VALMER

Marine ecosystem services

Assessment and valuation in support environnemental management

SCENARIO TOOLBOX

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About

The VALMER project is an eleven partner, €4.7 million project co-funded by the INTERREG IV A Channel programme through the European Regional Development Fund, which aims to examine how improved marine ecosystem services assessment can support effective and informed marine management and planning.

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Build scenarios

Objectives

- **to provide you a good comprehension of the different types of scenarios;**
- **to help you to identify the useful methods to be used in the context of your case study;**
- **to support you in terms of technical development of scenarios by providing concrete tools and examples.**

This section deals with the way to build scenarios in support to environmental management. Most of its content is extracted from the scenario guideline developed under the VALMER project [Herry et al., 2013]. The examples are mainly selected among the VALMER sites experience. Some others are examples available in other literature references. In that case, the original sources are always mentioned.

Coordination by M. Philippe[4], J. Ballé-Béganton[4] and D. Bailly[4] based on written contributions from J. Herry[2], W. Dodds[3], M. Philippe[4] and A. Winder[1]

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Scenarios, a tool to anticipate and consider the future

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The way we make decisions relating to the coastal and marine environment has seen a gradual change over a number of years and the involvement of people and those affected by the decisions has become more prominent.

The following elements have been collected in order to support the delivery of the European Union funded Interreg IVa Channel VALMER project, but its aim is to be relevant for any manager, decision maker who may want to use these methods and involve people in natural resource management decisions.

Scenarios are a proven tool that produces results. The method is simple in that it invites the 'audience' to react to a plausible set of events in the future or to build the future events themselves and then test these against a range of criteria. The criteria could be, for example, how real they are; how effective they are in delivering an outcome or whether all factors have been taken into account. The audience may wish to introduce their own criteria as they develop their scenario. The original hypothetical scenario can then be translated into one that represents a situation that can be achieved in reality by putting in place a series of policy decisions or actions. In this way it is possible to focus the scenario process on results, which is a strong driver for any participative activity. Scenario building can be a very flexible and adaptive process in that it can be used to develop ideas from a very basic starting point or to pick up and enhance ideas that have already been developed.

One way of involving stakeholders actively is to involve them with building the route to possible outcomes or developing 'scenarios'.

What do we mean by "scenarios"?

Scenarios are stories that portray plausible futures and are designed to systematically explore, create and test possible and/or desirable future conditions. Scenarios are a useful tool, often employed to help with complex management questions (e.g. environmental management, climate change, urban planning, etc.). Trans-disciplinary and collaborative, scenarios can support community-based management. Their advantages are numerous.

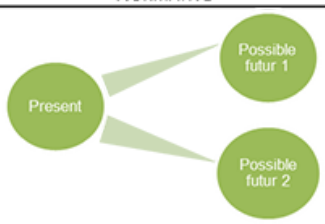
They can:

- ✓ Combine qualitative and quantitative information;
- ✓ Identify uncertainties and knowledge gaps;
- ✓ Organise and interpret our thinking about the future;
- ✓ Help understand how to create the conditions in which our desired future can be achieved;
- ✓ Support decisions which are more likely to implemented successfully and;
- ✓ Generate long term policies, strategies and plans.

Scenario building exercises can help people to process and interpret complex knowledge and information associated with multiple issues. Scenarios are a useful tool to create a range of possible futures by combining different elements in different way. In general many scenarios are developed in parallel (e.g. 3 to 4 narrative stories).

Different types of scenarios

There are three major types of scenarios: exploratory, normative and predictive scenarios. They can take many forms: a narrative story consisting of a few lines of text to many pages, with maps, graphics, drawings, pictures, etc. Modelling and/or simulations can also accompany scenarios.

EXPLORATORY	NORMATIVE	PREDICTIVE
		
WHAT MIGHT HAPPEN?	HOW CAN A SPECIFIC TARGET CAN BE REACHED?	WHAT WILL HAPPEN?
Different hypothesis of pathways leading to different possible futures.	Backcasting scenarios: knowing where we want to go, what has to be done between now and a future point in order to reach the objective.	From what we know about the present and the past, what is the most probable situation in the future?

The 3 major types of scenarios: exploratory, normative and predictive

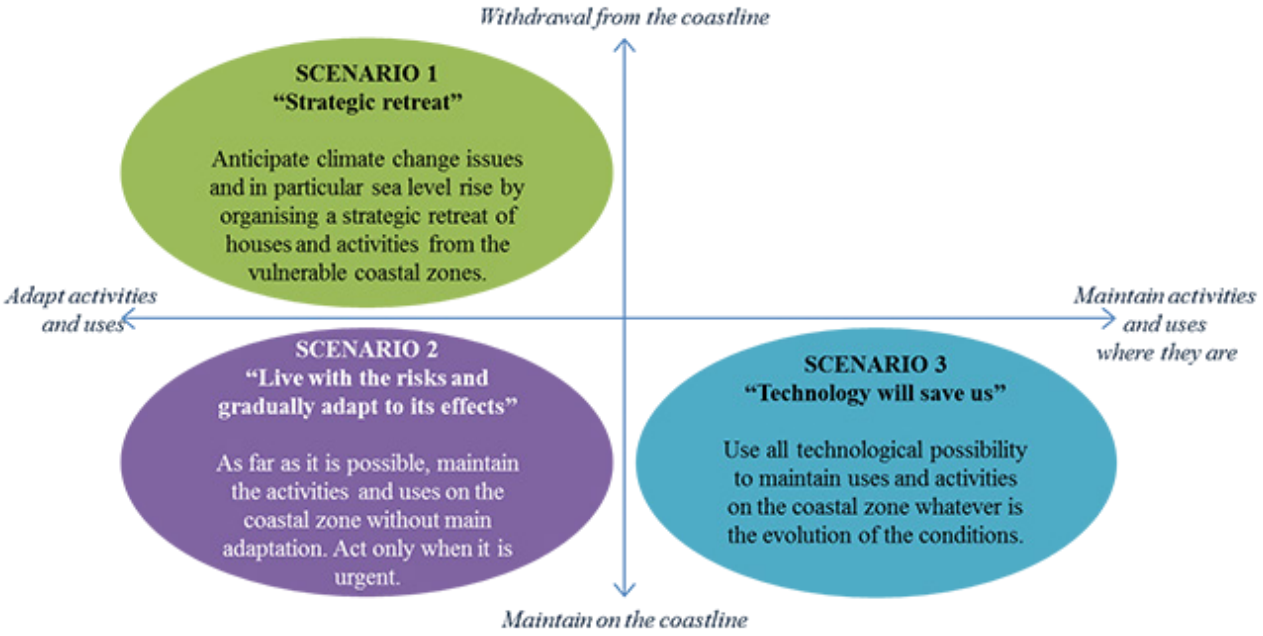
Exploratory scenario: What might happen?

The exploratory scenario describes events and trends as they could evolve based on alternative assumptions on how these events and trends may influence the future. They provide several plausible futures that include external factors (the ones we do not have any influence on) and internal factors (elements it is possible to affect).

