et al.*(2011), in the realm of Marine Protect Areas, propose a set of decision criteria. Although tailored towards MPAs they can be easily expanded to facilitate other marine decision processes. They encompass:

- Cost-Benefit analysis: evaluates the incremental monetary costs and benefits associated with a given policy relative to the status quo.
- Comparative risk analysis: a non-monetary approach that compares the risks involved with each alternative policy following a risk analysis (hazard identification, dose-response assessment, exposure assessment and risk characterization).
- Risk-benefit analysis: a compromise between comparative risk analysis and benefit-cost analysis. In a risk-benefit analysis, risks are valued in monetary terms and are treated as costs (Grafton *et al.*, 2011).

Parravicini *et al.*(2012) propose a modelling approach to visually represent the results of different practices upon seascapes that managers are entrusted by society to protect. The approach is suggested to assist policy in solving the dilemma of finding the appropriate balance between conservation and use of natural resources. Mapping potential pressures and assessment of the potential risk of impact by eliciting experts to quantify the vulnerability of different habitats to specific pressures can have potential since it can be applied over large scales and hence can assist in the planning of marine territory uses. Moving from planning to decision, however, requires information on how multiple human pressures interact. Human pressures can interact additively, synergistically, antagonistically and behaviour tends to be extremely context specific (Parravicini *et al.*, 2012).

Full trade-off analyses (including estimating the range of market and non-market benefits and costs of different spatial allocations) have rarely been used in marine spatial planning efforts to date; however many decision-support tools helped in assessing trade-offs (Collie *et al.*, 2013). Lester *et al.*(2013) advocate a model for trade-off analysis assessing the very nature of ecosystem interactions: non-interacting services, direct trade-off interaction in which increases in the provisioning of one service results in a proportional decrease of the other service; convex trade-off in which even a small increase in the provisioning of one service comes at a large cost for the other service; concave trade-off in which an increase delivery of one service does not imply a large cost to the other service; nonmonotonic concave trade-off: there are some levels of one service for which there are two potential outcomes for the other service; and finally backwards S trade-off: Over some range of one service, it can be increased at no cost to the other service, however, after a threshold it becomes very costly to increase that service in terms of the other (Lester *et al.*, 2013).

According to Börger *et al.* (2014) the adaptive management nature of marine planning provides both the opportunity to include new valuation findings in planning as the requirement for marine plans to be consistently reviewed in the future. This will allow MSP to provide an ideal area to begin to develop a baseline of ecological and economic valuation data in a place-based setting (Börger *et al.*, 2014).

However, one should bear in mind that, according to Jentoft and Knol (2014) MSP may not appear to be a win-win. On the contrary, for the least powerful stakeholders, those who are poorly represented and who have few resources to back up their claims, they risk being ignored in the planning process. For them MSP may add further pressure and result in a loss (Jentoft and Knol, 2014).

An assessment framework for MSP

In building the framework we will have to address the challenges as outlined in chapter one and the issues outlined above. As a starting point we will use a simple policy framework, as reflected in the skeleton models presented in 4.1 above. The cycle consists of 5 consecutive steps and has the continuation aspect as presented by Douvere and Ehler (2009). Hence once a full circle has been completed, automatically the next cycle initiates. It is based on rather simple do-plan-check-act and policy cycle models.

