Deltares

KPP Noordzee: Tools

Ina Krueger
Patricia Schouten-de Groot

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Title
KPP Noordzee: Tools

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Trefwoorden
Marine Spatial Planning, MSP, tool, interview

Samenvatting
In preparation of the new structural vision on spatial planning for the Dutch part of the North Sea (to be published in 2015), suitable tools for supporting the process of marine spatial planning for the Dutch Exclusive Economic Zone were explored. This research started with a broad assessment of existing tools, resulting in a list of 118 tools of very different types. Subsequently, a set of 11 tools was selected for further assessment, and a framework of analysis was compiled. The framework, consisting of a table of criteria and wishes, formed the bases for the evaluation of these 11 tools. After the table of criteria and wishes had been filled for every tool, tools were regrouped into categories according to the functions they deliver. This research showed, that the identified search criteria are interdependent, resulting in a contradiction of some of the wishes. As wishes are not prioritized, it is at this stage not possible to make a scientifically robust recommendation about which tool would best be suited for use on the Dutch continental plate.
Based on the results of this research, and without weighting wishes against each other, a set of two tools, SimCoast and Xplorah (a land planning tool), are identified as possibly suited use in the marine spatial planning process for the Dutch EEZ. SimCoast and Xplorah can be employed to support map-based landuse planning, integrate multiple sectors and calculate cumulative effects. Both tools still require modification and adaptation for the system and case at hand. Recommendations for follow-up action on this research are to more narrowly define the future user base, to weight criteria together with future users, and to ensure a close harmonization with the other existing marine management tools in the Netherlands (Informatiehuis Marien, Noordzee Atlas, Kennisbibliotheek).

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Table of content (or Index)

1 Introduction

With the increase of anthropogenic pressure on the seas and oceans in the last couple of years, Marine Spatial Planning (MSP) emerged as a new concept in marine management. According to Maes et al. (2005), MSP is a measure to: "Create and establish a **more rational organization** of the use of marine space and the **interactions between its uses**, to balance the demands for development with the need to protect the environment, and to **achieve social and economic objectives** in an open and **planned** way." However, in most countries, marine management is still conducted independent from plans which articulated an overall spatial vision for the use of marine areas in future (Douvere, 2008, and Douvere & Ehlers, 2009). Consequently, regulation of activities took and still very often takes place only within individual economic sectors, largely managed by disconnected sectoral policies and management authorities.

However, while they are managed separately, in reality different uses impact each other in many and often times very complex ways. As Douvere (2008) describes, "The multiple objectives related to achieving economic and environmental sustainability, and the need to minimize and reduce conflicts of both types (user– user and user– environment conflicts) can only be dealt with through an integrated approach to management". As they adopt the concept of MSP, policy makers in Europe are struggling with the complexity of the interaction between different uses and their impact on the environment.

MSP tools can give insight into these effects and help to identify optimal planning solutions for marine areas, which accommodate all possible uses in the most efficient and effective way. Furthermore, they can visualize negative and positive impacts of plans on different uses and help to find mitigation measures. Thereby, the political decisions are made more transparent and deducible.

As a means to help structure and analyze complex systems, MSP tools are becoming more and more important for MSP. However, the definition and typology for MSP tools has stayed relatively broad and vague.

The first integrated MSP for the Dutch EEZ was published in 2009 (Beleidsnota Noordzee).

In preparation of the new structural vision on spatial planning for the Dutch part of the North Sea (to be published in 2015), the expectation is that tools can play an important role to support the process of MSP. In light of this development, Deltares was asked to explore current MSP tools. The main goal of this research is: 'Defining the needs and success factors of a MSP tool'. By gaining an insight into the type and functioning of tools which are currently available for MSP, the selection of a tool which satisfies the user demands is facilitated. In the final step of this research, possible practical wishes and needs of future users are analysed and compared with the outcome of this study.

In this research, the following definition of the word tool is used (adapted from Cronin, oral and written communication):
A tool is a means which helps and supports the realisation of any work. In the context of governance, and planning, among others, the following tools can be listed:

- *Methodology*
- *Guideline*
- *Framework*
- *Criterion*
- *Instrument*
- *(Software-)Model*
- *Map*
- *Communication-means*

A tool can offer conceptual, operational, analytical and/or technical support in the planning process.
The following chapter (chapter 2) describes the research methodology. The results are presented and discussed in chapter three. The conclusions and recommendations can be found in chapter four.

2 Methods

This research is based on three distinctive phases: At first, an assessment of existing tools was made. Then, the wishes and experiences for tools were inventoried. In the last step, a number of useful and suitable tools were described and identified. Table 2.1 gives an overview of the structure of this research. In the following paragraphs, the method which was applied in each of these three steps will be explained in detail.

Table 2.1: Overview of the structure of this research

Research step	Methods	Product
1 Assessment of existing tools	Literature review, desk research.	Table of 118 tools, sorted by type, including pre-selection.
2. Inventory of wishes and experiences	Brainstorming with potential users at RWS and I&M, literature research, semi-structured[1] telephone interviews.	List of wishes, list of selected tools by potential users at RWS and I&M, and a more thorough analysis of these tools.
3 Description and identification of useful tools	literature research evaluation and assessment of data assembled in phase 1 and 2.	Framework of analysis and List of useful tools and how they perform in relation to wishes.
Final product: Report and final version of table		

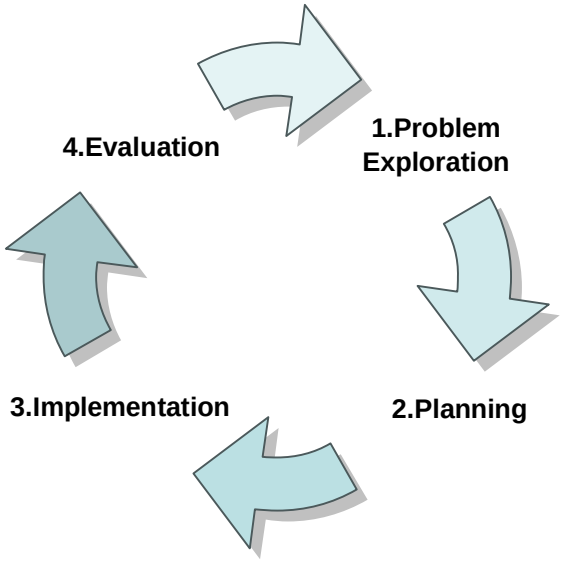
1. Assessment of existing tools

For supporting the execution of the policy cycle (see figure 2.1), a wide variety of tools exist. In this first research phase, an inventory is made of tools which could be of relevance for spatial planning in the North Sea, including tools which are developed and used in other countries. In this phase, close cooperation has taken place with the two projects KPP Zeeverkenner and SO Instrumenten en methoden. The results of this first assessment are presented in a table; including explanations (see attachment 1).

1. *In semi structured interviews, the interaction between interviewer and interviewee is characterized by a combination of structure and liberty. As opposed to fully structured interviews, in which the interviewer uses a pre-defined questionnaire with a fixed set of questions, semi-structured interviews rely on a more open interview guide prepared by the interviewer on beforehand, which provides a set of important topics or questions that have to be discussed with the interviewee at some point during the interaction. Besides these key topics, the interview protocol allows for flexibility and offers the possibility to go into depth if a topic proves to be particularly important to the interviewee or to ask on and clarify complex questions if necessary. Often, semi-struuctured interviews will be prefered over structured interviews, beause the provide the interviewer not only with the answer to is question, but also with the reasons behind the answer.*

This list of tools is compiled from different sources of information, starting with an overview of the different planning tools which have been (co)produced by Deltares. (e.g. KRW verkenner, blokkendoos, etc.). For this, contact was made with the leaders of the roadmap Methods and Instruments. Apart from this, other overviews of tools were used as additional source of information. A big part of the more general methods originated from the webpage www.waterwerkvormen.nl, and many of the more complex tools were taken from a publication by Stelzenmüller *et al*. (2008) over marine planning tools. Furthermore, an overview of tools which was assembled by Deltares for the project Climate Proof Areas was used as a source. Finally, use was made of an overview of tools which was created by MESMA[2], an EU project. All tools which were found in other overviews and which matched the definition of the word tool as presented in chapter 1, were taken into consideration. In a final step of analysis, the table was completed and supplemented by a broad literature research.

Figure 2.1 Policy and planning cycle



2. Inventory of wishes for and experiences with tools

In an interactive meeting with potential users at RWS and I&M, a list of wishes and a list of criteria were assembled in a brainstorming session, based on which tools could be analysed. The list of criteria was further elaborated and supplemented in various meetings and brainstorm sessions within Deltares. Furthermore, the list of tools provided by the previous research step was reduced by potential users at RWS and I&M to a set of 11 tools, which would undergo a more thorough and detailed analysis.

This analysis consisted of a literature research and a semi-structured interview with developers and/or end-users of the respective tools. In these interviews, interviewees were asked to supply missing information and to give insight into their experience with the tool. They were asked to evaluate the usefulness of the tool, and mention its success and fail factors from their perspective.

[2] *For more information, see also http://public.deltares.nl/display/MESMA/Home*

3. Description and identification of useful tools

An analysis of the results from phase 1 and 2 (wishes, and detailed analysis of 11 tools with respect to criteria) results in an overview of how possibly useful tools fill in these criteria, and how they perform in relation to the identified wishes. A system of clusters is developed to support the process of tool analysis. Finally, an insight into conclusions which can be made from the interviews is given.

3 Results & Discussion

3.1 An inventory of existing marine spatial planning-tools

The inventory of existing Marine spatial planning (MSP) tools consists of a table of 118 tools (see attachment 1). For assembling this list of tools for (spatial) planning, the term 'tool' is deliberately understood in its widest sense, based on the definition of Cronin (see chapter 1).

Since this broad search resulted in a very heterogeneous, comprehensive list of (spatial) planning tools which belong to different categories, a system of eight tool categories is established, according to which tools are sorted (see Table 3.1, and colour-code in attachment 1). These categories were determined, based on a framework developed by Stelzenmüller et al. (2008), and supplemented according to the similarities between and differences of the tools, identified in this research.

Table 3.1 Overview of tool categories and number of tools falling into these categories

Category	Number of tools in this category
1. Tools for data gathering & storage	7
2. Tools for gathering+ storing data, simple evaluation and visualization (/mapping)	10
3. Tools for data storage, visualization, modelling and scenario prediction	23
4. Tools for cumulative effect assessment (scenarios +measures)	27
5. Tools for cumulative effect assessment and decision support	19
6. Communication tools	7
7. Participation tools	15
8. Education tools	5
9. other tools which do not fall within either of the above mentioned categories	5
TOTAL	**118**

Most of the tools in this table belong to group 3 (tools for data storage, visualization, modelling and scenario prediction) and group 4 (tools for cumulative effect assessment).
The numbers of tools per category have to be interpreted with caution, however, since this tool list is by no means a complete compilation of all existing tools which can be used in MSP. Its comprehensiveness was restricted both by the availability of information and the limited availability of time. This is also valid for the uneven distribution of tools over different groups, which originates from the different sources that were consulted for this research. Nevertheless, it also seems logical that the majority of tools fall into categories 3-5, looking at the aim of the research step for which this table was compiled: The task was to identify tools for the use in (marine) spatial planning. Since spatial planning is closely connected to the work with maps, especially tools which can facilitate the storage and evaluation of spatial data (and thus, the tools from category 3-5) are needed.

3.2 Meeting for selection of tools and identification of criteria and wishes

In preparation for the meeting of May 25, a pre-selection was made of the tool inventory, in which the list of 118 tools (see attachment 1) was reduced to 40 tools. These tools were computer-based, and belonged to category 3, 4, 5 or 7. According to the results of a first, broad scoping based on literature research, these tools have been or could be applicable in marine policy making and/ or planning (see attachment). For these tools, the following information was collected: a short description of the tool, the 'sector' for which the tool was developed, its 'potential users' and other interesting 'comments'.

During a meeting with the potential users at RWS and I&M on 25th of May, from this list of 40 tools, 11 tools were identified as especially interesting for the Dutch case of marine spatial planning. This selection of 11 tools (for list and short tool descriptions, see § 3.3), which subsequently underwent a more detailed analysis, was based on the desired use-functions for the tool, which were determined by RWS, and a recommendation by the research team, based on expert knowledge which had been accumulated at that time.

Ten of these tools belonged to category 5 (Tools for cumulative effect assessment and decision support). In contrast, the tool 'Habitat', which was included following a request by I&M, belongs to group 3 (Tools for cumulative effect assessment).

Consequently, in a brainstorming session, potential users at RWS and I&M compiled a list of criteria and wishes, which they acknowledged as especially important in the context of marine spatial planning (see table 3.3).

Table 3.2: Overview of criteria and wishes as identified during the workshop May 25

Criteria	**Wish**
Ability to add new information	Fast, e.g. through a tool for information management (e.g. *Kennisbibliotheek*, *Informatiehuis Marien)*.
Flexibility	Tool has to be compatible with (nationally and internationally) existing tools and it should be easy to integrate new tools (modular setup).
Ease of use	High; Tool should be easy to use and perform calculations fast.
Adaptation to the needs of future users	High, future users= knowledgeable civil servants (management and administration), stakeholders, (politicians); NOT general public.
Adaptation to existing planning and policy processes	High
Reliability	High (model itself should not be subject of discussions anymore during procedure).
Transparency	High (no black box, formulas need to be clear and not too complex, deducible)
Dealing with uncertainties	Has to show where uncertainties exist, has to leave room for discussion.
Dealing with fundamental cause-effect relationships	Have to be clear and understandable, also dealing with uncertainties within cause-effect relationships is important.
Level of exploration	High, tool has to be tested and maybe also already been used in other countries.
Guidance in/ support of process	Output has to be adapted to reporting.
Presentation	Output has to be useful, has to give an understandable overview for stakeholders, not too big in document size, common format.
Costs of tool	Preferably open source.
Usefulness for different sectors	Tool should be multi-sectoral, give ecological as well as economical insights.
Time scale	Tool has to deal with time in a flexible manner, should be useful for different time scales.
Spatial scale	Different spatial scales (it has to be possible to zoom in), sea-land relationships have to be accounted for (e.g. harbours, breeding places for birds).
International usefulness	Internationally employable / compatible
Availability of decision making framework within tool.	Desirable, e.g. MCA[3] or CBA[4], also from the perspective of balancing and deciding between different stakeholders ("Who will be affected by changes"), weighting of different stakes has to be apparent, supporting joint fact finding.