Exploratory scenarios example

Within the context of the European IMCORE project, stakeholders in the Golfe du Morbihan took part in 2 workshops in March and May 2010, supervised by members of a university (UBO) and a public syndicate (SIAGM), to determine how the area may evolve under climate change effects (possible futures).

The scenario-building process focused on the theme of 'urban planning and infrastructures'. 3 scenarios around 5-6 pages each were developed and were then subjected to critical scrutiny by a panel of around sixty people to complete them, amend them and make them more realistic. These scenarios are available here.



Done by Manuelle Philippe and Juliette Herry

Normative scenario: How can a specific target be reached?

Normative scenarios explore the pathways that need to be taken in order to reach a desirable future situation. Normative scenarios are very effective for decision support, as they permit the exploration of strategies to reach the desired objective [Notten et al., 2003]. This objective can be considered as the vision for the future.

Predictive scenarios are often used by managers to anticipate the question "What...if...?".

Predictive scenario: what will happen?

The predictive scenario attempts to predict the future at a given date. It is based on science and probabilities. The usefulness of such scenarios is to make possible the planning and adaptation to situations that are expected to occur. Predictive scenarios are mainly based on modelling and try to calculate the most probable evolution of a situation under certain conditions.

Predictive scenario examples

The simplest and most well-known predictive example is meteorological prediction (led by external events) knowing the present situation, the depressions and anticyclones around and there more probable behaviour known from the observation of past events leading to questions such as 'what will be the meteorological events in the next 6 hours?'

Another example could be energy consumption (led by internal decisions and external events): knowing the present needs for a country and

its probable development (individual and for industry) leading to questions such as 'what will be the needs of energy during the next month / year?'

Sometimes different types of scenarios can be also combined. This is the case, for example for the Intergovernmental Panel on Climate Change (IPCC) scenarios on climate change, which are both exploratory and predictive scenarios. If you refer to exploratory scenarios below, you will see that the example given are different scenarios of greenhouse gas emissions made from different options for the development of human activities. From these exploratory scenarios, by assuming relations between greenhouse gas concentration, the earth's temperature and the sea level rise, predictive scenarios can be created. See below the different predictions made from the different scenarios.

Case	Temperature change (°C at 2090-2099 relative to 1980-1999) [a, d]		Sea level rise (m at 2090-2099 relative to 1980-1999)
	Best estimate	Likely range	Model-based range excluding future rapid dynamical changes in ice flow
Constant year 2000 concentrations[b]	0.6	0.3 – 0.9	Not available
B1 scenario	1.8	1.1 – 2.9	0.18 – 0.38
A1T scenario	2.4	1.4 – 3.8	0.20 – 0.45
B2 scenario	2.4	1.4 – 3.8	0.20 – 0.43
A1B scenario	2.8	1.7 – 4.4	0.21 – 0.48
A2 scenario	3.4	2.0 – 5.4	0.23 – 0.51
A1FI scenario	4.0	2.4 – 6.4	0.26 – 0.59

[IPCC, 2007]

Activity 1: you have seen the 3 different types of scenarios. To be sure that you properly understand the difference between them, search on the internet other examples of scenarios and identify which of these 3 categories they fall into.

Building scenarios, why and how?

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In the context of environmental management, a scenario building process involving stakeholders is a way to:

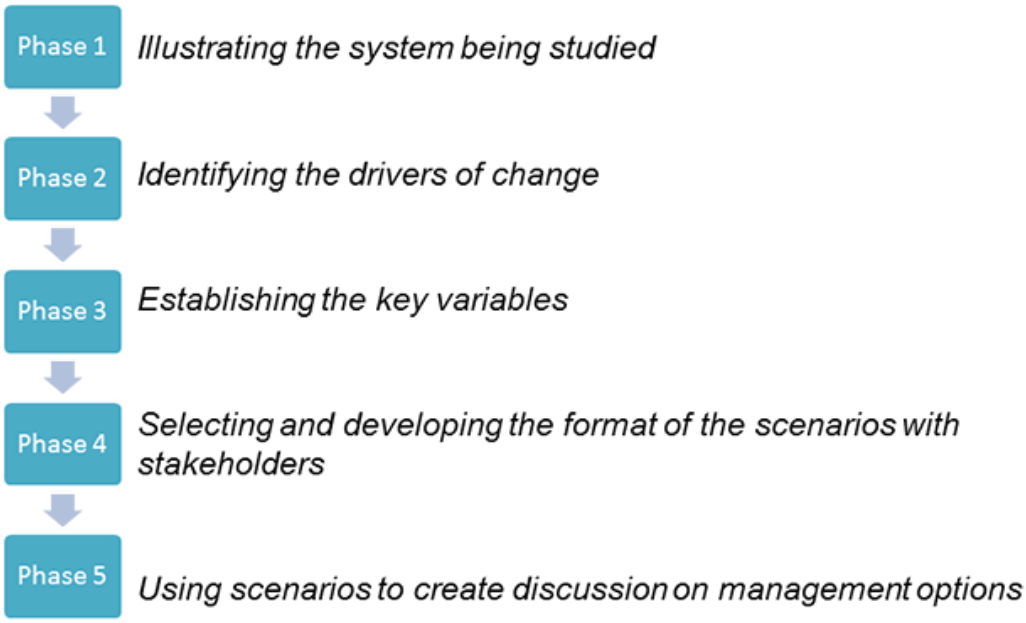
- ✓ Better understand longer-term issues;
- ✓ Better understand the links between the ecosystems and human activities;
- ✓ Create a "common culture" between stakeholders;
- ✓ Develop perspectives together on possible futures (exploratory scenarios);
- ✓ Compare these perspectives and choose the best one;
- ✓ Develop an action plan (normative scenario) and
- ✓ Inform decisions and actions that need to be taken to achieve the desired future.

The aims, and consequently the type of scenarios developed, will be different depending on:

- ✓ The management question studied;
- ✓ The governance and environmental contexts of the case study sites and
- ✓ The legitimacy and skills of the case study team (e.g. implementation of measures).

The scenario building process is divided into 5 complementary phases that occur sequentially.

The scenario building process can take several months but can be longer or shorter depending on the methodologies chosen, resources available and the required level of stakeholder participation.



5 phases of the scenario building process

Before beginning the phase 1, a preparatory phase is necessary. It is dealing with the objectives:

- Identify the common focus (management question, issues, topic)
- Define the geographical scope of the study
- Analyse the governance context and define stakeholder participation in the scenario process
- Identify data availability and data issues

These different phases and the associated tools that can be used were developed in the section "Chapter 18 Building scenarios, why and how?", page 11.

Activity 2: before looking forward to the different phases of scenario building, be sure that you have covered all elements of the preparatory phase. Answer the questions in the context of your case study:

- What is your common focus?
- What is your geographical scope?
- Do you have information about the governance context (or do you know where to gather it)?
- List the stakeholders to engage
- Are the data you need available?
- What are the data management issues?