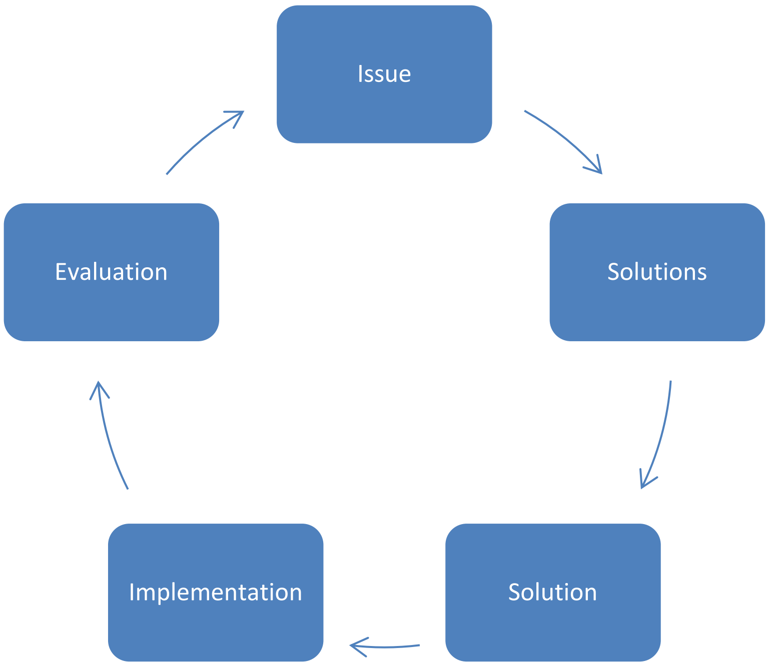


Figure 11: A policy cycle

Starting point of this cycle is the definition of the problem or the issue that is driving this process. Prior to this the issue has been put on the political agenda, either from an evaluation of the present situation, or from an issue defined in wider society. It can be a policy challenge (such as realising a certain amount of renewable energy production at sea), it can be a societal problem (coastal defence in times of climate change) or can be a generic desire to devise a zoning plan of the marine ecosystem.

As mentioned above, defining the issue or problem at hand is a crucial step in the entire process. Different actors involved may well have different perceptions of the problem, its causes and its effects and hence may have different ideas about possible solutions. It is already in this step that the owners of the planning process should decide on the way stakeholders can be involved in the process and who these stakeholders are. Steendam (2014) in analysing implementation of Natura 2000 in the Dutch part of the North Sea clearly concludes that stakeholders would like to be involved early on in the process, would clearly like to know their place in the process and their role in the process. It is at this stage that it should be clear whether the actors involved in the process can only contribute by providing information and reacting to decisions made, or have a more active role in this process.

Noting this crucial role of stakeholders in the process, and as analysed in chapter 2, the governance set up of the process we have, contrary to Stelzenmüller *et al.* (2013), not opted for a separate stream of governance considerations, but incorporate governance considerations in every step of the process. This would involve normative governance considerations (such as openness, transparency, legitimacy, accountability and responsibility), analytical governance considerations (the participating actors' role in the process, their ability and availability to contribute to the process, their power relations and discourses) and the second level governance considerations of the underlying principles and values held by the different stakeholder groups.

Following Hull (2013) in order to devise successful and thus accepted plans the sensitivities of different stakeholders need consideration at an early stage and engagement needs to be tailored to the needs of different socio-economic groups so that trust and the full participation of all stakeholders is captured. Early and continuous engagement can lead to joint learning amongst participants when information is shared and explored together to develop understanding. This specifically works well to address conflicts and devise solutions early on in the process of engagement (Hull, 2013).

The next step is to, based on a joint analysis of the problem or issue at hand, develop solutions. Whereas in the first step the integration over stakeholders, activities, sectors, policies, institutions and ecosystem components was already needed, in the step of devising solutions it is crucial. This step focusses on creating options. These options can be derived from the perspectives of the different actors involved and the way they articulate the issue being addressed. However solutions should be found in an integral analysis of options, not in the least by considering co-location of activities.

Weighing the outcomes and impacts of the different options, using methodology as described above in chapter 3, will initiate the process of selecting the option that will be implemented. Again in this step it is crucial to have all actors involved especially in devising the system to be used to arrive at selecting the one solution that is going to be used. Full trade-off analyses can be facilitated by decision-support tools, noting that the users of the DSS should be involved in defining the decision to be taken and in defining the way the system supports that process.

After the solution has been chosen it can implemented and evaluated. For both actions it is important to beforehand define who is going to undertake the action, who is responsible and who is accountable. Especially for evaluation it is important to already know beforehand on which elements a certain action will be evaluated and the role the different actors involved will play in the evaluation.