3. *Multi Criteria Evaluation*
4. *Cost-Benefit Analysis*

3.3 Detailed analyses of a specific set of tools

In order to prepare for the analysis, the criteria from table 3.2 were complemented with several other, mostly technical criteria, which were found valuable for this research (see attachment 2). Based on these criteria, a thorough analysis was conducted on the 11 selected tools (see paragraph 3.2). Most information was drawn from available literature. In addition, interviews were conducted to fill remaining knowledge gaps and assess what experiences developers and users have concerning the success- and fail factors during tool use (/development). As a short overview, a description was made of each of the 11 tools (see paragraphs below).

BOSdA (English: Definite)
Definite is a decision support system focused on improving environmental decision making. It consists of a toolkit of methods, such as different multi-criteria-analyses, cost-benefit analyses and sensitivity analyses. With these, DEFINITE can compare and weigh alternative decisions and thereby support the selection of the best suitable alternative.

Community Viz
Community Viz is a group of extensions to ArcGIS Geographic Information System software, mainly consisting of two components (Scenario 3D and Scenario 360) that allow scenario planning, sketch planning, 3-D visualization, suitability analysis, impact assessment, growth modelling, and others. It allows users to export and share their data, among others, through Google Earth.

Windspeed
Windspeed is a decision support tool for renewable energy planning in the North Sea. It helps to determine suitable areas for the establishment of offshore wind farms by relating geographic position and setup of the park to its socio-economic costs and its impact on conservation. The tool was made for use at political level and is not suitable for application on a site-specific level (resolution too coarse).

Xplorah
Xplorah is a spatial decision support system, which was developed to support policy-makers in integrated decision making on the island of Puerto Rico. With this tool, the user can explore the impact of different scenarios (which consist of external factors and policy options) on indicators relevant to policy, by simulating future developments of the region over a time span of 20-30 years. Xplorah helps to evaluate the impacts of different alternatives and their associated policy measures. By this means it promotes the decision making process.

Open OceanMap
Open OceanMap is an open source software tool that was designed for data collection of local expert knowledge by means of a computer or online-based stakeholder survey. Ecological and economic data can be combined with stakeholder knowledge and values and expressed in a map to support marine spatial planning processes.

Marxan
Marxan is a conservation planning software. While old Marxan versions allowed users to assign only one type of conservation zone, its newest version, ‘Marxan With Zones’, allows users to draw different types of conservation zones into a map, each of which can have its own objectives and use-constraints assigned (e.g. Marine Protected Areas with different objectives, use limitations, etc.). Marxan can examine the trade-off between competing objectives (economic, social, cultural and biological) and help solve the spatial resource allocation problem.

MaRs
MaRs is a tool which calculates whether a proposed use meets the conditions for issuing a use-permit. It can assess optimal alternative locations based on environmental, sustainability and financial criteria.

Expert Choice 11.5
Expert Choice 11.5 is a desktop-based decision-making application that helps to structure complex decisions by prioritizing weighting criteria with respect to multiple alternatives and creating what-if scenarios.

WebHIPRE
WebHIPRE (HIerarchical PREference analysis on the World Wide Web56) is an online software which offers tools for problem- and decision structuring and preference elicitation. Results can be shared over the internet. The program is based on the development of a hierarchical model of the different objectives (problem tree) related to the problem and stakeholders' preferences.

SimCoast
SimCoast is a tool based on fuzzy knowledge rules. The conceptual basis of SimCoast consists of a *two-dimensional multi-zoned map* into which key *features* such as legal regimes, harbors, different habitats and *activities* such as shipping, tourism, aquaculture are mapped.

HABITAT
HABITAT is a spatial analysis tool that can be used to analyze the availability and quality of habitats for individuals or groups of species and to map spatial units (e.g. ecotopes). Furthermore, HABITAT can be used to predict potential damage and/or risks for different kinds of land use caused by human interventions, extreme events and autonomous developments.

The complete results of the collection of information via literature research and interviews can be seen in attachment 2. This table still contains several gaps since for some tools, it proved to be very difficult and in some cases even impossible to find detailed information on the functioning of tools.
However, a number of observations can be made on this table, which will be presented in the following paragraphs. Subsequently, the success and fail factors of MSP tools, as found during the interviews will be discussed (paragraph 3.3.5).

3.3.1 Different categories of tools

From the description of the tools it becomes apparent that they belong to different tool types, which offer very different services to the user, despite the fact that all of these tools (apart from Habitat) had been classified as "tools for cumulative effect assessment and decision support" (see paragraph 3.1, Table 3.1). This classification was based on an adapted system of tool classification from Stelzenmüller *et al*. (2008), which originated from a first, more coarse screening exercise.
In scientific literature, there is, however, no system of tool classification which is being used in a coherent and consistent manner. Instead, very different classifications can be found:
While using the same term, for example "decision support system", different scientists may in fact be talking about very different things: In literature, the term decision support system is used as a basket term for all tools which can help decision-makers in any way, either by making information available, by setting up a system of criteria and indicators and weighing them against each other, or by giving a comprehensive picture of the performance of one measure under different scenarios.

With respect to our analysis, we can conclude that the classification of Stelzenmüller et al. (2008) is not sufficiently detailed to capture and reflect the diversity actually present in the 11 tools which we analysed.
For the purpose of making a more detailed distinction of these 11 tools (see attachment 2), an alternative, more specified and elaborate typology, based on four different types, is suggested:

1. Generic tools, designed for structuring and guiding a decision-making process (not area dependent).
   a. Excluding stakeholder participation/ public participation feature (Expert choice 11.5, BOSda).
   b. Including stakeholder participation/ public participation feature (Web HIPRE).

2. Generic tools, designed for structuring and guiding a decision-making process (area dependant) (Ocean Communities, Community Viz).

3. Tools for zonation of uses from a sectorial/ mono-dimensional perspective (Habitat, Windspeed, Marxan with zones) Tools in this group are generally designed for a high level of detail (fine resolution)[5].

4. Tools for map-based land use planning, integrating multiple sectors (SimCoast, MaRs, Xplorah). The tools in this group are, with the exception of Xplorah, generally designed for a much lower level of detail and have a coarser resolution (SimCoast, MaRs). However, to feed these tools with accurate information, the user can be dependant on using other tools, for example from group 3.

This typology shows how the analysed tools differ with regard to the tasks for which they were made. Because the way in which a tool deals with the different criteria is dependant on the task for which this tool was designed, and thus the skills with which it was equipped, it is scientifically problematic to compare tools across categories (compare with attachment 2). Comparing a tool like ‘Marxan’ or ‘Habitat’ with a tool like ‘Communicty Viz’ would therefore be equal to comparing apples with oranges.
Keeping in mind that tools were designed in context of different projects, following different objectives and setting different priorities, it is not surprising that they fill in the criteria in different ways.

3.3.2 Differences between generic tools and specific, tailored tools

Apart from the description of the different tools, attachment 2 shows how the 11 tools fill in the different criteria. A prominent characteristic of this table is that for some tools (e.g. CommunityViz, Ocean Communities, Web HIPRE, DEFINITE/BOSda, SimCoast) a big quantity of cells were filled in with the words “unknown”, or “depends on user input”.

This can be explained by looking at the nature of the respective tools. Two groups become apparent:

a. Tools which were specifically tailored for use in one particular area (such as, e.g. MaRs, which was produced for use on the EEZ of the UK, or Xplorah, which was specifically tailored for land-use planning on the island of Puerto Rico), and
b. More generic tools, intended to be adaptable to different regions around the world.

Tools of the latter type can also be understood as “empty shells” which have to be customized to the case at hand and fed with a lot of information before they can be used for calculation.
Whether a tool belongs to type (a) or type (b) will have consequences for its flexibility with respect to the different criteria reflected in the table. In other words: A tool which has a more generic and flexible (“empty shell”) nature such as ‘SimCoast’ can evaluate different spatial measures from an integrated perspective, or from the perspective of only one sector, depending on the input. In the same way, the amount of indicators the tool bases its calculations on also depends on the knowledge rules with which the user has fed the software prior to its use. For such “empty shell tools”, many cells of the table in attachment 2 are thus filled with the words “unknown”, or “depends on user input”.

3.3.3 Interrelationships between criteria

In the two previous paragraphs the differences between tools with respect to the categories they belong to (categories 1 to 4), and with respect to the degree to which the tools are (a) case- and site specific or (b) generic was discussed.
The table in attachment 2 has shown that also within these categories, tools differ with regard to the criteria, i.e. the applications they offer, their degree of preciseness, resolution, and the way they deal with uncertainties.

These criteria, however, are not independent from each other: Tools with spatial application do require more calculating capacity and will hence become slower, and they use much more complex knowledge rules than tools which only structure a decision into a MCA procedure.
As a tool increases more and more in complexity, it automatically also more and more runs the danger of becoming less transparent and more difficult to use.
With respect to the 11 tools which were part of this research, several criteria which positively or negatively correlate with each other can be identified. Table 3.3 shows those criteria, which were found to be interrelated in this research, and gives insight into the nature of their relationship.
With the help of an example, this positive or negative relationship between certain criteria becomes more apparent: A tool such as WebHipre, which operates based on a simple analysis of a problem tree and offers no possibility to connect problems to a map or zoning plan, will depend on the following relationship: The more criteria and indicators the calculation requires, the slower the calculation will become (dependant also on the capacity of the hardware, with which this tool is operated, of course). Furthermore, the more criteria and indicators need to be reflected in a calculation, the more complex knowledge rules will become.
While it is important to acknowledge this interdependency of criteria with respect to the tools which were analyzed in this study, it is just as important to note that the correlations between criteria do not necessarily have to persist in time: Innovation in tool programming and development in the coming years, as well as the investigation of new knowledge rules may produce new tools, which might manage to overcome this trade-off between criteria.
Some of the tools which were part of this research have already managed to jump the gap between two negatively correlating criteria:
‘SimCoast’, for example, can (depending on its input) rely on relatively simple knowledge rules and still calculate the effects for a big amount of sectors. However, this has only become possible at the cost of spatial and temporal resolution, and the deducibility of knowledge rules.
Other tools, such as ‘Xplorah’, can operate different temporal and spatial scales, however, its degree of uncertainty will differ between the different scales, and its speed will decrease with increasing resolution.

Table 3.3: List of criteria used in this research which are interdependent. (↑ = Positive correlation between criteria; ↓ = Negative correlation between criteria; x = No direct correlation between criteria)

	Temporal resolution	Spatial resolution	Amount of criteria & indicators used in calculation	Amount of sectors for which cumulative effects are calculated	Expertise necessary to setup& operate tool	Duration of calculation	Clarity of knowledge rules	Simplicity of knowledge rules
Temporal resolution		x	x	x	↑	↑	↓	↓
Spatial resolution	x		x	x	↑	↑	↓	↓
Amount of criteria & indicators used in calculation	x	x		x	↑	↑	↓	↓
Amount of sectors for which cumulative effects are calculated	x	x	x		↑	↑	↓	↓
Expertise necessary to setup& operate tool	↑	↑	↑	↑		x	↓	↓
Duration of calculation	↑	↑	↑	↑	x		x	↓
Clarity of knowledge rules	↓	↓	↓	↓	↓	x		↑
Simplicity of knowledge rules	↓	↓	↓	↓	↓	↓	↑	

We can conclude that at the current stage of development, no tool is capable of completely overcoming these inherent negative relationships between some of the criteria. This means that it is impossible to make choices and prioritize between criteria.
Also, while choosing between different types of tools, one must well be aware of the tradeoffs that are associated with them, since they e.g. directly translate into consequences for the daily use and maintenance of the selected tool: A complex tool such as 'Xplorah', which integrates the (cumulative) effects of several different uses on many different indicators with a high temporal and spatial resolution will need a constant body of experts which continuously work on operating the model, maintaining the databases and security functions, which protect the sensible data from leakage and hacking.

Another observation which can be made on table 3.3 is that the first four criteria are much more dependant on the availability of good knowledge rules. The second four criteria, in contrast, are more based on the user- friendliness, or the ease of tool use by the end-user.
The relationships shown in this table thus also reflect a certain disconnection between the two parties that have to cooperate in order to develop and use an MSP tool, namely the scientists or consultants, who develop the knowledge rules on which a software is based, and the end users of a tool, who are, in this case, policy-makers. Experience in tool development has shown, that a close cooperation between these two parties in the development of a tool is indispensable for assuring that a tool will be used sustainably.

3.3.4 Relationship between wishes and tools

This paragraph sheds light on the question, how, according to the findings of this research, the tools relate to the wishes, which were identified in the meeting of May 25 (see table 3.2).

Table 3.4 summarizes and integrates the comprehensive overview of results of this research (for complete overview, see attachment 2). This table has to be read with care. As paragraph 3.3.1 has shown, the way in which a tool deals with the different criteria and wishes, is dependant on the task for which this tool was designed, and thus the skills with which it was equipped. Since the 11 tools identified for deeper analysis in this research are very heterogeneous and were designed to support different parts of a planning process, it is scientifically problematic to compare tools across the categories which are mentioned in paragraph3.3.1.

Furthermore, table 3.3 showed, that some of the wishes identified are interrelated, because they depend on related criteria. This means, that they cannot be seen as separate wishes. Therefore, as paragraph 3.3.3 has shown, at the current stage of tool development, not all wishes can be fulfilled at the same time.

However, within categories, an attempt can be made to compare tools. Table 3.4 lists the wishes which were identified in paragraph 3.2 against the 11 tools, sorted into categories according to the typology developed in paragraph 3.3.1.

From this table, we can see that no tool meets all wishes which were expressed. However, there are some tools which score better than others.

In group 1b, for example (Generic tools, designed for structuring & guiding stakeholder decision-making processes (not area dependant)), Expert Choice 11.5 scores much better than WebHipre. In group 2 (Generic tool, designed for structuring & guiding decision-making processes (area dependant)), Community Viz scores better than Open Ocean Map. As for group 3 (Tool for use zonation from monodimensional perspective (conservation, or wind energy, or…, etc)), Habitat scores slightly better than Windspeed and Marxan. In group 4, which includes the most abstract level of tools (Tools for map-based landuse planning, integrating multiple sectors and calculating cumulative effects), there is a tendency for Xplorah and SimCoast to score better than MARs, however, for MARs there are relatively many knowledge gaps, so this has to be interpreted with care.

While this table can indicate tendencies by comparing tools with respect to wishes which were voiced, it is important to note that some wishes might be more important than others for the choice of tool to support the Marine Spatial Planning on the Dutch continental plate. Furthermore, this list of wishes is by no means complete, and there are many more criteria which can be used to assess tool quality.