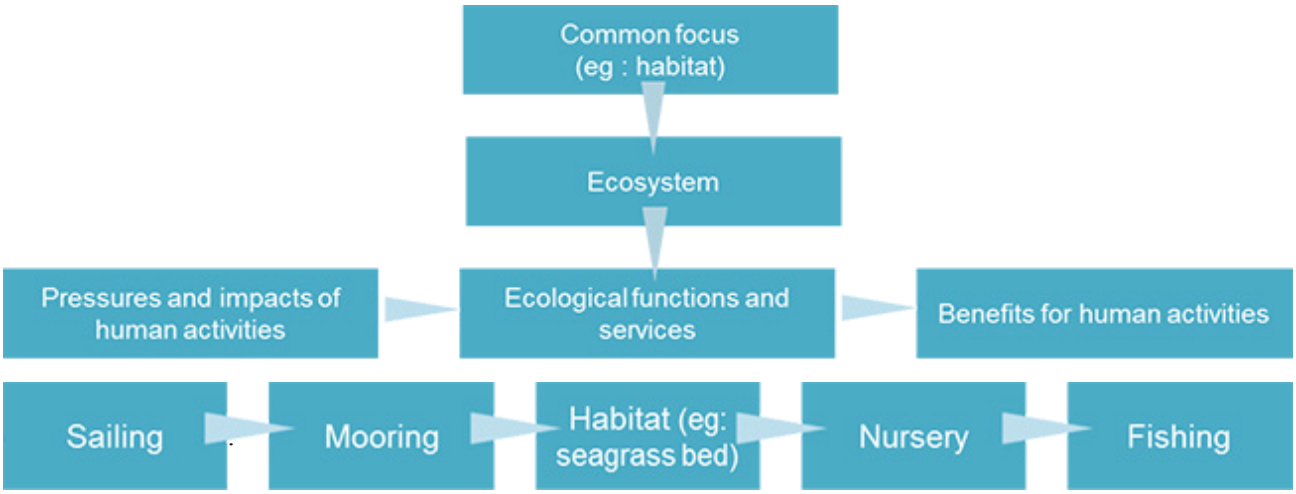
PHASE 1: Illustrating the system being studied including natural processes and human activities

This is commonly known as a socio-ecological system. This diagram gives the managers and stakeholders an overall vision of the system; it is useful to understand the qualitative, and if possible the quantitative links, between all the elements of the system considering natural processes and human activities.

The diagram represents the links between habitats, species, ecosystem services, human activities, governance context and indicates the potential pressures or impacts, the management issues, the knowledge gaps and uncertainties, etc. The links can be represented in terms of direction, nature and intensity.

Phase 1 consists of building a 'conceptual' diagram of the links between the environment and the human activities practiced in the case study site.

Example of information categories that can be in the diagram:



Advantages: builds a common culture shared by stakeholders; builds relationships between stakeholders and managers; better comprehension of the ecosystem and local issues.

Difficulties: availability and involvement of stakeholders; availability and quality of data; uncertainties.

Stakeholder participation in constructing the diagram can help to build and share a common understanding of the socio-ecological system. The challenge is to find a suitable representation, which contains as much information as possible while remaining understandable and without discriminating against some activities. There are several software packages which can be used (e.g. PowerPoint, C-Map, Mind Map and ExtendSIM).

Tools that can be used to reach the objectives of this phase:

DPSIR

ARDI

INTERVIEWS

BRAINSTORMING

DELPHI

TOOLS TO REPRESENT THE SYSTEM

PHASE 2: Identifying drivers of change in the case study ecosystem

Having built the socio-ecological diagram and defined the temporal horizon of your scenarios (e.g. 2030), it is important to identify with stakeholders the possible changes in the system

.The changes in the system can be : environmental changes, uses and human activities, governance and management contexts, etc. Changes in the system may represent a risk or an opportunity, they can be influential or be influenced, they can show high or low flexibility.

These changes, also called variables, are:

- ✓ The **heavy trends**, i.e. possible changes that are considered important and almost certain. Their evolutionary direction is known and will influence all the scenarios in a same way (e.g. climate change, demographic predictions).
- ✓ The **critical uncertainties**, i.e. major possible changes but uncertain.
- ✓ The **weak signals**, i.e. signal difficult to decode, or a signals which, after analysis, seem unlikely" [Vaughan, 2001] but can "announce future major changes" [Blanco and Lesca, 2003].
- ✓ The **seeds of change**, i.e. elements that can cause a change.
- ✓ The **break possibilities**, i.e. elements that can cause a break with the actual situation (e.g. an oil spill).
- ✓ The **development opportunities** and main sectors driving innovation... [Fauchard and Mocellin, 2009]

Each possible change (e.g. variable) can then be associated with different evolutionary hypotheses, in general between 2 to 4 hypotheses per variable. The identification of variable and associated hypotheses can be conducted with the participation of stakeholders and experts during workshops, interviews and/or surveys.

It is useful to prepare a summary sheet for each variable to have a clearer view of all the possible changes. This sheet may contain the name of the variable, its definition, its descriptors, the past and future data and action levers. The variable sheets gather quantitative and qualitative data on which scenarios can rely, that enhance their credibility [Michel et al., 2013].

The variable sheets can be distributed to the participants at the beginning of a workshop to collect their suggestions/knowledge. The sheets can then be refined and used to select with the stakeholders 2 to 4 hypotheses per variable selected that will then be used to build the scenarios. The selection of variables and hypotheses must be justified and the reasons clear.

Advice: define at the start of the process a maximum number of critical uncertainties (e.g. 5 to 10 maximum). To identify these critical uncertainties it is useful to ask the following questions: "What determines the evolution of the system? On what can we act? ".

Tools that can be used to reach the objectives of this phase:

INTERVIEW

BRAINSTORMING

DELPHI

REGNIER

DPSIR

PESTLE

BAYESIAN

PHASE 3: Establishing the key variables and associating them to explore and build the scenarios

Once the critical variables of change have been selected, it is then possible to start constructing the scenarios by associating hypotheses.

The 'hypotheses associations' reveal different possible pathways and form the framework for the scenarios.

In the case of exploratory scenarios, generally 3 to 5 scenarios are designed, while in the case of a normative scenario, only 1 scenario is defined, the preferred future, that associates only the desired hypotheses.

The choice to build exploratory or normative scenarios depends of the aims of the scenario building exercise.

1 scenario =
1 association of
hypotheses with
1 hypothesis per variable

Tools that can be used to reach the objectives of this phase:

- **Exploratory scenarios:**

BRAINSTORMING

REGNIER

PESTLE

- **Normative scenarios:**

REGNIER

BAYESIAN

BACKCASTING

PHASE 4: Selecting and developing the format of the scenarios with stakeholders

Once the scenarios frameworks are defined, it is necessary to feed them with qualitative and quantitative data.

It is essential to find the right information that will allow each scenario to be distinguished. The scenario's format is important as a means to generate stakeholder's interest. Finding the most relevant and clear information to disseminate will make this task easier. There are various possible scenario formats, from a narrative text to a creative visual presentation.