In the next section we will reflect in more detail on some of the steps presented above and specifically will address the issue of knowledge and the role it can play in the assessment framework.

Knowledge and the assessment framework

Managing the multifaceted socio-ecological marine system is a complex task. It not only seeks to strike a (sustainable) balance between the ecological, economic, political and societal system but needs to take into account all of the complexities of the compound environment of other actors such as neighbouring nations, competing uses, adjacent ministries and policies and multiple sets of stakeholders. Currently available (scientific) knowledge does not always answer relevant management and planning questions and contains high degrees of uncertainty. In addition available knowledge hardly addresses cumulative effects and lacks an integral assessment of impacts and effects.

This situation leads in practice to a lot of uncertainty, unclarity and ambiguity and sometimes to unforeseen effects of (policy) measures or activities as the (integral) impact was not foreseen. This on the one hand leads to the need for a substantial request for more scientific research to address newly emerging questions and issues. On the other hand it leads to delays in implementation and sometimes results in legal action as users contest policies.

From the perspective of the science suppliers they increasingly are confronted with their advice not being congruent with the demands from the real world. In addition research is rather fragmented and hardly manages to integrate ecological, economic and societal considerations. In addition, through the use of different research methodologies and paradigms research does not always result in a clear single advice. As the knowledge produced lacks relevance and credibility the reliability of scientific knowledge is put to question. The role of scientific knowledge in decision processes hence is thinning. What role can science still play in this context?

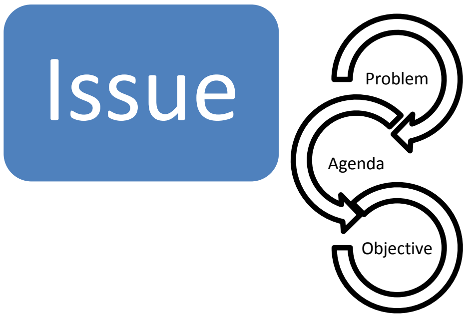
First step is that the knowledge produced for the MSP cycle fits with the issue at hand. As mentioned above, both the knowledge from science as from stakeholders needs to have a fit with the decision at hand and needs to contribute to the process of generating options to address the problem or issue at hand. In addition knowledge and understanding can assist in assessing the different options and choose a solution.

This knowledge should address in an integral way the issue at hand. Realising that we are dealing with a socio-ecological system the analysis should focus both on (wo)man and ecosystem. In this it is helpful to realise that managing ecosystems signifies managing human behaviour. Also as the ecosystem as well as human behaviour are complex entities, and although integration should be a strive, a full integration over all socio-ecological components is but an aspiration. In fact it can be queried whether when all causes and effects in the socio-ecological system are known still man is able to make a management decision.

Based on the latter, but also stemming from the fact that the sum of components that define an issue or problem are usually not all equally perceived as problematic or are all equally controllable or manageable, it is suggested to together with the actors involved in the decision process, focus on those decision points in the process that are found crucial. This can either be a consensus of which decisions are crucial in the process (and hence other choices are left aside) or can be a choice for those decisions where apparently the actors involved see conflicts and issues arising. This involves also defining the criteria a solution should fulfil.

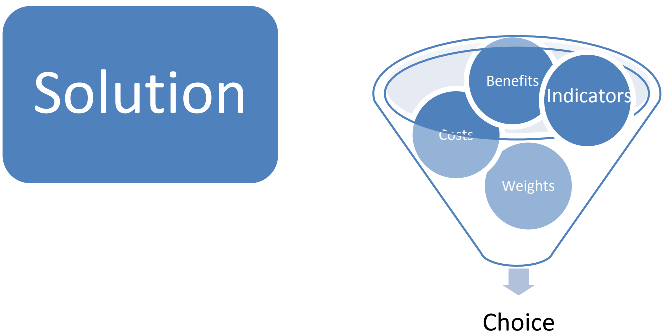
These crucial decision points will become the focal point of the assessment framework. So in the first step of the process the actors involved should define the problem that will be addressed. This also implies defining the (sub)system that is being considered. And decide on the decision points and choices to be made.