Table 3.4: Relationship between (groups of) tools and wishes. Legend: + (green) = meets wish completely; +/- (orange) = meets wish to certain extent; - (red) = does not meet wish; X (grey) = unknown. 1a = Generic tool, designed for structuring & guiding decision-making processes (not area dependant);1b = Generic tool, designed for structuring & guiding stakeholder decision-making processes (not area dependant); 2 = Generic tool, designed for structuring & guiding decision-making processes (area dependant); 3 = Tool for use zonation from monodimensional perspective (conservation, or wind energy, or…, etc); 4 = Tools for map-based landuse planning, integrating multiple sectors and calculating cumulative effects.

Category	1a	1b		2		3			4		
Wishes \ Tools	BOSda (engl.: Definite)	Expert Choice 11.5	Web Hipre	Open Ocean Map	Community Viz	Windspeed	Marxan	HABITAT	Xplorah	MaRs	SimCoast
Easy & fast to add new information & knowledge rules	+	+	X	+	+/-	+/-	-	+	+/-	X	+/-
Compatible with existing tools and easy to complement with new tools	X	X	-	+/-	+	+/-	+/-	+/-	+/-	+/-	-
Easy to use, fast performance of calculations	+	+/-	+	+	+	+/-	+	+	+/-	X	+
Adapted to the needs of future users (politicians, civil servants and stakeholders)	+/-	+/-	-	+/-	-	+/-	+/-	+/-	+	+	+
Highly adapted to existing planning and policy processes	+	+/-	-	+	+	+	+/-	+	+	+	+
High reliability	+	+/-	X	+/-	+	-	+	+/-	+	X	+/-
High transparency, no complex formulas, deducible	X	+	+	+	+/-	+	+/-	+/-	+/-	+/-	+
Reflection of uncertainties	+	X	X	-	X	X	-	+/-	+	X	+
Dealing transparently with fundamental cause-effect relationships	+	+	+/-	+/-	+	+/-	+/-	+/-	+/-	+/-	+
Highly explored and tested	+	+/-	X	+/-	+	-	+	+/-	+	X	+/-
Good guidance in/ support of process, adaptation of output to reporting needs	+/-	+/-	-	+	+/-	+	+/-	+	+	+	+
Understandable output in common format	+/-	+/-	-	+	+/-	+	+/-	+/-	+	+	+
No (to low) purchase costs	-	X	+	+	+/-	+	+	+	-	X	+/-
Multi-sectoral	+	+	+	+	+	+/-	+/-	+/-	+	+	+
Deals with time in flexible manner, covers many time scales	+/-	+/-	-	+/-	+	+/-	X	-	+	+	+
Has to be able to work on broad range of spatial scales, zoom in and out	+	+/-	+/-	+/-	+	+/-	+/-	+/-	+	+	+
Internationally employable	+	+	+/-	+	+	+/-	+	+	+	+/-	+
Decision- making framework available (MCA, CBA)	+	+	+	-	+	-	-	-	-	-	-

3.3.5 Results from interviews

In scope of this research, seven interviews were held to support the literature research in filling in the table. In one case (Windspeed) the interview had to be replaced by a questionnaire, since it proved difficult to arrange a telephone interview, and the interviewee preferred written communication. Of these seven interviews, only one was held with a user, the other interviews were limited to software developers.
As has been mentioned above, it proved particularly difficult to reach tool users. Here, several observations were made:

- Especially for the less known, younger tools, a lack of online documentation complicated the search for suitable interview-partners.
- Most of the available publications on tools were issued by tool developers, who proved reluctant to respond on requests about current users of their tools.
- In those cases, were we could find the name and contact details of users, information proved not always correct and users were reluctant to communicate or settle an appointment for interviewing (main argument: time pressure).

It is difficult to name reasons for the problems encountered in obtaining users as interview partners. Apart from practical difficulties such as difference in time zones, full agendas, etc, one assumption could be that for some tools, especially the rather new ones, there is still no established user base. Furthermore, not all developers seemed to have ever been in contact with the users of their tool. Thus, developers could not provide us with any contact details of their users.

Any conclusions drawn from the interviews are thus based on a low sample size and on information obtained from different types of stakeholders.

However, those users or developers who could be contacted named also a few factors which were not considered by our table of criteria, but which seemed to be important factors inhibiting the use of tools in practice:

- The use of Xplorah in the Puerto Rican planning agency, for example, was inhibited by changing conditions within the organization, causing a strong fluctuation and layoff among staff. This resulted in the crucial loss of trained and specialized users of the tool.

- Furthermore, financing was an issue: Xplorah, being a very comprehensive and broad tool, while at the same time guaranteeing detail and integration proved to be very cost-intensive, not only for purchase and development but also for maintenance (maintaining database, updating security features, etc).

- Another problem encountered was the commitment of users, and the adaptation of the tool to local needs. The same problem was encountered by the developers of MaRs, a tool which was developed for marine spatial planning on the UK continental shelf. Both these experiences point at the importance of an early involvement of stakeholders and users in the development of a tool.

The results of interviews held in scope of this research are supported also by van Delden et al (2007, p 236), who claimed that the "actual use [of a tool] by its intended end-users in their decision-making tasks requires a careful consideration of all six questions formulated below:

- The strategy question. What is the usefulness of the system? What are the possibilities for its application and what is its added value? What are the intended functions of the system (analysis, knowledge management, communication, etc.)?

- The availability question. How difficult is it to obtain and update the necessary data, knowledge and models? Is their availability, quality and quantity sufficient to offer support beyond the obvious? Is this worth the cost of development, maintenance, training and use?

- The credibility question. Is there consensus on the models and the underlying assumptions? Can the system be calibrated? Validated? Can its output be trusted?

- The language question. Does the system provide output that relates to the information needed by the end-users? Can information available to end-users be used as an input for the system?

- The structure question. Where and how can the system be introduced in the organisation? Who is going to work with it, and what are actual and practical changes required?

- The culture question. Are the end-users willing to adopt the system? Are they willing and able to adjust their decision- making process to it?"

The issues identified by this research, and the questions that van Delden et al (2007) asked, can give useful guidance for the future development of a MSP tool.

4 Conclusions and recommendations

4.1 Conclusions

The main goal of this research 'Exploration MSP tool' was to define the needs and success factors of a MSP tool.

In this research, a tool is defined as follows:
A tool is a means which helps and supports the realisation of any work (Cronin, 2010).

The results of this research lead to the following conclusions:

1. There is a high amount of variation in existing tools which can be used for marine spatial planning.
2. This variation can be structured by a typology of tool categories
3. Criteria and wishes are interrelated, and sometimes correlate negatively with each other. Prioritization of wishes is necessary.
4. It was difficult to find suitable people willing to be interviewed about the development and use of existing MSP tools. The limited amount of people that were interviewed identified the following success and fail factors:
   - For the successful use and development of a tool, a stable and committed organisation of users and developers is essential.
   - A very comprehensive, broad and at the same time detailed tool can be very cost-intensive, not only for purchase and development but also for maintenance (maintaining database, updating security features, etc).
   - The commitment of users, and the adaptation of the tool to local needs may take time. It is important to have an early involvement of stakeholders and users in the development of a tool.
5. At this moment it is not possible to make a scientifically robust recommendation about which tool would best be suited for use on the Dutch continental plate. This is due to the fact that the requirements / wishes for the tool still have not yet been prioritized and narrowed down in more detail with a more representative number of future users.

Excursus: The role of serious gaming for the development of MSP tools

Serious games are different from casual games in that they focus on specific and intentional learning outcomes to achieve serious, measurable, sustained changes in performance and behaviour (Derryberry, 2007). In relation with marine spatial planning, serious games can be a helpful means to give planners and stakeholders an insight into the complex relationships between different use functions and the bio-physical system, and the relationship between planning processes and temporal and spatial scale.
The advantage of serious games is that they can reflect reality in a reduced and simplified 'game reality': Factors such as time, spatial resolution, and social relationships between actors can be modified and designed to best meet learning objectives. In the 'game reality', system complexities can be filtered out, and social barriers and taboos can be broken for the purpose of enhanced learning. Thus, in the 'game reality', a process can be painted more sharply and vividly, than in tools which have the pretence to provide an accurate reflection of reality.
Although the border between serious games and tools which are applied in reality to manage complex processes are fluctuating (which among other reasons can be attributed to the fact that scientists and literature handle very heterogeneous definitions of what the term "serious game" means), in the transition from game to tool developers have to overcome many barriers: Knowledge rules have to be changed to improve the reflection of processes, and the 'game reality' has to be conformed to reality, in order for the tool to become more scientifically robust. Also, adapting the game setting to the real process, in which the future tool is to be used, can become challenging.

Textbox 4.1: Excursus: The role of serious gaming for the development of MSP tools. This textbox is based on information obtained from personal communication with Deltares experts in serious gaming, and academic literature, among others from Harteveld, C. 2011, and Derryberry, A. 2007

However, based on the results of this research, and on the assumption that the tool which is sought in this exercise will be mainly employed in the preparation of the new structural vision on spatial planning for the Dutch part of the North Sea (to be published in 2015), we can assume that tool category 4 offers the most suitable tool candidates (Tools for map-based landuse planning, integrating multiple sectors and calculating cumulative effects). Assuming a situation in which all wishes are of equal importance to the end-users, within category 4, the most suitable tool would be SimCoast, closely followed by Xplorah. About the suitability of MARs, no judgements can be made, due to lack of data. Both of these tools, however, would need considerable adaptation and

4.2 Recommendations

Defining the MSP tool

This research offered an insight into the current availability of tools under development or already in use. A selection of 11 tools underwent a closer analysis, which provided valuable information that can help to sharpen and narrow down the main questions which need to be answered in the search of a tool (or group of tools) that could possibly be applied in marine spatial planning (MSP) on the Dutch EEZ.
The consequent path for this search for such a MSP tool would be to narrow down the choice by further defining what category of tool is wanted and to prioritize the criteria and wishes, which the tool should comply to. In this search, it is important to keep in mind that any tool will need to be adapted and tailored to the local case.

For this, two main steps are recommended:

1. Narrow down future tool users or identify a key user group. The needs of locally or specialized administration issuing permits (e.g. with respect to spatial and temporal resolution, cumulative impact assessment, etc.) are different from the needs of national policy makers.

2. Define the specific focus for the desired MSP-tool. This results in the choice of a tool type (the categories defined in chapter 2 can offer support in precisely defining which type of tool could be appropriate).
   a. An intermediate step can be to prioritize the tool criteria, taking into consideration that tradeoffs have to be made between the two clusters of criteria.
3. Make sure the chosen-tool fits into the overall context in which it will be applied. The six questions defined by van Delden et al. (2007) (see above) can be used in this context.

Trans-boundary cooperation
Marine ecology and user impact are by definition trans-boundary. If possible it would be wise to co-develop a MSP-tool together with neighbouring countries. Exchange or even co-production of knowledge will increase the value of marine spatial planning and management.

Next research steps
Concrete follow up actions can be:
- A workshop with end users to further specify the main goal of the MSP tool and to prioritize between criteria. Furthermore, it would be recommendable to closely cooperate with the intended end-users of such a tool, in order to make sure, the ultimate choice meets their needs and fits to their daily work.
- Ideally, a new MSP-tool would only be one of the elements in the MSP process. Among others, this tool would be supplied with data from the Informatiehuis Marien, maps from the North Sea Atlas and calculations would be made based on the knowledge rules, which are currently developed in the Kennisbibliotheek. A close coordination between these different projects would be wise. In the following period, close cooperation should be searched with the project Kennisbibliotheek. Ideally, both projects should co-develop their focus and make agreements to ensure technical compatibility.

One of the ways to facilitate this interaction is to organize one or two workshops in 2012.

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A Attachment 1

Composition of this table
This table is distributed into columns and rows. In the rows, different tools are named. The tools were sorted according to their degree of complexity: In the beginning, the more simple tools are named. Towards the end, the tools successively become more complex.
A difference in the categories of tools is indicated with different colors. This difference is not very rigid. There are tools which can fit into more than one category. The purpose of attributing tools to different categories was to indicate broad differences in tool types, in order to make the table more readable.

Categories are used as follows:

1. Tools for gathering+ storing data, simple evaluation and visualization (/mapping) (orange)
2. Tools for data storage, visualization, modeling and scenario prediction (blue)
3. Tools for cumulative effect assessment (scenarios +measures) (light blue)
4. Tools for cumulative effect assessment and decision support (light green)

Broadly, it can be stated that the 'tools for cumulative effect assessment and decision support' (light green) can be called 'umbrella tools'. These integrating tools make use of several specific tools, which are oftentimes named also earlier in this list. (e.g. stakeholder participation in combination with GIS based tools).

Subsequently, the tools for stakeholder communication and –participation are listed:

5. Participatory tools (dark rose)
6. Education (light rose)

Furthermore, different characteristics of the tools were included in columns. Not all cells in all columns are filled, because not every characteristic was known or easy to find for every tool. Because of the lack of time for this exercise, the choice was made to display all information which was given in the source and fit into the aim of this research, as well as to fill in those cells that could be filled in without too much effort
Below, columns are further explained

- The first three columns capture the number, category and name of the tool.
- The fourth column ("description of tool") describes the tool and names the purpose for which the tool can be used, and which output the tool gives.
- De column "Potential users" (column 5) consequently informs, for which end user the tool was created and designed. This is also gives a hint at what degree of previous knowledge is needed to operate the tool.
- Column 6 ("Country of application") lists the countries where the tool is already being used.
- The following column contains the source of information per tool.
- The column 'spatial and temporal scale' (column 8) gives insight into the scale at which the tool can be employed. (temporal as well as spatial).
- De column 'sector' describes, for which sector the tool was produced (e.g. Conservation planning/ fishing, windparks, or multiple sectors)
- Subsequently, an estimation is made of the necessary type of data (data requirements)

- The column “adaptation for MSP possible / available” gives an estimation of whether the tool can be used in scope of MSP, or even it is already is used for this purpose.
- The purpose of column 12 was to give an expert opinion on which phase of the planning cycle the tool can be used (‘Exploration (=1)’, ‘Planning(=2)’, ‘Implementation (=3)’ and ‘Evaluation (=4)). This task proved to be relatively difficult, because most tools have either the aim of storing knowledge, or B) Offer a function to promote participation. Such tools can be used in all phases of the planning process. Only for the evaluation phase, no specific tools were found.
- De last column gives important information which does not fit into any of the above named columns.