Example of senario formats:

Narrative:

- ✓ Stories
- ✓ Letters
- ✓ Postcards
- ✓ Newspaper articles

Visual:

- ✓ Pictures
- ✓ Maps
- ✓ Graphics
- ✓ Drawings
- ✓ Timelines

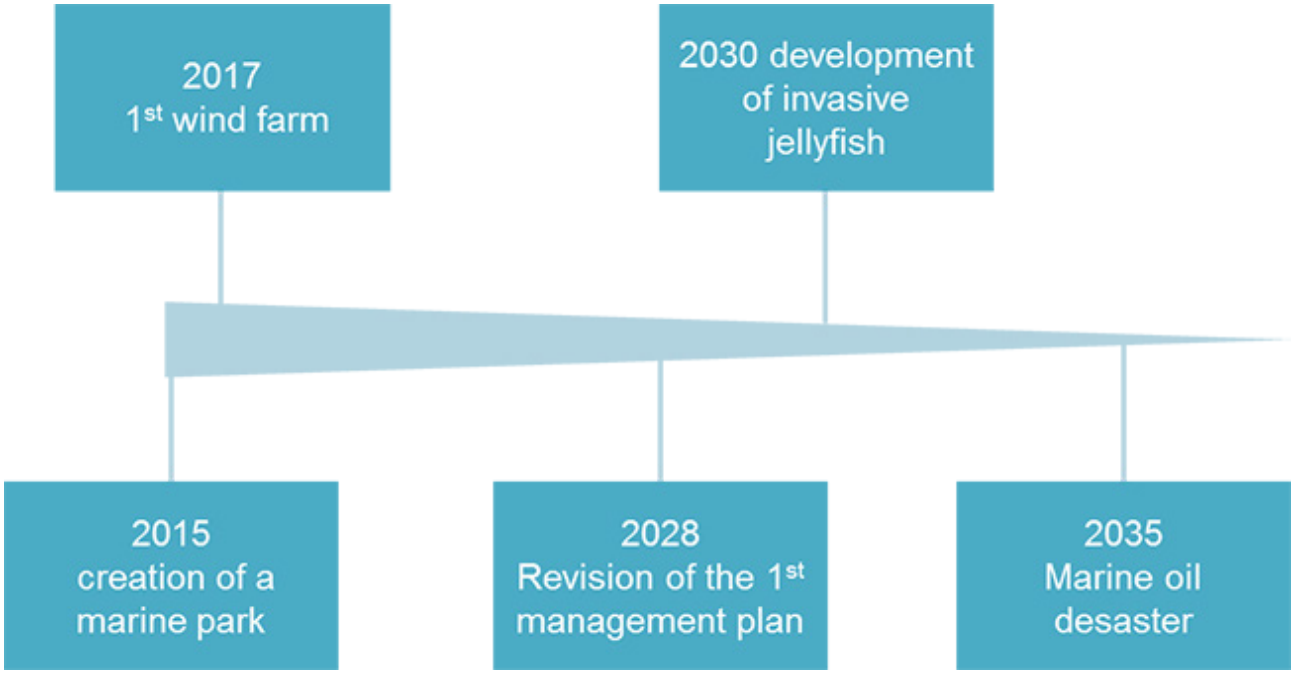
The choice of the scenario formats depends on:

- ✓ Their aims;
- ✓ The target audience (e.g. policy makers, scientists etc.) and
- ✓ The time and resources available within the case study site team.

Several formats can be combined and/or coupled with modelling and simulation using, for example, InVEST or ExtendSim softwares. Stakeholders can help to define the most appropriate scenario format. This approach can encourage buy-in, support and ownership.

When the scenarios are created in the format decided with stakeholders, it is important to submit them to the stakeholders and experts involved in the scenario building process in order to collect their suggestions, comments and advice. Scenarios can then be strengthened and finalised, with the stakeholders' trust. Feedback can be collected via workshops, focus groups or online surveys.

Example of timeline:



Scenario for a management plan dealing with a marine protected area and possible events.

Tools that can be used to reach the objectives of this phase:

TOOLS TO REPRESENT THE SYSTEM

INVEST

PHASE 5: Using scenarios to create discussion on management options

How to combine scenarios and ecosystem services assessment (ESA)?

The interaction between ecosystem service assessment and scenarios depends very much on your objective and the methods you will use to conduct the ecosystem service assessment.

Scenarios and ecosystem service assessment are closely linked and can feed and influence each other. Ecosystem service assessment can be used at the preparatory phase to assess the situation in the case study site and then be used to compare possible future scenarios by providing information to feed/illustrate these.

For example, each scenario can include elements of ecosystem service assessment on different aspects of the problem from one scenario to another. Alternatively ecosystem service assessment can be undertaken on the different scenarios generated by stakeholders, if we consider that the different scenarios are management options that need to be evaluated and compared in order to make a management decision.

How can scenarios be used for management?

Scenarios can be the mechanism to engage stakeholders by creating an informed debate on a management question and raising awareness amongst local politicians, with ecosystem service assessment feeding these discussions.

In the case of exploratory scenarios, stakeholders can explore possible futures and their consequences can be evaluated and compared and help to shape discussions about management options and trade-offs.

A preferred scenario chosen with the stakeholders is a basis to construct a common coastal and marine vision or action plan.

The scenario outputs can also input into, or influence, a range of existing policy frameworks and associated plans and strategies.

This depends on the legitimacy and management role of the case study site team, the participants involved, and also of the governance context that needs to be understood to make the best choices and management decisions.

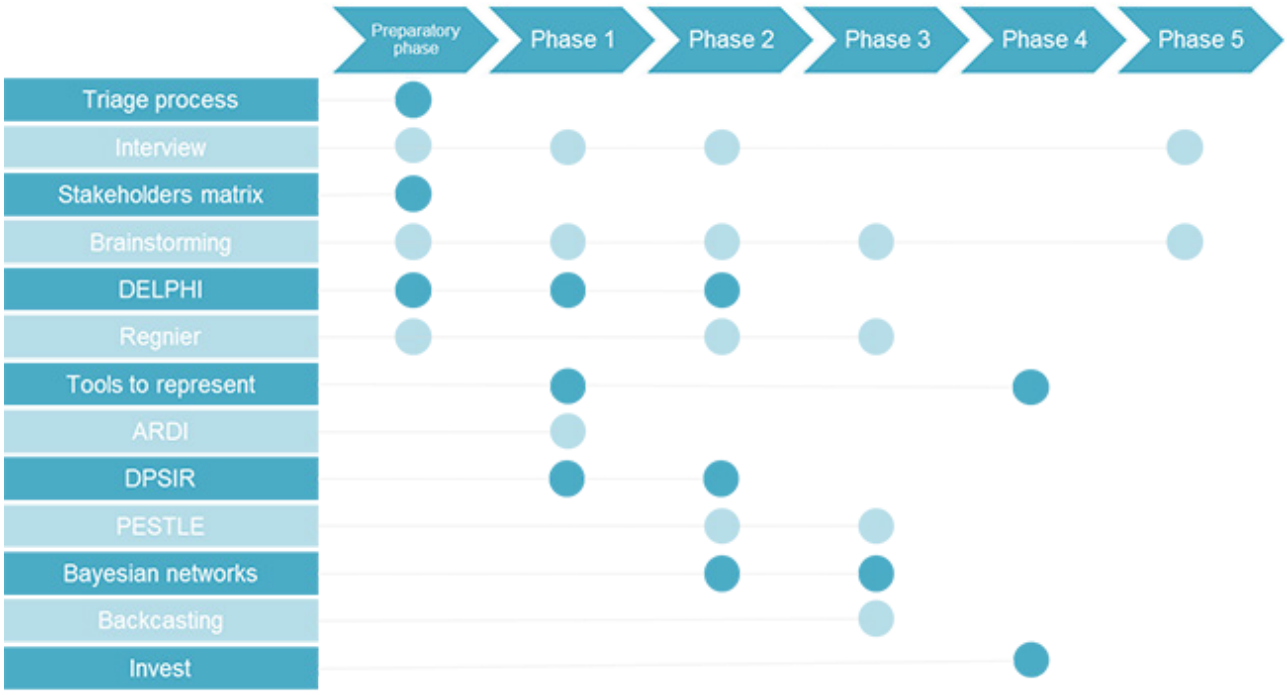
For normative scenarios, the objective is different; the result should be a preferred scenario with concrete proposals to reach the desired future. The process can be used to devise plans or determine the concrete actions necessary to reach a desired management future sought by stakeholders with immediate or short-term implementation.