In the section below we will describe which role scientists and scientific knowledge can play in this process.

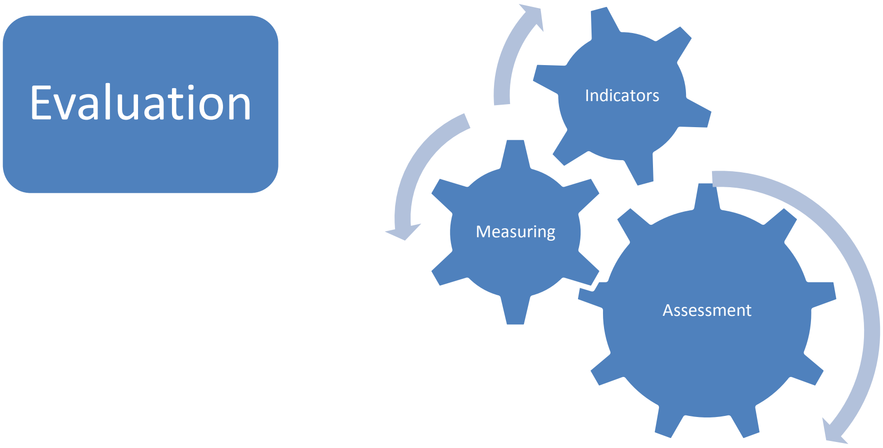


In the step of defining the issue in the MSP cycle experts can assist in defining the problem, help with setting of the agenda and contribute to establishing the goal of the exercise. As mentioned above it is helpful if all actors involved can bring knowledge to the table and in a process of joint fact finding can come to a shared definition of the problem or issue to be addressed. This issue can then by the actors be translated into a concrete set of issues or decisions that need to be attended to and result in a concrete goal of the (planning) exercise.

The next step specialists can assist in is the development of solutions. All actors can bring knowledge to the table, the specialists can assist in using this information in the process. Also the specialists can assist in developing alternatives and new perspectives on the issue to be addressed. In this step decision support systems can be used to generate alternative solutions. It also focusses on generating alternative ways to frame the problem and solutions in order to open up perspectives on alternative ways of finding solutions.



After different solutions have been generated the process will entail selecting a preferred solution that will be implemented. This process entails generating a measure for the costs and benefits of the different alternative solutions, decide on indicators which will be used to make a decision and the weights to be assigned to the different indicators. Whereas the actual process of choosing a solutions is a political process of the actors involved in the process scientific methods can assist in ordering and ranking the information and providing additional analyses.



In the evaluation process science can assist by collecting data, measuring the impact of proposed measures, by using a set of indicators agreed upon by the actors involved in the process. These indicators should be congruent with the indicators and criteria used to define the decision points and selection of the final solution being implemented. It is the actors involved that should, based on the information available, decide on the assessment of the impact of the measure.

Concluding reflection

Today with conceptions of the ecosystem approach to management, regionalisation of policy and the Marine Strategy Framework Directive the ecosystem has become the fundamental unit of management. Issues that immediately relate to this are where are the (geo-political) boundaries of that system and how do we address the complexity of such socio-ecological system? In such a complex socio-ecological environment stakeholder involvement is crucial. Not only to arrive at a shared definition of the issues that need to be dealt with but also to select the crucial factors that the planning process needs to address. Joint fact finding and building a shared knowledge base between all actors involved will contribute to successful and thus accepted plans and will assist in addressing conflicts and devise solutions early on in the process.

Following Jentoft and Knol (2014), MSP is applied to social and ecological systems that are inherently diverse, complex and dynamic, and work at multiple scales. In such situations, one should not expect quick fixes; the problems are not expected to go away anytime soon. As wicked problems they are not solved once and for all but need constant attention, and it is hard to determine if and when they are solved, and for how long. They can at best be “tamed.” Solutions are less than ideal and never given. Instead they are negotiated among stakeholders who tend to have different ideas about what the problem is. Decisions would therefore require compromise if agreement cannot be made.