Tool No	Categor	Tool name	Description of tool	Aim / Type of Output	Potential users	Example/ reference	Uncertainty	Spatial and tempora l scale	Sector	Strength	Weakness	Data requireme nts	Adaptatio n for MSP possible / available	Phase of Policy-cycle in which tool can be applied
1	Tool for gathering information	Reviews of previous local investigations, similar inventories elsewhere and in the literature		Identification and primary inventory of potential benefits and risks.		In Project Climate Proof Areas used for WP1 and WP2 reports including Arvika specific examples		-	various	Use of published results and previous work Best practice	The results depend on the available information, the interests, knowledge and experience among the individuals performing the reviews			1, (2), (3), (4)
2	Tool for gathering information	Scientific Literature review/resear ch		State of the art knowledge		CPA report 2011.Adaptation toolkit for the North Sea Region in a changing climate. CPA Work Package 4 report, March 2011. Applied in: Wesermarsch rural/ urban	Documen-tation of handling uncertainty	Current state / past	–	State of the art knowledge	Predominantly theoretical knowledge	Access to papers		1, (2)
3	Tool for gathering information	Data collection		Data set		CPA report 2011.Adaptation toolkit for the North Sea Region in a changing climate. CPA Work Package 4 report, March 2011. Applied in: Wesermarsch rural/ urban	Consideration of all possible data sources	10s of years	–	Best available representatio n of the system	Data gaps, short time series, limited system representation, costs, limited availability, inadequate quality, quantity	The more the better		1, 2, (3), (4)
4	Tool for gathering information	Field Visits	Method for gathering information (creating public support)	Local knowledge		CPA report 2011.Adaptation toolkit for the North Sea Region in a changing climate. CPA Work Package 4 report, March 2011. Applied in: Wesermarsch rural/ urban	–	current state	–	Regional knowledge, visual impressions, direct confrontation with the situation of concern	Few information on temporal dynamics, time consuming, preparation time	Photograph s, video movies		1, 2, (3), (4)
5	Tool for gathering information	Stakeholder analysis	Tool for assessing present stakeholders, their needs and wishes	Stakeholder profile		CPA report 2011.Adaptation toolkit for the North Sea Region in a changing climate. CPA Work Package 4 report, March 2011. Applied in: Wesermarsch rural/ urban	Representativ eness of stakeholder groups	Current state	–	Sound decision-basis for the participation process; in-depth knowledge about the stakeholders	Time consuming, i.e. different types of data mining and information retrieval	Sectors, representat ives, interlinkage s and relationship s		1, (2), (3), (4)

Tool No	Categor	Tool name	Description of tool	Aim / Type of Output	Potential users	Example/ reference	Uncertainty	Spatial and tempora l scale	Sector	Strength	Weakness	Data requireme nts	Adaptatio n for MSP possible / available	Phase of Policy-cycle in which tool can be applied
6	Tool for gathering information (and creating public support)	Networking with other local projects / organizations	Method for gathering information (creating public support)	Examples from comparable projects, best practice		CPA report 2011.Adaptation toolkit for the North Sea Region in a changing climate. CPA Work Package 4 report, March 2011. Applied in: Wesermarsch rural/ urban		Short, with outlook to long term	various	- Present problem: attention - Possibilities to make solutions more robust or flexible against small additional costs	- Present problems determine the possibilities for change - No overall vision	- Project data climate scenarios		1, 2, 3, 4
7	Tool for gathering and evaluating information	1 to 1 interview		Personal opinions, assessments		CPA report 2011.Adaptation toolkit for the North Sea Region in a changing climate. CPA Work Package 4 report, March 2011. Applied in: Wesermarsch rural/ urban	Discussion of different possible futures, rising awareness on uncertainty	Current state	–	Participation, collecting the opinion of 'all' participating stakeholders in an "intimate" surrounding	providing of selected and biased information	information on the difference between positions and interests and needs of stakeholder groups		1, 2, (3), 4
8	Tool for data gathering, and simple evaluation	Statistical data analysis		Trends, significance		CPA report 2011.Adaptation toolkit for the North Sea Region in a changing climate. CPA Work Package 4 report, March 2011. Applied in: Wesermarsch rural/ urban	Analysis of statistical significance		–	Trend analyses, system dynamics	Limited system representation, limitations of statistics	Collected data		1, 2, (3), (4)
9	Tool for knowledge collection, storage, evaluation and visualizatio n	GIS		Maps, spatial analyses		CPA report 2011.Adaptation toolkit for the North Sea Region in a changing climate. CPA Work Package 4 report, March 2011. Applied in: Wesermarsch rural/ urban	Illustration of uncertainty	–	–	Illustrative presentations , maps, evaluation, visualisation	Content difficult to validate, heterogeneous quality and quantity of data, data rights, different projections of spatial data, scattered data bases	Collected data		1, 2, 3, 4
10	Tool for knowledge collection, storage	Seazone	Collation of data sources needed for MSP into one database		Scientist, Strategic Planner, Case officer	(Stelzenmüller et al., 2008), http://www.seazone.com Applied in UK			various				yes	1, (2), (3)

Tool No	Categor	Tool name	Description of tool	Aim / Type of Output	Potential users	Example/ reference	Uncertainty	Spatial and temporal scale	Sector	Strength	Weakness	Data requirements	Adaptation for MSP possible / available	Phase of Policy-cycle in which tool can be applied
11	Visualization and Mapping tools	Digitale Noordzeeatlas (Noordzeeloket)	Atlas containing maps and explanatory tests related to the water system, use, policy and management of the North Sea. Maps can be combined with each other or with external data.		Various, experts-stakeholders, publich	http://www.noordzeeatlas.nl/en/index.html		Dutch part of North Sea	various	maps are convenient tools for comparing and discussing information about water system, use and policy and thus suitable for every step in the planning cycle.		Using free software provided by ESRI		1, (2), (3), (4)
12	Visualization and Mapping tools	MESH	Tool for the generation of GIS habitat maps and meta-data for north-west Europe. Seabed maps for Marine spatial planning and conservation			http://www.marine.ie/home/services/surveys/seabed/Mesh.htm (contact Jan Dalfsen, Deltares for more info) Applied in various case studies								
13	Tool for knowledge collection, storage	Fishermap (Finding sanctuary)	A web based mappng tool allowing fishermen to value areas		Scientist, Strategic Planner, Case officer, Public	(Stelzenmüllr et al.,2008), http://www.fs.no-ip.com/mainpage.aspx Applied in UK			Fishery				yes	1, (2), (3)
14	Visualization and Mapping tools	Irish Sea Pilot	Collation of geodata and approaches to map human pressures		Scientist	Stelzenmüller et al., 2008; Lumb et al., 2004, (cited in Stelzenmüller et al. 2008) Applied in Irish Sea			various			GIS layers on human pressures	yes	1, (2), (3)

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15	Tool for assessing and integrating knowledge	Volg- en Stuursysteem waternet	Tool for collecting, manageing and displaying knowledge over the water system. an integrated toolbox offers instruments for analysis and reporting	Knowledge database supporting river basin governance and administration in accordance with EU WFD		http://www.nelen-schuurmans.nl/downloads/678/Folder_KRW%20Volg-%20en%20Stuursysteem.pdf		Variable, up to river basin level					This tool was developend for river basin management in scope of the EU WFD. There is no information about its applicability to MSP	1, 2, (3), (4)
16	Tool for visualization of maps in 3D	Visual Nature studio (VNS)	Tool for displaying data stored in Arc Gis in 3D			Also other 3D visualizations: Deltares								2, (3)
17	Tool for visualization in 3D	VirtuoCity	Tool for building vitual environments for big cities, big scale infrastructure projects			Movaris								2, (3)
18	Tool for evaluating and assessing data	Model		Model simulations, maps, time series, trends		CPA report 2011.Adaptation toolkit for the North Sea Region in a changing climate. CPA Work Package 4 report, March 2011. Applied in: Wesermarsch rural/ urban	Monte Carlo analysis, consideration of different scenarios, climate models	10s to 100s of years	various	Forecasts, scenario calculations	Uncertainty due to data, process representation, subjectivity by the modeller, ...	Model dependent (climate, soils, dem, land use, scenarios, etc.)		1, 2, 3, (4)
19	Tool for evaluating and assessing data	Morphological modelling		Calculations		CPA report 2011.Adaptation toolkit for the North Sea Region in a changing climate. CPA Work Package 4 report, March 2011. Applied in: Galgeplaat Oosterschelde	Process description and scenario-analysis	Long	Water safety and nature	- Insights and predictions of morphological processes	- Requires a good model and data availability	- Requires lots of data		1, 2, 3, (4)
20	Tool for evaluating and assessing data	Soil functional assessment		Changes in soil functions		CPA report 2011.Adaptation toolkit for the North Sea Region in a changing climate. CPA Work Package 4 report, March 2011. Applied in: Wesermarsch rural/ urban	???	10s to 100s of years	Agriculture	Change in soil potentials	Dependent on the (uncertain) scenarios	Soil types, texture, gw, climate change		1, 2, 3, (4)

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21	Tool for water level analysis	REGCEL	Tool for analysing and predicting water level development	Water levels	Scientists / experts	http://toolbox.watersketch.net/index.php?page=210		Local-regional	Hydrology, various				This tool has been designed for regulated lakes. Whether it can be adapted to MSP is unclear	1, 2, 3, (4)
22	Tool for modelling ecosystem and supporting mgt	Atlantis	Ecosystem model to support strategic fisheries management		Programmer, Scientist	Stelzenmüller et al., 2008; Fulton et al., 2007 (cited in Stelzenmüller et al. 2008) http://www.csiro.au/science/ps3i4.html#1 Applied in Autralia, US			Fisheries			Model parameters	yes	1, (2)
23	Tool for assessing and integrating knowledge, scenario prediction	Ecospace	Ecopath - a static, mass-balanced snapshot of the system; Ecosim - a time dynamic simulation module for policy exploration; and Ecospace - a spatial and temporal dynamic module primarily designed for exploring impact and placement of protected areas		Programmer, scietist	Stelzenmüller et al., 2008; MESMA wiki http://public.deltares.nl/display/MESMA/Home , http://www.ecopath.org/ Applied worldwide		worldwide	Conservation, fisheries				yes	1, (2), (3)
24	Tool for information storage and visualization, scenario prediction and zoning	Doris-Marine Protected Areas Decision Support tool	Web-based application for designing, viewing and reporting on marine protected areas		Scientist, Strategic Planner,. Case officer, Public	Stelzenmüller et al. 2008); http://marinemap.org/doris/ http://marinemap.org/mlpa/ Applied in California			various				yes	1, (2), (3), (4)
25	Hydrological modelling tool	DHRAM (The Dundee Hydrological Regime Assessment Method)	statistical excel application which assesses alterations in the hydrology of the watercourses	Comparison of differences between the impacted and unimpacted state of the river.		http://toolbox.watersketch.net/index.php?page=211		Water course level	Hydrology			Flow data	Tool has been designed for rivers, but similar models for marine hydrology exist	1, 2, (3)

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26	Tool for Modelling damage caused by floods	Schademodule (HIS)	Tool which models consequences of floods			Deltares			Flooding/ hydrology				Possible(?)	1, 2, (3)
27	Tool for Modelling damage caused by floods	Schademodule (PCRaster/Habitat)	Tool which models consequences of floods			Deltares			Flooding/ hydrology/ ecology				Possible(?)	1, 2, (3)
28	Tool for Modelling damage caused by floods	Schademodule (wateroverlast)	Tool which models consequences of floods			Deltares			Flooding/ hydrology				Possible(?)	1, 2, (3)
29	Tool for simulating flooding events	SOBEK-2d	Tool which simulates flooding events			Deltares			Flooding/ hydrology				Possible(?)	1, 2, (3)
30	Tool for flood prediction	FEWS	Tool predicting and warning from floods			Deltares							Possible(?)	1, 2, (3)
31	Tool for assessing and integrating knowledge, scenario prediction	Ribasim	Model for simulating water distribution			Deltares							Possible(?)	1, 2, (3)
32	Tool for assessing and integrating knowledge, scenario prediction	SOBEK	Model simulating currents and discharge, water quality and water distribution			Deltares							Possible(?)	1, 2, (3)
33	Tool for assessing and integrating knowledge, scenario prediction	RiverLifeGIS	a software for hydrological and water quality computations on river catchments using geographical information (GI) and monitored water quality data			http://toolbox.watersketch.net/page_view.php?page=6		River Basin	Environmental, flood protection				Possible(?)	1, (2), (3), (4)

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34	Tool for assessing and integrating knowledge, scenario prediction	Delft 3d				Deltares							Possible(?)	1, 2, 3, (4)
35	Tool for exploration and integration of knowledge, Scenario prediction	Quantitative methods such as model based scenario analysis		Basis to assess the potential probability for flooding which in turn can be used to make a quantitative inventory of objects that may be at risk.		- Water balance for the Wesermarsch pilot in Germany. - Arvika (see WP 2 pilot reports for further information).	Model based scenario studies have been performed to increase the knowledge on pilots and local scale climate change impacts.	Scenario dependent	Arvika: focus on the water and sewage systems. On municipal scale also other elements at risk can be identified and mapped.	Detailed quantitative or semi quantitative information as a basis to assess further steps in a risk analysis	can be costly and time demanding depending on the ambition level	Depend on the study to be performed. For the Arvika study estate maps, topographic maps and climate change scenarios were used as the basis for the analysis.	Possible	1, 2, 3, (4)
36	Tool for exploration and integration of knowledge, Scenario prediction	Future scenarios		Possible futures		CPA report 2011.Adaptation toolkit for the North Sea Region in a changing climate. CPA Work Package 4 report, March 2011. Applied in: Wesermarsch rural/ urban	Considering different scenarios	10s to 100s of years	–	plausible description of future development, neither false nor true, but possible	No probability, uncertainty, assumptions not verifiable	Temp., Precip., Wind, Sunshine (radiation)		1, 2, 3, (4)

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37	Tool for exploration and integration of knowledge, Scenario prediction	Local or regional scale climate scenarios		local information on primary climate change impacts (eg drought / flood risks, annual /seasonal changes in run off		SMHI climate change scenarios for Arvika pilot to identify primary and secondary impacts in Arvika.	The uncertainty can be visualised by showing the variation among different models and time scales and results from sensitivity analysis of assumptions and known uncertainties within the simulations.	Own choice of scenario s and timescal es	Arvika: focus on the water and sewage systems. On municipal scale also other elements at risk can be identified and mapped.	An increased knowledge basis to identify potential benefits and risks on local and regional scale. The uncertainty a municipality has to plan under for the nearest decades can be illuminated and visualised.	Costly to perform on local scale, There are risks of disinformation if the uncertainties are not shown.	Local scale scenarios can be achieved from national meteorolog ical and hydrologica l institutes such as SMHI. SMHI and most of similar national institutes can offer such analysis for other countries		1, 2, 3, (4)
38	Tool for exploration and integration of knowledge Scenario prediction	Scenarios for sea level rise		Bandwidth of expected sea level rise and speed during a certain period (2100)		National sea level rise scenarios (KNMI '06)	Sea level rise scenarios give insights in possible bandwidth of effects	Long	Mainly water safety	- Insights in bandwidth of effects - Commitment to the national scenarios	- Assumptions in the scenarios	- Requires data and assumption s		1, 2, 3, (4)
39	Tool for managing and assessing different model schemes	Database modelschema tizaties				Deltares								1, 2, (3), (4)
40		Open Earth Tools (in GE)	Open source initiative to manage and distribute models and tools for coastal managers and scientists. In scope of this initiative, Deltares has developed interfaces fro visualization of data with Google Earth			Deltares, TU Delft and UNESCO-IHE, Applied in: Delft Cluster - Noordzee en Kust, Building with Nature en MICORE								1, 2, 3, 4