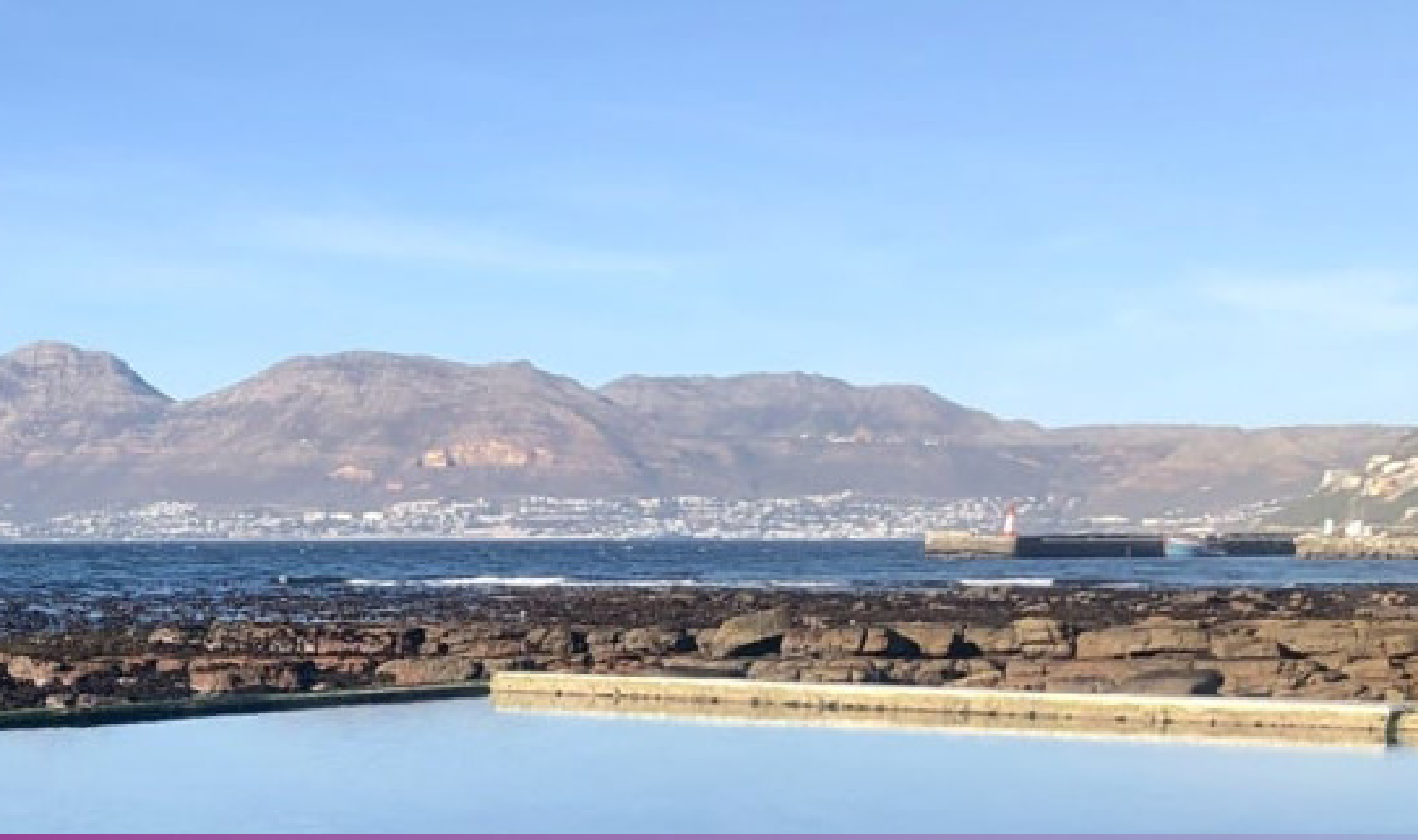
Tools that can be used to reach the objectives of this phase:

INTERVIEW

BRAINSTORMING

In brief: List of tools that can be used for each phase of the scenario building process





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Each of the tools presented here can be considered separately according to the user's need. Wherever possible, concrete examples of implementation and supporting documents for an effective implementation of the tools are provided. The different tools are identified by the acronyms in the previous table.

Tool box content:

- Interviews with stakeholders and/or experts
- Stakeholders matrix
- BRAINSTORMING
- DELPHI
- REGNIER'S ABACUS
- TOOLS TO REPRESENT THE SYSTEM, PRESENT AND COMBINE INFORMATION, SYNTHESIZE KNOWLEDGE
- ARDI METHOD
- DPSIR
- PESTLE AND MATRICES TO CLASSIFY THE POSSIBLE CHANGES
- BAYESIAN ANALYSIS
- BACKCASTING
- INVEST

Interviews with stakeholders and/or experts

For what phase this tool may be useful

Interviews with stakeholders, scientists, experts and elected-members are a good way to collect information and knowledge on:

- ✓ The ecosystem studied;
- ✓ The interaction between the ecosystem services (ES) and human activities;
- ✓ The data available, gaps and uncertainties and
- ✓ The different perceptions of stakeholders.

Before the interviews it is essential to prepare a guide that gathers all the questions that need to be asked of the stakeholders and/or experts. It may be helpful to record the interviews; to keep all the information and to transcribe it later. However, some stakeholders may be concerned if they know that they are being recorded. In this case, you will have to decide if it is preferable to record them or not. You should gain the interviewee's agreement before any recording is undertaken.

Interviews can take up to to 2 hours, plus the time necessary to transcribe the interviews and analyze them.

Time: 1 to 2 hours/interview
Technical level: 1/4
Advantages: create links and confidence between the stakeholders and managers; better comprehension of the ecosystem studied and local issues; useful to collect expert's opinions.
Limits: availability and involvement of stakeholders; time consuming.
Resources needed: recording device.
Advice: well prepare the interview guide and collect information on the interviewees and their activities.