According to Kidd (2013) close examination of the integration issues within MSP reveals that formal MSP processes cannot be expected on their own to deliver integrated planning and management of the sea. It is worth remembering that MSP is only one of a range of tools and measures that can contribute to this wider objective, and that MSP development should be considered only as part of a wider integrated management regime (Kidd, 2013).

According to Fletcher *et al.*(2013), effective MSP, in the view of participants in two marine planning pilot studies on the English south coast, should be inclusive, evidence based and well resourced. However, it should be noted that wherever MSP is undertaken there will be a unique mix of contextual factors, including the ecological and socio-economic priorities associated with MSP, stakeholder working methods, the level of support offered by the pre-existing marine and coastal governance framework, and the prevailing physical coastal and oceanographic conditions. Therefore the extent to which the conclusions can be applied elsewhere may be variable, or require some degree of adaptation (Fletcher *et al.*, 2013).

References

Alter, S. 1998. Information Systems, Addison-Wesley Longman Publishing Co., Inc. Boston, MA, USA.

Bellinger, G., Castro, D., and Mills, A. 2004. Data, information, knowledge, and wisdom. URL: http://www. systems-thinking. org/dikw/dikw. htm: 47.

Bolman, B. C., Jak, R. G., and van Hoof L. 2014. Unravelling the myth – The use of Decisions Support Systems in marine management. *In* Report of the Zee op Zicht project. IJmuiden.

Börger, T., Beaumont, N. J., Pendleton, L., Boyle, K. J., Cooper, P., Fletcher, S., Haab, T., et al. 2014. Incorporating ecosystem services in marine planning: The role of valuation. Marine Policy, 46: 161-170.

Carneiro, G. 2013. Evaluation of marine spatial planning. Marine Policy, 37: 214-229.

Cash, D. W., Clark, W. C., Alcock, F., Dickson, N. M., Eckley, N., Guston, D. H., Jäger, J., et al. 2003. Knowledge systems for sustainable development. Proceedings of the National Academy of Sciences, 100: 8086-8091.

Christie, N., Smyth, K., Barnes, R., and Elliott, M. 2014. Co-location of activities and designations: A means of solving or creating problems in marine spatial planning? Marine Policy, 43: 254-261.

Collie, J. S., Adamowicz, W. L., Beck, M. W., Craig, B., Essington, T. E., Fluharty, D., Rice, J., et al. 2013. Marine spatial planning in practice. Estuarine, Coastal and Shelf Science, 117: 1-11.

Commission of the European Communities 2000. TERRA – AN EXPERIMENTAL LABORATORY IN SPATIAL PLANNING chapter 2 Towards a new system of spatial planning. Office for Official Publications of the European Communities.

Commission of the European Communities 2007a. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. An Integrated Maritime Policy for the European Union.

Commission of the European Communities. 2007b. An integrated maritime policy for the European Union. Commission staff working document accompanying document to the communication from the Commission to the Council, the European Parliament, the European economic and social Committee and the Committee of the regions.

Commission of the European Communities 2008. Routekaart naar maritieme ruimtelijke ordening: werken aan gemeenschappelijke principes in de EU.

Commission of the European Communities 2013. Directive of the European Parliament and of the Council establishing a framework for maritime spatial planning and integrated coastal management COM(2013) 133 final. Brussels.

Commission of the European Communities 2014a. Blue Growth. Commission of the European Communities, , Brussels.

Commission of the European Communities 2014b. Innovation in the Blue Economy: realising the potential of our seas and oceans for jobs and growth. COM(2014) 254 final/2. Commission of the European Communities,, Brussels.

De Santo, E. M. 2011. Environmental justice implications of Maritime Spatial Planning in the European Union. Marine Policy, 35: 34-38.

Dickinson, M., Rutherford, M., and Gunton, T. 2010. Principles for integrated marine planning: A review of international experience. 37: 21-46.