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41	Tool for cumulative effect assessment	WadBOS	integrated model linking knowledge about wadden sea and integrating ecological and economical functions and demographic and social characteristics	link physical, economical, ecological and societal information and present it in an understandable manner to decision-makers	Decision-makers	http://www.riks.nl/projects/WADBOS		Local to wadden sea region, days to years				GIS information, economic, demographic and ecological data	Tool has been designed for the Wadden Sea, would have to be modified and expanded to North Sea scale	1, 2, (3), (4)
42	Tool for cumulative effect assessment in fishery	Fishing reallocation model	Tool for predicting where fishing effort may be relocated if areas are closed, Tool for predicting fish population development under different mgt scenarios		Programmer, Scientist	Stelzenmüller et al., 2008; Hutton et al., 2004 (cited in Stelzenmüller et al., 2008) Applied in UK			Fisheries				yes	2, 3
43	Tool for cumulative effect assessment in fishery	Isis-fish	Tool for predicting fish population development under different mgt scenarios		Programmer, Scientist	Stelzenmüller et al., 2008; Pelletier and Mahevas, 2005 (cited in Stelzenmüller et al., 2008) http://www.ifremer.fr/isis-fish/objectivesen.php Applied in France			Fisheries				yes	(1), 2, 3
44	Tool for cumulative effect assessment and habitat analysis	HABITAT	spatial analysis instrument for assessing the quality and suitability of a habitat for a certain species, also under conditions of changing landuse			Deltares http://public.deltares.nl/download/attachments/16384257/Folder+Habitat+2010+NED+A3.pdf?version=1&modificationDate=1285759711000		various	Ecosystem Conservation					1, 2, (3), (4)
45	Tool for cumulative effect assessment in conservation planning	OSS: optimisation support system	Tool for identification of comprehensive, adequate and representative locations for conservation planning		Scientists	Stelzenmüller et al., 2008; Crossman et al., 2005 (cited in Stelzenmüller et al., 2008) http://www.mssanz.org.au/modsim05/papers/crossman.pdf Applied in Australia		various	Ecosystem conservation			Not clear, linked to ArcGIS and commercial optimisation software	yes	1, 2, (3)
46	Tool for cumulative effect assessment	Index	Interactive GIS planning support tool for designing future scenarios and ranking by goal achievement		Scientist, Strategic Planner	Stelzenmüller et al., 2008 www.crit.com/index/index.html Applied in USA			various				no	(1), 2, 3

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47	Tool for cumulative effect assessment, zoning	ACEA GIS demo	GIS and remote sensing tools are used for providing the means for data and models integration, thus providinf a technical foundation for characterizing environmental effects across the Denver metropolitan region.		Scientist, Strategic Planner	Stelzenmüller, et al., 2008; http://www.itre.ncsu.edu/ADC10/PDFs/2007_Winter_Conference/session585/Paper_(07-2611).pdf Applied in Denver, USA		various	various			GIS layers	No	1, (2), (3)
48	Tool for cumulative effect assessment	Netica	visualizes and analyses Bayesian Belief networks. Visualizes cause-effect relationships under conditions of limited knowledge	Visualization and clarification of complex cause-effect relationships	experts	http://www.norsys.com/		various	various	can be helpful in displaying and discussing causes and effects, and in determining the impact of planned measures.		Variables and the relations between them can be entered as probabilities or equations or learned automatically from data files.		(1), 2, 3
49	Tool for cumulative effect assessment	BALANCE GIS tools	GIS approach to predicting anthropogenic influence on coastal lagoons and large shallow inlets and bays		Scientist, strategic planner	BALANCE website www.balanceeu.org, Stelzenmüller et al., 2008; EU MESMA wiki http://public.deltares.nl/display/MESMA/Home Applied in Baltic Sea						GIS layers on human pressures	yes	(1), 2, 3
50	Tool for cumulative effect assessment	WaterWare	tool supporting implementation fo the EU WFD / national water legislation through integration of databases, GIS, analytical tools and simulation and optimization models into a common framework			http://www.ess.co.at/WATERWARE/		River basin	various	Easy to use			Tool has been designed for river basin management. It is unclear whether it can be adapted to MSP	1, 2, (3), (4)

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51	Tool for cumulative effect assessmen t	Optimisation support System (OSS): Integer Programming coupled to GIS	Integer programming algorithms used to derive optimal solutions. Implemented in ArcGis, uses commercial software (ILOG's CPLEX) for optimisation engine		Programm er, Scientist	Stelzenmüller et al., 2008; Crossman et al. 2005 (cited in Stelzenmüller et al., 2008) http://www.ilog.com/products/cplex/ Applied in: Encounter MPA, South Australia			various			Environme ntal, Social, Cultural and Economic datasets	yes	(1), 2, 3, (4)
52	Tool for cumulative effect assessmen t	Impact assessments on water safety and nature		Predictions on the impacts		Calculations on the effects at the "voorland" of Oosterschelde	Scenarios and process descriptions give insights in possible bandwidth of effects	Long	Water safety and nature	- Insights in bandwidth of effects	- Assumptions in the assessment	- Requires data and assumption s		(1), 2, 3, (4)
53	Tool for cumulative effect assessmen t	Effect analysis		Overview of expected effects on different sectors		Country report WP1	Climate change and economical developments and probable changes in policy	Long term outlook	For each sector and an integral overview	- Systematic approach for different sectors - Insight in relative impact: urgency	- No solid figures - Difficult to make distinction between factors - local knowledge required	- Many different sources		(1), 2, 3, (4)
54	Tool for cumulative effect assessmen t	GIS-based cumulative effects assessment	GIS approaches to assess environmental impact assessment		Scientist	Stelzenmüller et al., 2008; Blaser et al., 2004 (cited in Stelzenmüller et al., 2008). Applied in Colorado						GIS layers on ecology and human pressure	no	1, 2, 3
55	Tool for cumulative effect assessmen t	deltaverkenne r	tool for integration and visualisation of knowledge and information about the south-western Delta, The effect of future developments on different uses can be assessed Geeft informatie en inzicht in het effect van maatregelen op gebruiksfuncties in het kader van planstudies die tot doel hebben tot komen tot een nieuwe (ruimtelijke) inrichting	Better integration and harmonisation of uses and water quality , transparent and accessible information, and analysis of the effects of future development on uses	Planners, Managers and Scientists	Deltares		South western Delta	various					1, 2, 3, 4

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56	Tool for cumulative effect assessmen t	KRW Verkenner	Tool to predict the effectiveness of measures in relation to the aims of the EU WFD, particularly with respect to the ecology. Flexible instrument which can integrate different scales and calculate material balances De KRW-Verkenner is ontwikkeld om toegepast te worden in gebiedsprocessen, tijdens het afwegen van maatregelen voor de Kaderrichtlijn Water. De KRW-Verkenner is daarbij gericht op (deel-)stroomgebieden. In de KRW-Verkenner kunnen zowel de effecten van de landelijke maatregelen (m.n. brongericht) als van regionale maatregelen (m.n. effectgericht) inzichtelijk worden gemaakt.	simplify, analyse and compare measures with perspective on the EU WFD water managers and administrators	Water managers, administrat ors, experts	Deltares			various			Spatial characterist ics, ecology, hydrology emissions, possible measures	Tool has been designed for river basin manageme nt. It is unclear whether it can be adapted to MSP	1, 2, (3), (4)
57	Tool for cumulative effect assessmen t	RiverLifeDSS	toolpackage that comprises tools for gathering an processing information and for analysing cause-effect relationships					River Basin	various				Tool has been designed for river basin manageme nt. It is unclear whether it can be adapted to MSP	1, 2, (3), (4)
58	Tool for cumulative effect assessmen t	An approach to identify vulnerable areas	GIS based model to assess the probability of disturbance of whales by considering combined stressors. Multiple stressors were added, where each activity layer reflected probability of response.		Scientist	Stelzenmüller et al., 2008; Zacharias and Gregr, 2005(cited in Stelzenmüller et al., 2008) Applied in Canada, British Columbia		regional	Environmenta l Conservation			GIS layers on ecology and human pressures	yes	1, 2, (3)

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59	Tool for visualisatio n of data and cumulative effect assessmen t	Ontwerptafel	The maptable is a digital design table. It is an instrument which can connect the World of calculators and designers. The maptable contains a lot of information which facilitates a direct, multi-faceted interaction between technical data and design choices.At the same time, it is a real table with a big, interactive computer screen as table plate. You can walk around it, calculate, draw, and discuss at the same time		Municipaliti es, provinces, water boards	Reference: Ronald Lanters, WING Wageningen (Personal Communication) Applied in Vlakte van Raan								(1), 2, 3, (4)
60	Tool for cumulative effect assessmen t	Assessment of the intensity of human activities	GIS based approach to map and rank the impact of human activities.A stressor value beyond location of occurrence is created to account for spatial distribution.		Scientist	Stelzenmüller et al., 2008; Band and Alder, 2008 (cited in Stelzenmüller et al., 2008) Applied in British Columbia, Canada			Environmenta l Conservation, various.			GIS layers on human pressures, expert group	yes	1, 2, (3)
61	Tool for cumulative effect assessmen t	MARA (Marine Aggregate Extraction Risk Assessment framework)	Performs structured probabilistic environmental risk assessments for aggregate extraction		Programm er, Scientist, Strategic Planner	Stelzenmüller et al., 2008; WIlingford, 2008 (cited in Stelzenmüller et al., 2008) http://www.mara-framework.org.uk Applied in UK			various		Availability not clear, runs in ArcGIS		yes	2, 3
62	Tool for cumulative effect assessmen t	Estimating marine cumulative effects	GIS based approach to assess the yield based on the interaction of various activities		Scientist	Stelzenmüller et al., 2008; Sutherland et al., 2007 (cited in Stelzenmüller et al., 2008) Applied in Bay of Fundy, North America			various			GIS layers on human pressures, expert group	yes	(1), 2, 3
63	Tool for cumulative effect assessmen t AND Tool for organising the planning process	Marine planning framework for South Australia	GIS approach within a marine spatial plan, delineates ecological zones based on objectives, strategies and evaluation criteria. Contains a system for performance assessment, which can be used for evaluating the success of marine spatial plans		Scientist, Strategic planner	Stelzenmüller et al., 2008; Day et al., 2008 (cited in Stelzenmüller et al., 2008) Applied in South Australia			various			GIS layers on human pressures, expert group	yes	1, (2), 3, 4

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64	Tool for cumulative effect assessmen t	Performance Assessment System and Marine Planning Framework	Evaluates the effectiveness of each marine plan by assessing the maintenance of ecosystem conditions		Scientist, Strategic planner, Case officer	Stelzenmüller et al., 2008; Day et al., 2008(cited in Stelzenmüller et al., 2008) http://www.environment.sa.gov.au/coasts/pdfs/mp_framework_pas.pdf Applied in Australia, Great Barrier Reef			Ecosystem protection		Not clear whether it has available software tools		yes	2, 3
65	Tool for cumulative effect assessmen t	InVitro	InVitro is an agent based ecosystem-level management strategy evaluation modelling framework. It has been specifically designed to consider multiple use management questions for the marine environment. This is a 3D proecess driven whole of ecoystem model (spans biophysical and human components) that uses a hybrid agent-based modelling framework.			http://www.cmar.csiro.au/research/mse/invitro.htm, Applied in Australia								
66	Tool for cumulative effect assessmen t	Tools for assessing risks and unsecurities												(1), 2, (3), (4)
67	Tool for cumulative effect assessmen t	DEAN	Economical model											(1), 2, (3), (4)
68	Tool for cumulative effect assessmen t, Decision support	Tools for multi-criteria evaluation	Compares pro's and con's of different measures		various				various				Yes	(1), 2, (3), (4)
69	Tool for cumulative effect assessmen t, Decision support	BOSdA	Tool for supporting Multi-Criteria Analysis			Ministerie van Financiën en IVM								(1), 2, 3, (4)

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70	Tool for cumulative effect assessment, Decision support	Tools for cost-benefit analysis	Compares pro's and con's of different measures		various				Various				yes	(1), 2, 3, (4)
71	Tool for cumulative effect assessment, Decision support and zoning	Spatial Analysis: Boolean Constraints	Identification of areas of exclusivity. Designation of 'no-go'areas. Usually a pre-cursor to multi-criteria analysis		Programmer, Scientist, case officer (with some training)	Stelzenmüller, et al., 2008; Bailey et al., 2003 (cited in Stelzenmüller et al., 2008) Applied in many and various locations		various	various			GIS layers relevant to constraints	yes	1, (2), (3)
72	Tool for cumulative effect assessment, Decision support	CommunityViz	GIS software tool to visualize, analyse and communicate about land-use decisions		Scientist, Strategic planner, Case officer, Public	Stelzenmüller et al, 2008; www.placeways.com/communityviz/ Applied in US			various				no	2, 3
73	Tool for cumulative effect assessment, Decision support	Spatial Analysis: Multi-criteria analysis	Identification of factors/ costs/ criteria, Standardisation of data to single measurement scale. Combination of factors (may be weighted) to give total çost'surface.		Programmer, Scientist	(Stelzenmüller 2008; Boyes et al., 2007 and Day, 2002, Day et al., 2008; Kitsiou et al., 2002; Lewis et al., 2003; Portman, 2007; Villa et al., 2002 (all cited in Stelzenmüller et al., 2008) Applied in: Australia			various			GIS layers relevant to objectives	yes	(1), 2, (3)
74	Tool for ecosystem mgt, Tool for cumulative effect assessment, Decision support	Ecosystem Management Decision Support (EMDS)	Knowledge-based decision support of ecological assessments		Programmer, Scientist, Strategic planner	Stelzenmüller et al. 2008, EU MESMA wiki http://public.deltares.nl/display/MESMA/Home , http://www.fsl.orst.edu/emds Applied in US		various	Ecosystem mgt			Landscape data	no	2, (3)
75	Tool for cumulative effect assessment, Decision support	MultCSync	Software Package designe to aid incorporation of multiple criteria into conservation planning		Programmer, Scientist	Stelzenmüller 2008, http://uts.cc.utexas.edu/~consbio/Cons/MultCSync.pdf			conservation				n/a	(1), 2, 3, (4)