Example of an interview guide on interactions between maritime activities and seagrass beds

- ✓ Date / Name of the interviewer / Name of the interviewee(s)
- ✓ Seagrass beds:
- ✓ What is the present distribution of seagrass beds and their evolutions observed?
- ✓ What are the essential parameters to the development of seagrass beds?
- ✓ What are the sensitivities of seagrass beds?

Activity:

- ✓ How do you go about your work/business/activity (where? when?)?
- ✓ Are seagrass beds a constraint for your activity?
- ✓ What are the potential impacts of your activity on seagrass beds?
- ✓ How could your activity change/ evolve in the future?

Opportunities:

- ✓ Do you think that the seagrass beds have a positive impact on your activities? If yes, why and how?

Contacts:

- ✓ Who could we contact to tell us about the seagrass beds and their management?
- ✓ Do you have any publications or books to advise us on the subject?
- ✓ Would you be interested in continuing to work with us and how?

Stakeholders matrix

For what phase this tool may be useful

An analysis sheet can be produced for each stakeholder to summarize their aims, interests, motivations and constraints.

Two matrixes can then be created to identify and describe the key stakeholders to engage in the scenario building process and the planning of their participation.

The case study team can use this tool if they have a good knowledge of their stakeholders. They can also do individual interviews with key stakeholders or experts to help them to define the interactions between the stakeholders and complete the matrix.

Stakeholders' positioning matrix...

...reveals the positions of stakeholders depending of their own objectives. The concept is to identify the conflicting and shared objectives of stakeholders.

This matrix's aim is to represent:

- ✓ The convergences and divergences between the stakeholders
- ✓ The unifying goals and conflict points
- ✓ The influences between the different stakeholders
- ✓ The apparent degree of freedom of stakeholders

Time: many weeks, depends of the number of stakeholders involved.
Technical level: 2/4
Advantages: better understanding of stakeholder's interactions, their positions concerning management objectives and their strategies.
Limits: based on personal judgements.
Advice: be sure to collect different views to be the most objective and impartial as possible.

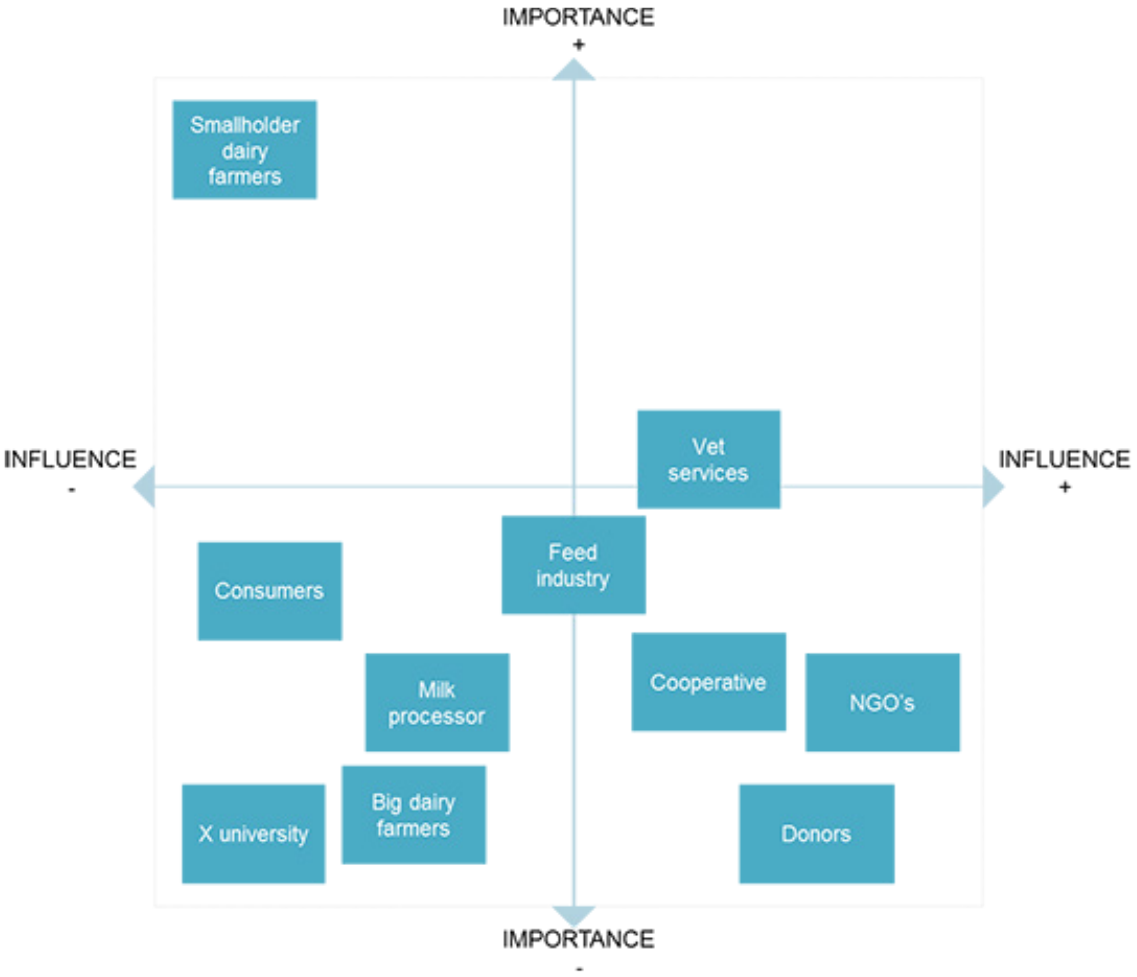
Pairs of key stakeholders	Conflicting objectives	Shared objectives
Local Administration, NGO, Ministry of Agriculture		Environmental conservation
Ministry of Agriculture and farmers	Cash crops versus food crops production	
Farmers, National Dryland Farming Research Centre, Kenya Soil Survey		(Research on) improved soil management practices to increase yield and facilitate weeding
Local Administration and NGO's versus farmers	Long-term conservation benefit versus short-term agriculture production benefit through mining resources	

Example of stakeholder's positioning matrix: stakeholder objective matrix for improved soil management (from [ICRA, 1998a])

Stakeholder's influence/ importance matrix...

This matrix plots stakeholders against two variables: the "importance" of the stakeholder against the 'influence' of the stakeholder considering the question studied. This matrix provides a clearer understanding of stakeholders and can be used to define the best way to engage them in our approach.

The "importance" refers to the priority given to satisfy stakeholders' needs and interests depending of the objectives defined. The 'influence' is the extent to which the stakeholder is able to persuade or coerce others into decision-making and/or implementation of actions.



Example of stakeholder's influence/ importance matrix (from [ICRA,1998b])

More information:

Stakeholder matrix by the Department of Environment and Primary Industries, state of Victoria (Australia)

Stakeholder matrix by the International Centre for Development Oriented Research in Agriculture (Foundation)

BRAINSTORMING

For what phase this tool may be useful

Brainstorming is a creative technique based on the production of ideas by a group of people. It is a good method for working closely with stakeholders and finding the most original ideas in the shortest period of time.