Douvere, F., and Ehler, C. N. 2009. New perspectives on sea use management: Initial findings from European experience with marine spatial planning. Journal of Environmental Management, 90: 77-88.

Eggenberger, M., and Partidário, M. R. 2000. Development of a framework to assist the integration of environmental, social and economic issues in spatial planning. Impact Assessment and Project Appraisal, 18: 201-207.

Ehler, C., and Douvere, F. 2007. Visions for a Sea Change. Report of the First International Workshop on Marine Spatial Planning. Intergovernmental Oceanographic Commission and Man and the Biosphere Programme. . 48.

Ehler, C., and Douvere, F. 2009. Marine spatial planning: A step-by-step approach toward ecosystem-based management. Intergovernmental Oceanographic Commission and Man and the Biosphere Programme. , Paris, UNESCO.

Fletcher, S., McKinley, E., Buchan, K. C., Smith, N., and McHugh, K. 2013. Effective practice in marine spatial planning: A participatory evaluation of experience in Southern England. Marine Policy, 39: 341-348.

Foley, M. M., Halpern, B. S., Micheli, F., Armsby, M. H., Caldwell, M. R., Crain, C. M., Prahler, E., et al. 2010. Guiding ecological principles for marine spatial planning. Marine Policy, 34: 955-966.

Frazão Santos, C., Domingos, T., Ferreira, M. A., Orbach, M., and Andrade, F. 2014. How sustainable is sustainable marine spatial planning? Part I—Linking the concepts. Marine Policy, 49: 59-65.

Gilliland, P. M., and Laffoley, D. 2008. Key elements and steps in the process of developing ecosystem-based marine spatial planning. Marine Policy, 32: 787-796.

Grafton, R. Q., Akter, S., and Kompas, T. 2011. A Policy-Enabling Framework for the Ex-Ante Evaluation of Marine Protected Areas. Ocean & Coastal Management, In Press, Accepted Manuscript.

Hull, A. D. 2013. Managing Competition for Marine Space Using the Tools of Planning in the UK. Planning Practice & Research, 28: 503-526.