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76	Tool for cumulative effect assessment, Decision support	Windspeed (Spatial Developmenr of Offshore Wind Energy in Europe	Computer-based decision support system for identification of suitable areas for establishment of windparks in Central and Southern North Sea. Tool integrates knowledge on costs, technology, spatial information on other uses. Scenarios can be defined by users, and dss tool performs an exclusion analysis		Scientists and planners	Windspeed project EU www.windspeed.eu Applied in Denmark			Wind energy			Spatial data and economic data, data for description of scenarios	yes	1, 2, (3), (4)
77	Tool for cumulative effect assessment, Decision support and zoning	Xplorah	SDSS for integrated assessment of socio-economic and environmental spatial policies. Effectively a weighted MCA application.		Programmer, Scientist	Stelzenmüller 2008, And http://www.riks.nl/projects/Xplorah Applied in Puerto Rico			various			Environmental, social, cultural and economic datasets	No, but maybe possible	2, 3, (4)
78	Tool for cumulative effect assessment, Decision support and management	Conservation Management System	A practical approach to management planning for sites of conservation and recreation importance- terrestrial		Scientist, Strategic planner, case officer	Stelzenmüller et al., 2008 www.esdm.co.uk/?tabid=63 Applied in UK							No, but maybe possible	(1), 2, 3
79	Tool for cumulative effect assessment, Decision support	mDSS4	Tool which integrates hydrological, ecological and socio-economic models and combined them with MCA methods, based on DPSIR framework		Planners	http://scenarios.ew.eea.europa.eu/fol079729/online-model-inventory/mdss4		River Basin	various	Facilitates transparency and public participation required by the WFD			Tool has been designed for river basin management. It is unclear whether it can be adapted to MSP	1, 2, (3), (4)

Tool No	Categor	Tool name	Description of tool	Aim / Type of Output	Potential users	Example/ reference	Uncertainty	Spatial and temporal scale	Sector	Strength	Weakness	Data requirements	Adaptation for MSP possible / available	Phase of Policy-cycle in which tool can be applied
80	Tool for cumulative effect assessment, Decision support	MODSIM-DSS	DSS and network flow model for river basin management. analyses stream-aquifer conjunctions for integrated surface and groundwater mgt.and connect to GIS and water quality models. DSS function with graphical user interface					River Basin	various				Tool has been designed for river basin management. It is unclear whether it can be adapted to MSP	1, 2, (3), (4)
81	Tool for cumulative effect assessment, Decision support	Ocean Communities 3E Analysis (OCEAN)	GIS toolkit. Performs overlays or spatial queries, performs statistical analyses, provides summary statistics resulting from real or hypothetical area-based management scenarios or optimization analyses (such as cumulative weighting or simulated annealing)			Stelzenmüller et al., 2008, EU MESMA wiki http://public.deltares.nl/display/MESMA/Home , http://www.ecotrust.org/ocean/ Applied in USA		various	various				yes	1, 2, 3
82	Tool for cumulative effect assessment, Decision support	Global map of human impact on marine ecosystems	GIS based ecosystem-specific spatial model to synthesize global datasets of human activity. Weighting of impact of particular activities per ecosystem		Scientist, strategic planner	Stelzenmüller et al., 2008; Halpern et al., 2008a(cited in Stelzenmüller et al., 2008)		Global	Environmental Conservation			GIS layers on human pressures, expert group		1, 2, (3)
83	Tool for cumulative effect assessment, Decision support	MARXAN	Tool estimates efficient reserve networks by maximising estimated benefits and minimising estimated costs		Programmer, Scientist	Stelzenmüller et al. 2008, EU MESMA wiki http://public.deltares.nl/display/MESMA/Home , Webpage University of Queensland http://www.uq.edu.au/marxan Applied in: Australia (Great Barrier Reef), California, Welsh inshore waters			various				yes	2, 3
84	Tool for cumulative effect assessment, Decision support	Expert Choice 11.5 Çomparion Core	Web application for decision makers, allows definition of decision criteria and identification of potential solutions 'Comparion Core' tracks all participants' judgements, data and comments allowing focus on objectives, analysis, and results.		Programmer, Scientist, Strategic planner, Case officer, Public	Sources: Stelzenmüller et al., 2008 ; Soma and Leung, 2003, Soma, 2000; (cited in Stelzenmüller et al., 2008) http://www.expertchoice.com/products/ec11.html Applied in Hawaii, Norway, Trinidad &Tobago.				Easy to use, intuitive work flow		Expert-defined objectives	yes	(1), 2, (3), (4)

Tool No	Categor	Tool name	Description of tool	Aim / Type of Output	Potential users	Example/ reference	Uncertainty	Spatial and tempora l scale	Sector	Strength	Weakness	Data requireme nts	Adaptatio n for MSP possible / available	Phase of Policy-cycle in which tool can be applied
85	Tool for cumulative effect assessmen t, Decision support	MaRs	GIS based tool to identify areas of potential development opportunity in UK waters and resolve planning conflicts in a transparent, evidence-based manner.	The outputs, maps and rationale make available the data and decision-making logic for stakeholders and opinion formers, enhancing certainty in planning decisions.	Governme ntal bodies, planners	http://www.thecrownestate.co.uk/mars personal comments by Mr Jamie Moore of the Crone Estate, UK.				provides a transparent way for structuring the problems and showing back ground information in a participatory decision making			yes	(1), 2, (3), (4)
86	Tool for cumulative effect assessmen t, Decision support	Web HIPRE	Web-based tool for public/ stakeholder involvement in decision making: software for analytic problem structuring, MCA and prioritization based on value trees		Programm ers, scientists, Strategic planners, Case officers, Public	Stelzenmüller et al. 2008 and Mustajoki et al. 2004, http://toolbox.watersketch.net/page_view.php?page=6, http://www.hipre.hut.fi/ Applied in Lake Päijänne, Finland		Local / regional	various	MCDA provides a transparent way for structuring the problems and elicitating the preferences in participatory decision making		Expert defined objectives	yes	2, 3

Tool No	Categor	Tool name	Description of tool	Aim / Type of Output	Potential users	Example/ reference	Uncertainty	Spatial and temporal scale	Sector	Strength	Weakness	Data requirements	Adaptation for MSP possible / available	Phase of Policy-cycle in which tool can be applied
87	Tool for cumulative effect assessment, Decision support	SimCoast	interdisciplinary and multi-sectoral tool for creating and evaluating different policy scenarios for Coastal Zone Management. Combines different knowledge on coastal zone with a set of reasoning and analytical tools. Experts involved include engineers, natural and social scientists, lawmakers, administrators, community and national leaders. Via workshops and consensus discussions, sensitive issues such as transboundary pollution and cross-sectoral socioeconomic effects can be translated into rules for policy formulation and decision-making. The conceptual basis of SimCoast is a two-dimensional multi-zoned map onto which key features such as ports, legal regimes and different habitats and activities such as shipping, tourism, aquaculture are mapped.		researchers, managers and decision-makers	http://www.hd.gov/HDdotGov/detail.jsp?ContentID=603		various	various					1, 2, (3), (4)
88	Communication tool	Newsletter		Distribution of information		CPA report 2011.Adaptation toolkit for the North Sea Region in a changing climate. CPA Work Package 4 report, March 2011.	Informing on uncertainty	Current state	–	Illustrative, distribution	Feedback? No direct possibility to ask questions	Project results		1, 2, 3, 4
89	Communication tool	ppt-presentation		Distribution of information		CPA report 2011.Adaptation toolkit for the North Sea Region in a changing climate. CPA Work Package 4 report, March 2011.	Informing on uncertainty	Current state	–	Cheap, illustrative	Person needed to present; audience needed	Project results		1, 2, 3, 4
90	Communication tool	Press release		Distribution of information		CPA report 2011.Adaptation toolkit for the North Sea Region in a changing climate. CPA Work Package 4 report, March 2011.	Informing on uncertainty	Current state	–	Chunky information, wide access	No background information	Project results		1, 2, 3, 4
91	Communication tool	Radio feature		Distribution of information		CPA report 2011.Adaptation toolkit for the North Sea Region in a changing climate. CPA Work Package 4 report, March 2011.	Informing on uncertainty	Current state	–	Illustrative, wide access	Few background information	Project results		1, 2, 3, 4

Tool No	Categor	Tool name	Description of tool	Aim / Type of Output	Potential users	Example/ reference	Uncertainty	Spatial and tempora l scale	Sector	Strength	Weakness	Data requireme nts	Adaptatio n for MSP possible / available	Phase of Policy-cycle in which tool can be applied
92	Communic ation tool	Report		Distribution of information		CPA report 2011.Adaptation toolkit for the North Sea Region in a changing climate. CPA Work Package 4 report, March 2011.	Informing on uncertainty	Current state	–	Comprehensi ve		Project results		1, 2, 3, 4
93	Communic ation tool	Website		Distribution of information		CPA report 2011.Adaptation toolkit for the North Sea Region in a changing climate. CPA Work Package 4 report, March 2011.	Informing on uncertainty	Current state	–	Illustrative, wide access	Time-consuming to keep up to date	Project results		1, 2, 3, 4
94	Communic ation tool	Vision booklets		Distribution of information		CPA report 2011.Adaptation toolkit for the North Sea Region in a changing climate. CPA Work Package 4 report, March 2011.	Informing on uncertainty	Current state	Water management	Illustrative, New, visionary	Expensive, labour intensive, distribution?	Project results		1, 2, 3, 4
95	Tool for gathering and evaluating information , description of problems and selection of measures,	Expert group discussion		Discussion, expert assessment		CPA report 2011.Adaptation toolkit for the North Sea Region in a changing climate. CPA Work Package 4 report, March 2011.	Discussion of different possible futures, rising awareness on uncertainty	Current state	–	Participation, preparation of solutions based on expert knowledge	No interaction with 'non-expert' stakeholders	–		(1), 2, (3), 4
96	Tool for gathering and evaluating information , description of problems and selection of measures, tool creating public support	Participatory development of guiding principles (landscape vision)		Common vision of the future		Wesermarsch rural/urban	–	10s of years	–	Common picture of the region as a target to be realised by adaptation measures	Not necessarily in line with policies, subjective	Regional knowledge, experience, …		1, 2, (3), (4)

Tool No	Categor	Tool name	Description of tool	Aim / Type of Output	Potential users	Example/ reference	Uncertainty	Spatial and tempora l scale	Sector	Strength	Weakness	Data requireme nts	Adaptatio n for MSP possible / available	Phase of Policy-cycle in which tool can be applied
97	Tool for gathering and evaluating information, description of problems and selection of measures, tool creating public support	Participatory assessment (development of measures/ solutions)		Common set of possible solutions, integrative process problem analysis and development of solutions		ComCoast	Suggestion of solution being aware of uncertainty; flexibility of suggested measures	10s of years	–	Joint development of possible solutions, agreeing on those common solutions	Not necessarily in line with policies; costs?	Regional knowledge, experience, …		1, 2, (3), (4)
98	Tool for gathering and evaluating information, description of problems and selection of measures, tool creating public support	Workshop with residents and stakeholders		- Views and ideas of residents. - Knowledge transfer		Workshop forum Schouwen-Duiveland	Climate scenarios for creating a bandwith of climate impacts that have to be handled	Long term (or short term in the phase of designin g solutions)	Depends on fields of interest of the residents.	- Views of the residents - Opportunity to explain the project - local knowledge of residents	- No extensive knowledge of climate change and all sectors	- Effect analysis		(1), 2, (3), (4)

Tool No	Categor	Tool name	Description of tool	Aim / Type of Output	Potential users	Example/ reference	Uncertainty	Spatial and temporal scale	Sector	Strength	Weakness	Data requirements	Adaptation for MSP possible / available	Phase of Policy-cycle in which tool can be applied
99	Tool for gathering and evaluating information, description of problems and selection of measures, tool creating public support	Regional forum (round table conference)		Distribution of information, participation, discussion		Wesermarsch rural/urban	Discussion of different possible futures, rising awareness on uncertainty	Current state	–	Participation, engagement and involvement	Process often dominated by individual persons or dominant stakeholder groups, interests	local knowledge, relationship between stakeholder groups,		(1), 2, (3), (4)
100	Tool supporting knowledge exchange and public participation	Group Decision Instrument (GDI)	Electronical system to allow virtual meetings, supports knowledge sharing and creates support for decisions	Enhanced stakeholder participation		www.waterwerkvormen.nl		various	various					(1), 2, (3), (4)
101	Discussion instrument	Blokkendoos WV21 en DOS-AVV	De Blokkendoos WV21 is gericht op het vraagstuk van de waterveiligheid in Nederland. Het product van toepassing van de Blokkendoos WV21 is inzicht in het complexe vraagstuk en in het al dan niet robuust/efficiënt zijn van bepaalde beleidsmaatregelen. Doel en opzet van het DOS AVV zijn in grote lijnen gelijk aan die van de Blokkendoos WV21. Bij DOS AVV meer accent op de lange termijn: 2100 en andere type maatregelen meer grootschalige, 'out of de box' ideeën.	Enhanced stakeholder participation		Deltares								(1), 2, (3), (4)

Tool No	Categor	Tool name	Description of tool	Aim / Type of Output	Potential users	Example/ reference	Uncertainty	Spatial and temporal scale	Sector	Strength	Weakness	Data requirements	Adaptation for MSP possible / available	Phase of Policy-cycle in which tool can be applied
102	Discussion instrument	Blokkendoos RvdR	nstrument for discussion of measures For the program Room for the River , the effects of a big amount of (combinations of) measures on the waterlevel had to be calculated. The aim was to make an instrument for water-expers, in a later fase the goal was also to bring together experts from different but interrelated scientific areas to a common line.	Enhanced stakeholder participation		Deltares Applied in the program 'Room for the River'								(1), 2, (3), (4)
103	Discussion instrument	Electronig Board Room (EBR)	Tool for facilitation of group discussions The electronic board room (EBR) is a unique meeting facility for efficient risk analysis, brainstorming sessions and prioritization processes. The EBR offers space for maximal 18 participants. Every participant contributes to the session via a notebook which is connected to a network The results are collected centrally and can also be analyzed, sorted and presented. The source of the contributions is protected so that everyone can brainstorm without reluctance. The EBR is a Deltares facility.			Deltares								(1), 2, (3), (4)
104	Tools supporting public participation	E-participation	Group of tools such as Wikis, online social networks and bloggs which include Web-based applications enabling users to access information(maps, pictures, videos/3D visualisations) and provide possibilities to queryplanning authorities and express opinions	Enhanced stakeholder participation		Website www.waterwerkvormen.nl , EU MESMA Webpage http://public.deltares.nl/display/MESMA/Home		various	various					(1), 2, (3), (4)