This exercise can be achieved just with the case study team but the output of a brainstorming workshop is richer if it involves more participants.

Brainstorming is a good way to:

- ✓ Collect information on the studied system
- ✓ Organize the ideas (phase 1)
- ✓ Identify and classify hypotheses of changes (phases 2 and 3)
- ✓ Share reflections and ideas between stakeholders

The ideal number of participants is between 15 to 20 people, above this number it will be more difficult to manage a constructive discussion and answer to all the questions. A facilitator should lead the workshop.

It is important for the facilitator to explain the topic of the workshop, its aims and the rules that the participants have to follow.

Facilitator:

- ✓ Presents the topic and the aims of the brainstorming
- ✓ Presents the approach as simply as possible
- ✓ Answers questions from the participants
- ✓ Avoids criticizing, interpreting, commenting or censoring ideas and encourage the participation of everyone.
- ✓ Writes down all ideas and makes them visible to everyone
- ✓ Discourages competition and encourages listening to others

Attitudes expected of the participants:

- ✓ Participating in a creative and inclusive way
- ✓ Cooperating rather than competing
- ✓ Collaborating and enjoying working together
- ✓ Accepting the challenge of finding ideas
- ✓ Preventing blockages by avoiding criticism
- ✓ Accepting the 'fun' nature of the technique

The basic rules of brainstorming:

- ✓ Record all ideas; do not criticize, suspend 'reality' and think and speak freely
- ✓ Give free rein to the imagination, spontaneity, surprise and the unexpected
- ✓ Produce a lot of ideas
- ✓ Combine ideas to create a new ones

The facilitator should ask the participants to give their ideas as to the aim of the workshop:

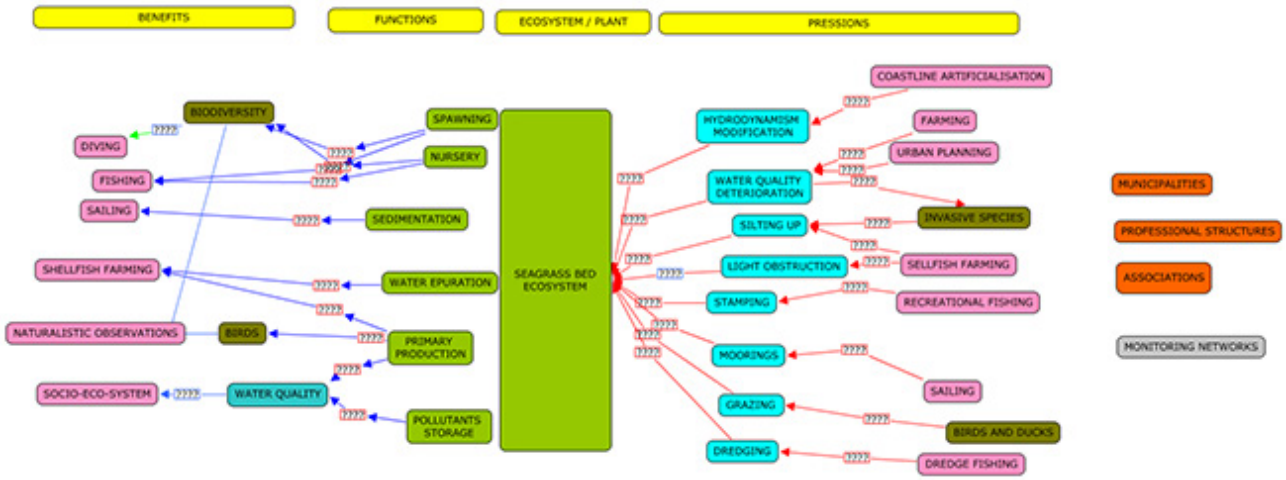
- ✓ Construction of a systems diagram
- ✓ Identification and ordering of issues
- ✓ Identification of possible changes and hypotheses associated
- ✓ Association of hypotheses to build the scenarios

The participants should be invited to write their ideas on sticky-notes and give them to the facilitator for the flip-chart. Then, the facilitator removes any duplicate ideas on sticky-notes and asks the participants to explain their sticky-note to the others participants to confirm they have the same understanding. The facilitator then organizes the ideas on the flip-chart, respecting the stakeholder's choices. The ideas can be organised by category with a PESTLE analysis for example, and linked by arrows that indicate the relationship between ideas.

At the end of the workshop, an individual written evaluation can be distributed to the participants to collect their opinions. This strengthens the spirit of democracy and contributes understanding to any following workshops, if needed. It can be beneficial to tell the participants during the introduction to the workshop that a written evaluation will be done at the end of it followed by a discussion time of 15 minutes to give them the opportunity to express their opinions on the workshop.

Time: 2 hours to 1 day
Technical level: 2/4
Advantages: quick and creative tool; helps to think outside the box; produces a lot of information; creates links and confidence between the stakeholders and managers; gathers knowledge and issues; useful in collecting experts' opinions.
Limits: availability and involvement of stakeholders; some people do not speak out in-group situations.
Resources needed: facilitator; sufficient amount of wall space; flip-charts; sticky-notes; pencils etc.
Advice: it is important to invite the stakeholders with plenty of timebefore the workshop;
Explain to the stakeholders that this work concerns long-term reflection and will not necessarily respond to their immediate issues;
Manage time well and ensure there is enough time for discussion;
Involving external consultants or experts can be useful;
Take photographs of the flip-charts at the end of the workshop.

Example of draft mapping achieved after the brainstorming workshop: ecosystem services, activities, natural drivers, pressures, organizations and legal framework.



Example of the results of a brainstorming workshop undertaken in the Golfe du Morbihan on seagrass ecosystem. (done by Manuelle Philippe)