Jay, S. 2010. Built at sea: <i>Marine management and the construction of marine spatial planning</i&gt. Town Planning Review, 81: 173-192.
Jentoft, S., and Knol, M. 2014. Marine spatial planning: risk or opportunity for fisheries in the North Sea? 12: 1-16.
Jordan, A. 2001. The European Union: An Evolving System of Multi-Level Governance…or Government? Policy and Politics, 29 193-208.
Juda, L. 2007. The European Union and Ocean Use Managament: The Marine Stratgey and the Maritime Policy. Ocean Development and International Law, 38: 259-282.
Kannen, A. 2012. Challenges for marine spatial planning in the context of multiple sea uses, policy arenas and actors based on experiences from the German North Sea. 1-12.
Katsanevakis, S., Stelzenmüller, V., South, A., Sorensen, T. K., Jones, P. J. S., Kerr, S., Badalamenti, F., et al. 2011. Ecosystem-based marine spatial management: review of concepts, policies, tools, and critical issues. Ocean & Coastal Management.
Kidd, S. 2013. Rising to the integration ambitions of Marine Spatial Planning: Reflections from the Irish Sea. Marine Policy, 39: 273-282.
Kidd, S., and Shaw, D. 2013. Reconceptualising territoriality and spatial planning: insights from the sea. Planning Theory & Practice, 14: 180-197.
Kidd, S., and Shaw, D. 2014. The social and political realities of marine spatial planning: some land-based reflections. ICES Journal of Marine Science: Journal du Conseil.
Kraan, M., Goldsborough, D., and van Hoof L. 2013. The tenet of ordering claims at sea. *In* Report of the Zee op Zicht project. IJmuiden.
Lester, S. E., Costello, C., Halpern, B. S., Gaines, S. D., White, C., and Barth, J. A. 2013. Evaluating tradeoffs among ecosystem services to inform marine spatial planning. Marine Policy, 38: 80-89.
Maes, F. 2008. The international legal framework for marine spatial planning. Marine Policy, 32: 797-810.
Merrie, A., and Olsson, P. 2014. An innovation and agency perspective on the emergence and spread of Marine Spatial Planning. Marine Policy, 44: 366-374.
Moisio, S., and Luukkonen, J. 2014. European spatial planning as governmentality: an inquiry into rationalities, techniques, and manifestations. Environment and Planning C: Government and Policy.
Newig, J., and Koontz, T. M. 2013. Multi-level governance, policy implementation and participation: the EU's mandated participatory planning approach to implementing environmental policy. Journal of European Public Policy, 21: 248-267.
Parravicini, V., Rovere, A., Vassallo, P., Micheli, F., Montefalcone, M., Morri, C., Paoli, C., et al. 2012. Understanding relationships between conflicting human uses and coastal ecosystems status: A geospatial modeling approach. Ecological Indicators, 19: 253-263.
Portman, M. E. 2011. Marine spatial planning: achieving and evaluating integration. ICES Journal of Marine Science: Journal du Conseil, 68: 2191-2200.
Qiu W, and Jones PJS 2013. The emerging policy landscape for marine spatial planning in Europe. . Marine Policy, 39: 182-190.
Reed, M. S. 2008. Stakeholder participation for environmental management: a literature review. Biological Conservation, 141: 2417-2431.
Richardson, T., and Jensen, O. B. 2000. Discourses of Mobility and Polycentric Development: A Contested View of European Spatial Planning. European Planning Studies, 8: 503-520.
Schaefer, N., and Barale, V. 2011. Maritime spatial planning: opportunities & challenges in the framework of the EU integrated maritime policy. 15: 237-245.
Smith, H., Maes, F., Stojanovic, T., and Ballinger, R. 2011. The integration of land and marine spatial planning. 15: 291-303.
Steendam, N. 2014. Stakeholder participation and the development of Natura2000 areas in the Netherlands North Sea Coastal Area (Bergen – Petten) Cleaver Bank. Masther Thesis.
Stelzenmüller, V., Breen, P., Stamford, T., Thomsen, F., Badalamenti, F., Borja, Á., Buhl-Mortensen, L., et al. 2013. Monitoring and evaluation of spatially managed areas: A generic framework for implementation of ecosystem based marine management and its application. Marine Policy, 37: 149–164.
Suchman, M. C. 1995. Managing legitimacy: Strategic and institutional approaches. Academy of management review, 20: 571-610.
Uran, O., and Janssen, R. 2003. Why are spatial decision support systems not used? Some experiences from the Netherlands. Computers, Environment and Urban Systems: 511–526.
Van den Hoek, R., Brugnach, M., and Hoekstra, A. 2012. Shifting to ecological engineering in flood management: Introducing new uncertainties in the development of a Building with Nature pilot project. Environmental Science & Policy, 22: 85-99.
van Hoof, L., van Leeuwen, J., and van Tatenhove, J. 2012. All at Sea; Regionalisation and Integration of Marine Policy in Europe. MAST.
van Hoof, L., and van Tatenhove, J. 2009. Up or Out: the changing role of Member States in EU Fisheries Management. *In* The XIXth EAFE Conference, 6th – 8th July 2009. Malta.
van Leeuwen, J., Raakjear, J., van Tatenhove, J., Long, R., van Hoof, L., Ounanian, K., and Delaney, A. 2014. Legal, institutional, and stakeholder obstacles in implementing the Marine Strategy Framework Directive. Marine Policy.
van Slobbe, E. 2010. Ecodynamic Design as a boundary object. A case study in Fryslan. *In* ERSCP-EMSU conference, Delft, The Netherlands, October 25-29, 2010.
van Slobbe, E., and Lulofs, K. 2011. Implementing "Building with Nature" in complex governance situations. Terra et Aqua, 124.
Wenger, E. 1998. Communities of practice: Learning, meaning, and identity*,* Cambridge university press.