Tool No	Categor	Tool name	Description of tool	Aim / Type of Output	Potential users	Example/ reference	Uncertainty	Spatial and tempora l scale	Sector	Strength	Weakness	Data requireme nts	Adaptatio n for MSP possible / available	Phase of Policy-cycle in which tool can be applied
105	Tool supporting public participatio n	Public Hearing Database	Public Hearing Database is a tool for handling contributions from citizens in public consultation phases	Enhanced stakeholder participation		http://toolbox.watersketch.net/page_view.php?page=6		various	various					1, 2, 3, 4
106	Communic ation and debating tool	Conference		Attention to the problem		- Conference on the Oosterschelde-problem	-	-	All sectors	- All relevant parties are present - Attention to the problem - Common statement at the end?	- Time consuming	-		(1), 2, 3, 4
107	Communic ation and debating tool	Parliament Debate		Assignment for survey Political attention		- Discussion in the Parliament about the Oosterschelde	Gradual process	-	Depends on the project	- Problem is known at national scale	- Considerable time	- It requires good foundations of the problem		(1), 2, 3, (4)
108	Communic ation and debating tool	Scholar projects		- Knowledge transfer to scholars - Awareness -creative input from the students		Scholar project Pontes High School Schouwen-Duiveland	-	Short to Long term	Depends on subject of project	- Awareness created by doing - Scholar's perspective can be new	- Profits (more awareness) on long term??	- Based on limited information		(1), 2, 3, (4)
109	Tool for communica tion, integrating knowledg	Sketch Planning	Allows public access to information, models maps, plan and compute methods on which official planning is based. Decisions are coordinated and innovations tested.		Programm er, Scientist, Strategic planner, Case officer, Public	Used by U.S. (EPA), Smart Growth INDEX (SGI) model University of Leed, Virtual Slaithwaite. (Harris, 1999 and Stelzenmüller et al, 2008), http://www.epa.gov/dced/pdf/Final-print.pdf and http://www.ccg.leeds.ac.uk/projects/slaithwaite/ppgis.html				Transformatio n of public hearing from confrontation into collaboration		Decision dependent. May be paper-based or digital.	yes	1, 2, (3), (4)

Tool No	Categor	Tool name	Description of tool	Aim / Type of Output	Potential users	Example/ reference	Uncertainty	Spatial and temporal scale	Sector	Strength	Weakness	Data requirements	Adaptation for MSP possible / available	Phase of Policy-cycle in which tool can be applied
110	Educational tool (serious gaming)	Priority Game Generator	tool for creating priority games for stakeholder education. Model for evaluation of effects of various planning alternatives based on the weights and priorities given by the player	The player is able to compare his first intuitive selection with a more analytical based choice computed by the game using the given weights and priorities.	Stakeholders, interested parties	www.waterwerkvormen.nl http://toolbox.watersketch.net/index.php?page=209		various	various				The Priority Game Generator has been designed for educational purposes only. There is no information as to how far this tool is adaptable for MSP	1, 2, (3), (4) Tool has been developed exclusively for education
111	Educational tool (serious gaming)	Games	Tool that creates a virtual environment to simulate dike inspections, etc			Deltares								1, 2, 3, (4) Tool has been developed exclusively for education
112	Educational decision support model (serious gaming)	COSMO	supports main steps in the preparation, analysis and implementation of Coastal Zone Management Plans and demonstrates the impacts of development projects and environmental and coastal protection measures. The coastal management process is approached from the perspective of the municipality, the city government, the public works department the environmental department and the private sector.	Education	Coastal zone managers, planner	http://unfccc.int/files/adaptation/methodologies_for/vulnerability_and_adaptation/application/pdf/decision_support_models_cosmo.pdf		Coastal management of local scale, various temporal scales					COSMO has been designed for educational purpose only. To which degree ot could be tailored to a real situation is unknown.	1, 2, 3, (4) But tool has been developed exclusively for education

Tool No	Categor	Tool name	Description of tool	Aim / Type of Output	Potential users	Example/ reference	Uncertainty	Spatial and tempora l scale	Sector	Strength	Weakness	Data requireme nts	Adaptatio n for MSP possible / available	Phase of Policy-cycle in which tool can be applied
113	Educationa l tool (serious gaming-card board)	Communicati emiddel water en ruimtelijke ordening: water-voor-ruimte-spel	Game to support planning, players can choose for different planning alternatives, and assemble them on a cardboard. There are prices attached to every measure, thus a choice has to be made	Education	General stakeholder s	Deltares								1, 2, 3, (4) Tool has been developed exclusively for educatio n
114	Educationa l tool (serious gaming-card board)	interactieve maquette	Game to support planning, players can choose for different planning alternatives, and assemble them on a cardboard. There are prices attached to every measure, thus a choice has to be made	Education	General stakeholder s	Deltares, Projectgroep Kustversterking Applied in Katwijk								1, 2, 3, (4) Tool has been developed exclusively for educatio n
115		Cost-benefit analysis		Overview of costs and benefits of measures/strategies		- Galgeplaat Oosterschelde: results showed that measures would yield more than it costs on the long term	Bandwidth in the outcomes of the analysis is the result of uncertainties	Long	All sectors	- Consistent methodology - Comparison of different impacts on different sectors	- Comparison between financial impacts and environmental impacts can be difficult	- Requires several index numbers - Discussions about valuing effects		(1), 2, 3, (4)
116	Economical Instrument s	Subsidies, licenses, etc	Economical tools can promote a development through providing financial incentives / disincentives for actors to change their behavior.	Promotion of certain developmens (e.g. the establishment of windmill parks, or the banning/ reduction of fishery activity in certain zones		www.waterwerkvormen.nl		Regional /national	All sectors					3

Tool No	Categor	Tool name	Description of tool	Aim / Type of Output	Potential users	Example/ reference	Uncertainty	Spatial and tempora l scale	Sector	Strength	Weakness	Data requireme nts	Adaptatio n for MSP possible / available	Phase of Policy-cycle in which tool can be applied
117		Field-test		- Evidence for broader application of a technique - Examples of tested measures including advantages, disadvantages experience and lessons learned if available		Applied in - Galgeplaat Oosterschelde (sand nourishment) - Oysterreef Oosterschelde - Hanging beach Oosterschelde	By performing a test, conclusions about the results in case of a broader application can be drawn	Short	Depends on the project (in this case water safety)	- Real life results - Reduction of risks (financial and less assumptions)	- Large investments - Interpolation of results to the future conditions	- It yields a lot of data. - It requires data for the design of the test		(1), 2, (3), (4)
118		Overview / List of possible measures		Compilation of examples of potential measures, including advantages, disadvantages experience and lessons learned if available		The SAWA list	-	-	-	Easily extractable information on examples of potential measures, including advantages, disadvantage s experience and lessons learned if available	The example descriptions can be based on site specific conditions or theoretical assumptions	-		(1), 2, (3), (4)
119		Thorough facts-based analysis of the urgency of the problem		Facts based on numbers Map		- Analysis report Oosterschelde	Reduction of the amount of assumptions	Long	Depends on the project	- Less discussion about the underlying assumptions	- Requires lots of data	- Requires lots of data		1, 2, (3), (4)

B Attachment 2

Overview of tools which could be used for supporting the MSP decision-making process and their characteristics with respect to previously defined criteria.

This table was filled in by means of literature research and interviews with key stakeholders who have been using the respective tools, if possible even in a Marine Spatial Planning Process.

Criteria		Definition/ Explanation	Level	Tool name										
				DEFINITE (Dutch acronym: BOSDA)	CommunityViz	Windspeed	Xplorah	Open OceanMap (previously: Ocean communities)	MARXAN & MARXAN with zones	MaRs	Expert choice 11.5	Web Hipre	SimCoast	Habitat
Input of new information	Input of new knowledge rules	Possibility to add new knowledge rules	Fast & easy Medium Slow& difficult	Unknown	Formula wizard and Formula editor provided. Assumptions can be entered numerically, or based on yes/no, or selected from a drop down list. Optional text import (.csv) (easy to moderate Unknown)	Tool offers a set of pre-defined rules, user cannot add more rules.	Complex, only by involving developers	Shapes can be manually drawn into map, weights can be attributed to these shapes also manually	Unknown	Unknown	Prioritization of criteria is done by entering relative weights into pair-wise matrices using numerical or verbal values	Unknown	Knowledge rules can be entered through compiling sentences which describe a relative relationship between different criteria/indicators (simple pointing and clicking)	Fast & easy
	Input of new data	Possibility to add new data	Fast & easy Medium Slow & difficult	The input of the program is easily done by the user. Type of input: All possible variables and aspects	Moderate: Data can be added in real time by someone knowledgeable in ArcGIS,	User can submit textual input via web interface, otherwise no possibility for input of new data by user (can still be developed)	Easy, can be done by all users	Easy, designed to be done by stakeholders themselves	Slow and difficult, before using MARXAN a number of time consuming steps need to be taken (i.e. Pre-processing of data)	high	Prioritization of criteria is done by entering relative weights into pair-wise matrices using numerical or verbal values	Unknown	Data can be read in through GIS and excel: medium difficult	Fast and easy. (requires basis information of i.e. GIS)
Format of input data		In this line, the data formats the tool is compatible with are named	None, list of formats	Excel tables	ESRI shapefiles, raster, ESRI Grid, External tables (excel)	Mandatory attributes for all datasets are OBJECT ID, Shape, CountryCode and CountryName. To be able to use the DSS tool, an ArcView license (Version 9.3 or higher) is necessary	Excel tables, GIS maps	GIS Maps, type in manually	Input: All Marxan input files use the .dat file extension. These files can be viewed in basic text editor programs such as Windows Notepad or TextPad.		Type in manually or read in from excel, Microsoft Project, and Oracle Databases	Unknown	Image files (BMP, JPG, PNG), gis (shape, DXF, MIF, CSV), excel.	Knowledge rules and maps in .asci or.bil format.
Level of integration of existing tools		Degree to which the tool builds on / can cooperate and communicate with other existing tools which are used in the MSP context e.g. HABITAT,	High integration Medium integration Low integration	Unknown	Can be used in combination with other ArcGIS software tools, e.g. NatureServe, Vista or N-	The results are provided in aggregated tables and reports for further usage with	Very integrated with other, Geonamica-based tools (e.g.WADBOS/RamCo). Other tools	Open OceanMap belongs to an open source tool package which was developed by Ecotrust,	Several, freely available user interfaces can assist in running Marxan. There are a number of		Unknown	Limited. Web-HIPRE allows importation of HIPRE 3+ models	At the moment, SimCoast is not compatible with other existing tools.	Low integration. Does not communicate with other tools. Input

		SimCoast, etc.			SPECT. Can also be linked to external tables (stemming from other models or excel) for real time update of scenarios	models such as ADMIRES REBUS.	require transfer into Geometrica	containing also Marine Map and Eureka	Marxan variations with modified functionalities that are available or in development					from other tools need to be transformed in to relevant data files.
Possibility to integrate new tools, extend tool.		Possibility to add newly developed functions, or to extend tool e.g. through modular setup	Easy Medium Difficult	Unknown	Tool is compatible with ArcGIS-based tools and linkable to external models via tables	Not possible	Tool has a modular setup. However, Integration with new tools would require their transfer into Geometrica	unknown	Easy	Easy	Unknown	Unknown	Linking SimCoast to new/existing tools is,possible, however, SimCoast differs from most other tools for spatial planning in that it is based on relative rules, not on absolute values.	Difficult
Ease of use	Compatibility with different operating systems	Names operating systems (Apple, Windows, Linux, etc) the model works on/is compatible with		Windows	Windows XP, Vista, Windows 7. Tool cannot be used with Mac. (requires ArcGIS)	Windows XP (also an ArcView licence Version 9.3 or higher is necessary!)	Windows XP	Open OceanMap can be used online (cloud) in Windows and Linux	Any Microsoft operating system	Yes	Windows 98, XP, Vista	Web-HIPRE is web-based and operates as a Java applet→ compatible to most operating systems	Windows XP vista, Windows 7. Tool cannot be used with Mac.	Windows
	Speed of model calculation	Time the model takes to calculate and display results	Fast Medium slow	Depends on input, usually fast	Fast, tool was designed for real-time calculation of scenarios, so that changes in parameters, weights or linked tables immediately update output	Depending on the complexity and amount of interdependencies that need to be taken into consideration minutes- hours	Seconds to hours, depends on the question you ask and the number of repetitions	unknown	Depending on amount of planning units , conservation feature, optional advanced Marxan settings and computer power from minutes to days	Fast	Unknown	Fast	Depends on amount of knowledge rules entered by user and question asked	Fast, minutes to several hours.
	ICT experts	Necessary degree of specialization and ICT expertise	Degree of specialization and ICT expertise needed to setup & maintain model, including updating data, changing knowledge rules, etc. (GIS;	High Medium Low	Unknown (running Definite can be done without the help of an ICT expert)	Unknown	Self explanatory for user	Medium- high	Low, designed to be set up by stakeholders	Unknown		Unknown	Unknown	Low-medium: operation of SimCoast mainly depends on knowledge in GIS and excel	Separate form content: medium-high

			other programming languages, etc)												
		Guidance provided for setup and maintenance	Way by which the setup and maintenance of the model is explained, and guided e.g. through tutorial/ course, manual, etc.	Name type of information provided. What is your impression concerning the quality of this information? Do you think it is good/ medium/ bad?	Unknown (running Definite can be done without the help of an ICT expert)	Online resources: manual, tutorials, instruction video, technical support (included in purchase)	Help function	Extensive training course provided by developers, handbook for training, guidelines for users under development	Demo Version, Instructions, short tutorial videos to facilitate data entering			Training services	Web based, explanation directed to decision-modeling experts.	User manual, classroom training, developer available in online chat for consultation, help file	Download from website: relatively easy
		Duration of necessary (self-) training	Time needed to be invested in (self-) training in order to be able to setup & maintain tool.	Do you think it is slow/medium /fast? How much time did it take you?	Unknown (running Definite can be done without the help of an ICT expert)	Unknown	hours	Probably long	unknown			Unknown	Unknown	Unknown (no user spoken other than developer)	Fast
	Users	Necessary level of skill to use tool and understand output	Amount of knowledge and experience necessary to make use of simple applications of tool, and to produce, assess and understand output	Very high (Experts only) High (Civil servants) Medium (Interest-/stakeholder-groups) Low (Politicians) Very low (general public)	Stakeholder groups, civil servants, experts. Theoretical knowledge on the functioning of decision-making models (MCA, CBA, etc) is necessary.	Unknown (Expertise in Arc GIS is indispensable)	Windspeed was made for use by experts, civil servants and interested stakeholder groups with basic knowledge. The user can easily define/ modify a set of input parameters in a dialogue box to define her/his own scenarios for future wind energy usage.	Trained policy makers,	Stakeholder groups, civil servants, experts	Unknown		Unknown	High/ medium	Low-medium: operation of SimCoast mainly depends on knowledge in GIS and excel	High: some expertise in necessary to conduct analyses.
		Guidance provided for users	Way in which the operation of tool is explained and how user is guided through tool. (e.g. tutorial, manual, etc.)	Type of information provided Personal user impression concerning quality of provided information	Basic tutorial and good help function. Menus, information screens and help screens.	Online resources: manual, tutorials, instruction video, technical support (included in purchase)	Help function and tutorial	Extensive training course provided by developers, handbook for training, guidelines for users	Demo Version, Instructions, short tutorial videos to facilitate data entering	Marxan User Manual Marxan Best Practices Guide Marxan Email List References Case Studies Marxan courses		Training services	Videos, quizzes, theory reports, learning paths, cases	User manual, classroom training, developer available in online chat for consultation, help file	Tutorial and courses.

				material						Online Tutorial Related tools and user interfaces					
		Duration of necessary (self-) training	Time / effort needed to be invested in (self-) training in order to be able to use tool	Estimated amount of time needed Personal user impression concerning time needed.	A simple user-interface guides users to step wise program and run the tool.	Unknown	hours	Several training sessions were provided for administrative users in Puerto Rico	Probably comparatively short (designed for simultaneous use during interviews)	Using the tool is relatively easy, however understanding output needs practice.		Unknown	Unknown	Unknown (no user spoken other than developer)	½ - 1 day (running the model)/ Satisfied
Tool output		User satisfaction with tool output		Highly satisfied Moderately satisfied Unsatisfied	The output consists of a customary set of graphs which can be copied into Powerpoint. Reports in html (inclusive tables and figures)	2d/3d spatial model showing effects of e.g. population development on indicators such as water demand. Model parameters can be adjusted but users to visualize model outcomes in real-time	Maps (Arc GIS and Google Earth) showing suitable areas and areas of exclusion or Operation of Wind Parks, containing information on Reason of exclusion, costs & energy potentials, statistics and cost curves.	Maps showing economical, demographical, environmental and other impacts of changes	--	All Marxan output files can be viewed in basic text editing programs such as Windows Notepad, or in spreadsheet and database software such as Microsoft Excel or Access. Marxan will not actually generate maps.	Highly satisfied: MaRs provides a transparent insight into how decisions came to place. by giving an overview of the information on which the decision-making process was based	Weighted-criteria based decision made by a diverse stakeholder group	Web-HIPRE has a simple graphical interface and provides a several ways to visualize the results, under which bar graphs and problem- and value trees	A 2D/3D transsect of a map. Type of map: effect map	maps or tables, images are rather difficult to generate
		Description of type of output													
Use in existing policy processes	Planning and	Steps of the planning process in which tool is being used		1. Problem definition & Exploration 2. defining & deciding on measures 3. Implementation of measures 4. Evaluation	DEFINITE offers support throughout the whole policy cycle. Its main benefits are concentrated in step 1 and 2	1-4, but mainly in Step1-2 (especially suited for stakeholder participation)	Mainly phase 2: planning and exploration of impacts of alternatives on a political level.	1-4, but mainly 1&2	Mainly for the collection of data (1), but can also be valuable in any stakeholder participation process (2-4)	Marxan solutions can form the basis of discussions towards a final plan that incorporates additional political, socio-economic and pragmatic factors.	MaRs only used by The Crown Estate, not (yet) by the NMO for MSP purposes	Mainly in step 2 and 3	Exploration of possibilities (step 1-2)	Step 1-4, but mainly 2	Exploration of possibilities (step 1)

Level of integration	Land-Sea integration	Description of whether tool also considers the interactions between land, coastal zone and sea		Depends on input.	Depends on input. All components can be integrated into spatial models (e.g. effect of residential density on coastal ecosystem density)	Limited (Used cost functions are distinguished between costs for onshore and offshore grid connection)	Xplorah was developed for land use planning. The model considers the coastal stretch as part of the island. High Sea based activities are not considered by Xplorah	OpenOcenMap does not integrate information on different criteria and indicators. It only goes as far as to aggregate data and display it	The tool can be used on land. Interactions between water and land are not mentioned as functionality.	The tool considers land-coastal zone interaction	Depends on input	Possible (depends on input), however, WebHIPRE is a generic decision making structure which guides people through a decision. It was not produced specifically for a spatial planning context.	Yes, tool was particularly designed for that purpose	Depends on cause effect relationship knowledge and in affect the knowledge rules.
	Integration of different uses:	Number of use-functions for which tool calculates and displays cumulative effects	1 2 3 4 5 6 and more	Multiple, dependent on the input by user.	Depends on input. Potentially unlimited	Windspeed includes14 use functions. It is unclear, however, if and how cumulative effects are considered	Multiple, dependent on user input (for Puerto Rico running with 19 land use functions	Multiple	Makes distinction between fisheries and multiple socioeconomic costs.	Multiple	Depends on input. Potentially unlimited	Multiple (depends on input)	Unlimited, depends on amount of knowledge rules entered (tool itself is multidisciplinary)	Several depending on available cause effect knowledge.
	Sectoral approach	Description of whether tool approaches a question from the perspective of one sector or more and list of sectors for which tool can be applied		No, applicable to multi sect oral (depends on user input)	The tool is completely integrated. It does not take the perspective of either of the functions	Tool uses sectoral approach: Wind energy.	No, applicable to multiple sectors	Yes (mainly used in Conservation, MPAs)	While Marxan was originally designed to ensure species and ecosystem representation in biodiversity conservation planning	MaRs is not an MSP tool. It is used by the crown estate to decide on pff shore permits. MaRs can take on many perspectiv es	Depends on input	No (depends on input)	Tool does not take perspective of either use function (completely integrated)	Primarily conditions of habitat. However cause effects can be translated to other sectors when the relationship is known.
	Applicability to different sectors	This criteria names the sectors for which this tool can be used	Nature conservation Fishery Sand abstraction Renewable energy Shipping Recreation others	Can be multi-sectoral however input needs to be pre-processed for specific functions.	In principle, CommunityViz can be used for calculating an unlimited number of sectors	Wind energy	Multi-sectoral, dependant on user input, for Puerto Rico running with 19 land use functions	Potentially multiple, depends on input	it has proven applicable to a broad range of planning challenges. Marxan can generally assist all problems related to the spatially-explicit selection of 'minimum sets'.	MaRs can be applicable to may sectors	Potentially multiple, depends on input	Potentially multiple, depends on input	In principle, SimCoast can calculate an unlimited number of sectors. However, the data requirement increases strongly with the amount of sectors.	Its applicability is not restricted to ecological purposes, it can be used for any spatial analyses where grid operations are needed
	Type of	Types of indicators on	Ecological	Depends on	Depends on input	The tool takes	Economical,	Self-selected	Economical and	Economic/	Depends on	Self-selected	Dependant on	Index

	indicators used for calculation	which tool bases its calculation on (this also determines the data needs of the tool)	Economical Chemical Physical Social Juridical	input. (Criteria and Indicators can be determined by the user himself)	(Criteria and Indicators can be determined by the user himself)	into account ecological factors (wildlife sensitivity, conservation zones), infrastructure of other industry branches (fishery, oil & gas, etc.), economic and administrative criteria.	environmental, social juridical/governance, transport	indicators and criteria (depends on input)	ecological	social and ecological	input	indicators and criteria (depends on input)	the knowledge rules entered by user.	numbers and available area of habitat.
Availability of evaluation/ decision-making function	This criteria indicates whether tool incorporates a decision-making function, for example Multi-criteria Analysis, Cost-Benefit analysis, etc		Type of decision making function provided None	CBA en MCA (under which weighted sums, Regime method, concordanti-analysis and Evamix).	Tool can be used as support for stakeholder processes. No decision-structuring application	Sector-based cost-benefit analysis	No appliance provided for structured decision	Open OceanMap is a generic, Map based surveying system which guides stakeholders through a mapping process during which they can assign values to specific areas. However, Open OceanMap provides no feature to guide users through decision-making process	Yes, generates different options to achieve some minimum representation of biodiversity features for the smallest possible cost.	No, since the tool is developed for permit decisions by the crown estate. Decisions are however made transparent	Expert Choice 11.5 is a multi-objective decision support system based on an analytic hierarchy process (Special type of MCA, based on pairwise comparison)	WebHIPRE uses an analytic hierarchy process for comparison of alternatives (Special type of MCA, based on pairwise comparison)	SimCoast does not incorporate a decision-making function	None
Reliability/ trustworthiness for users / transparency	Scientific credibility	Degree to which model has been explored, tested and validated in case studies.	High (validated in case studies) Medium Low (contested)	High tool was released in 2001 (see documented case studies by IVm 2001)	Validated in 25 case studies	Tool is relatively new (not yet widely tested)	Tool has been newly developed for application in Puerto Rico, and is still being tested and improved there.	Open Ocena Map has been tested in several case studies in the US	High has been tested in many case studies	Unknown	Validated in several case studies	Unknown	SimCoast is relatively new and has not yet been tested in a number of scientific case studies.	Medium, knowledge rules are validated for Ijsselmeergebied. Tool is also used in the Wadden Sea.
	Handling of underlying cause effect relationships	Degree to which the cause-effect relationships on which the model is built are communicated in a clear, understandable manner (Transparency)	High transparency Medium transparency Low transparency	Unknown	Depends on input: indicators and assumptions are entered by user	Mediium transparent (dependant on basic knowledge)	Transparent	High transparency, goes not further that data aggregation, no complex statistics used	High transparency	High transparency	Unknown	Unknown	This tool should be in principle very transparent, since it is the user himself, who enters the knowledge rules which the tool operates on.	Low transparency

	Referencing to knowledge rules	Way in which tool refers to sources of knowledge rules and data	High transparency Medium transparency Low transparency	Unknown	Unknown	Knowledge rules are clearly presented	Unknown	Weights entered by users are employed directly, without further calculation	Unknown		Weights entered by user are employed directly (verbal input is converted into numbers)→ transparency is guaranteed by simplicity of calculations	Unknown	Unknown	Simulates each step in knowledge rules= High transparency
	Simplicity of calculations or knowledge rules	Explains whether knowledge rules on which tool is based are complex and in which respect.		Unknown	Depends on specific model created by user.	Depends on user input	Complex (Complexity necessarily accompanies degree of integration)	Relatively simple, does not exceed mere aggregation	exact algorithms and heuristic (non-exact) algorithms		Depends on input, usually relatively simple	Unknown (probably relatively simple)	Dependent on input of knowledge rules by user	HABITAT systematically follows cause-effect chains. By making the knowledge explicit the impact assessment method becomes transparent and re-usable.
	Dealing with uncertainty	Degree to which uncertainty is dealt with in a transparent way openness in dealing with knowledge gaps in	High transparency Medium transparency Low transparency	High transparency in dealing with uncertainty. Definite contains several tools for sensitivity analysis	Unknown	Unknown	Includes a stochastic component (Monte Carlo- a random perturbation term)– model will be run a number of times in order to reflect intrinsic uncertainty and variation. The outcomes will then depicted in a probability map	No cross validation of data or statistics are applied to manage uncertainty	Marxan does not consider uncertainty in the data. Its is dependent on the adoption of sound ecological principles, the establishment of scientifically defensible conservation goals and targets and the development and inclusion of high quality spatial datasets.		Unknown	Unknown	SimCoast is based on fuzzy knowledge rules and was thus especially built for dealing with high amounts of uncertainty. User can associate knowledge rules with confidence factors to account for different levels of uncertainty.	Medium transparency
Costs	Purchase	Costs for initial purchase, and purchase of license prolongal		Range between 750 € (single user, academic use) and 2260 €	Initial purchase: $350 (self-service) $850 (including	Web excisable. free	Depends on necessary adaptations, maintenance costs	Open source	Free	Legal issues when wanting to	Commercial software. Price on request	Free for academic use	Purchase price: 350 £ for academic license, 500£ for	HABITAT is freely available for users which

	Operation & maintenance	Costs for operation and maintenance		(commercial, 5 person network use)	$850 (including 12 months technical support +free upgrades. Purchase of 12 month prolongal technical support: $650		considerable, because of need of specialized staff			purchase!! Crown estate can't invest time.			commercial license. Price for update/license prolongal negotiable	users which are willing to share their developed knowledge rules as part of the 'Dare to Share'
Scale	Temporal scale	Possibility of tool to deal with different temporal scales (flexibility) and scenarios	Months years 2015 2020 2040 2050 2100	Depends on input	Not specified. Tool has an implemented TimeScope Tool for extrapolations, compatible with the Timeline in Google Earth	Is dependent on existing data of sea use functions in the North Sea (as shipping routes, nature conservation areas, fishery effort etc.) for these time scales. Considers the	Resolution of the tool is 1 year, temporal horizon 2030, Xplorah can also make an animation in order to show the development of changes over a time period split up in years.	Depends on input	Unknown	Depending on data input. Highly flexible	Depends on input (Expert Choice was not specifically designed for time-dependant decision-making)	Not applicable. Web HIPRE can be applied on any temporal context.	SimCoast has a rule based part and a GIS part. The GIS part handles time intervals from seconds to millennia	No, only status quo
	Spatial scale	Possibility of tool to deal with different spatial scales (flexibility), possibility to "zoom into" map	Below national →Name & type of area concerned to be specified National International	Depends on input	depends on resolution of underlying maps (input dependant)	North Sea Area, 5km x 5km resolution.	Tool simulates activities that take place at 4 spatial scales: global, national, regional, local. However, since it was tailored for the use in Puerto Rico, its resolution is 240m (for municipalities 60m)	Depends on input	Depends on the deciding upon appropriate planning units, as it will influence the results of your Marxan analyses.	Depending on data input. Highly flexible	Depends on input (Expert Choice was not specifically designed for spatial decision-making)	Web HIPRE can be applied on any spatial context. It is, however, not made specifically for spatial planning (no mapping feature)	SimCoast can be used for all different spatial scales, it is possible to zoom in and out.	Below national