DELPHI

For what phase this tool may be useful

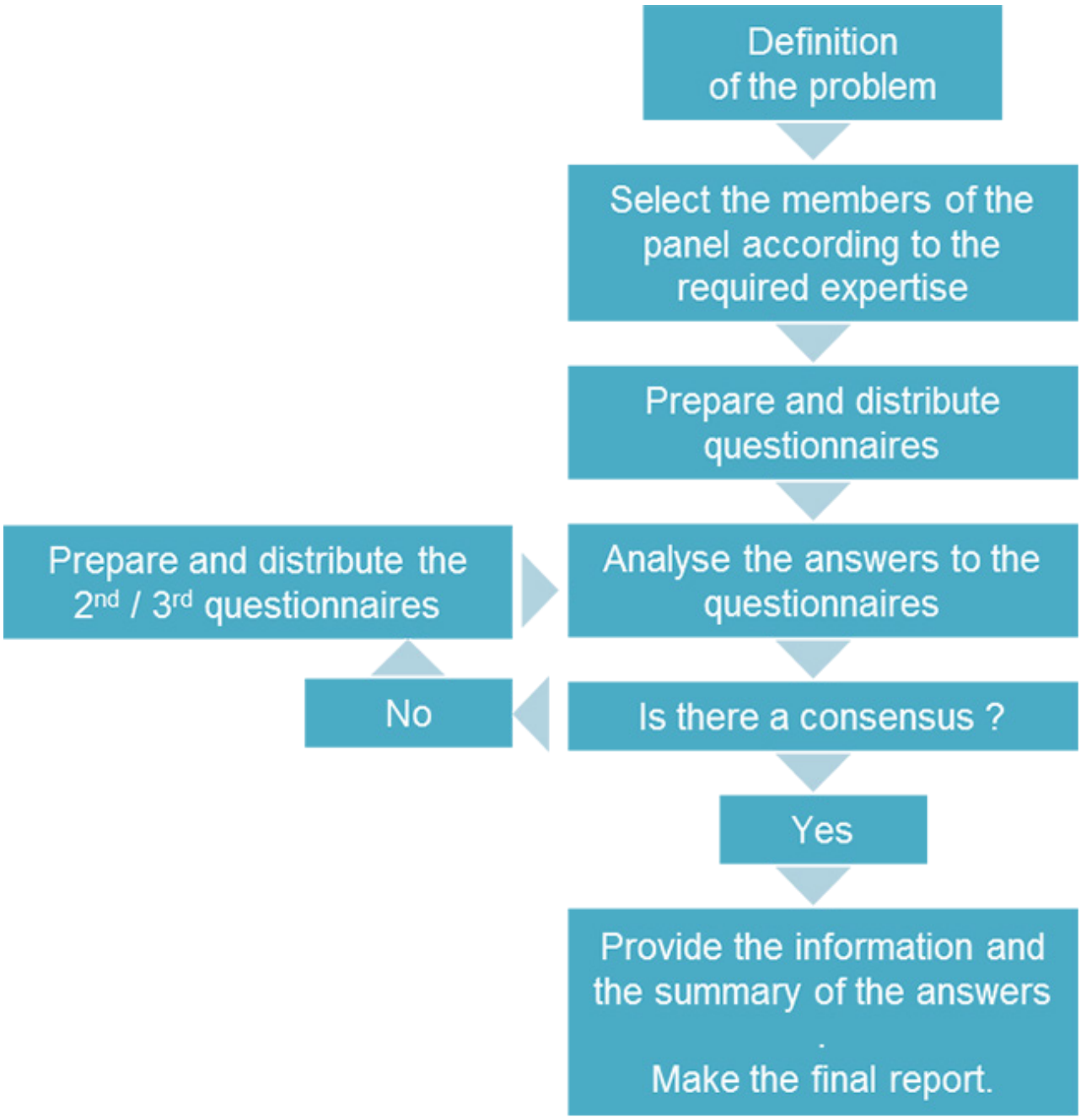
The "DELPHI" and "Régnier abacus" methods are presented separately but can be used simultaneously.

The RAND CORPORATION produced the DELPHI method in the 1950s originally to forecast the impact of technology on warfare.

The major objective of DELPHI studies is to collect experts' opinions on a subject on which you have some uncertainties in order to help you to take a decision. By expert, we mean persons who have a good knowledge on the topics the DELPHI analysis is dealing with. Experts are also selected for their ability to envision the future. They have to be chosen according to these criteria.

The DELPHI method is not a questionnaire sent to a diverse audience but a questionnaire sent to a chosen panel.

The DELPHI method aims to highlight convergences of opinion and to identify some consensus on specific topics through the interrogation of experts, using successive questionnaires.



The DELPHI steps

Questions should be specific and independent of each other (e.g. 20 questions divided into five themes). They must be relatively concise in their content and discuss only one topic.

Questionnaires (usually 3 to 4) are sent successively to identify a consensus. The method is interesting to use to collect at least 25 opinions. It is generally considered necessary to have a panel of 100 people in order to collect 25 answers. The questionnaires are sent by post or e-mail with a note explaining the goals, the spirit of DELPHI, and the practical conditions of the investigation (the response time should be specified and anonymity guaranteed). In order to increase the level of responses, experts can be contacted individually before sending them the first questionnaire in order to explain what is expected from them.

In the second round, the experts should be informed of the results of the first round before they provide their new answers in response. They are required especially to justify their opinions if they are very different from one of the majority of the group.

In the third round, each expert is asked to comment on the arguments of those with a different opinion. The fourth round gives the final answer: consensus opinion median and dispersion of opinions (interquartile ranges).

The questions are modified during the second and third rounds, depending on the responses obtained in the previous rounds (some deeper questions, new topics suggested by the experts at the end of their response etc.). It is important to have a question that identifies areas of questioning that had possibly not been covered previously.

Time: at least 1 month
Technical level: 3/4
Advantages: it is possible to obtain the opinion of each stakeholder not influenced by the group (no leader). It permits the generation of a consensus and the identification of deviations from the consensus, and explanations of this
Limits: time consuming; the need to conserve a high level interest of the panel so that the experts respond to each round
Resources needed: a questionnaire; postage costs or an email address or a website
Advice: it is important to limit the number of hypotheses so as not to be overwhelmed. It is possible to achieve a mini DELPHI in a shorter time as part of a workshop with the experts or stakeholders and discuss each question before answering

Example of implementation of a DELPHI: theoretical DELPHI experience build for a workshop held in Auray (France) in 2013. The example is dealing with a case study located in England and covers a coastal and marine area between Plymouth and Fowey (More information about the case study: https://participatory-assessment.eu/case-studies/). This DEPHI was not implemented on the territory. This example is also available in the scenario guideline [Herry and al., 2013].

More information:

DELPHI explained on the Encyclopaedia of business

DELPHI explained by the New Jersey Institute of Technology

DELPHI explained by the Rand Corporation

REGNIER'S ABACUS

For what phase this tool may be useful

The aim of this tool is to obtain the participants' opinions on a specific subject. It is not the consensus that is sought but rather the exchange and discussion between individuals on their different opinions.

The Regnier's abacus is an original method, effective, simple and quick based on questions to be asked to stakeholders and/or experts. It can be achieved through workshops, interviews, by post, or online.

The Regnier's abacus is an excellent communication tool very useful in reducing uncertainties by confronting participant's opinions. **It can also help to find out what the issues or the possible changes are that they consider as likely or otherwise.**

This exercise can be achieved during a workshop in 4 steps:

1. In introduction to the workshop, the facilitator explains to the stakeholders the aims of the exercise, distributes to each participants one sheet with items to mark and explains the items if needed. The item must be simple: subject + verb + complement. They can have been identified by stakeholders during a previous workshop or selected by the case study team.

Example of file used during a workshop. In that case, the file was distributed after a discussion about possible approaches of management. The participants had to express their opinion in terms of preferred approach and feasibility of them.

2. The participants read and mark each item using this notation:

Item	Notation
Very likely	1
Light likely	2
Mixed opinions	3
Unlikely	4
Very unlikely	5
No opinion	6

3. Then, the facilitator collects all the individual sheets and integrates the marks in an Excel file prepared in advance. That will allow the calculation of average results for each item. To do this, a scoring method is used. It provides a score for each notation:

Item	Notation	Score
Very likely	1	+6
Light likely	2	+3
Mixed opinions	3	0
Unlikely	4	-3
Very unlikely	5	-6

Item	Notation	Score
No opinion	6	0

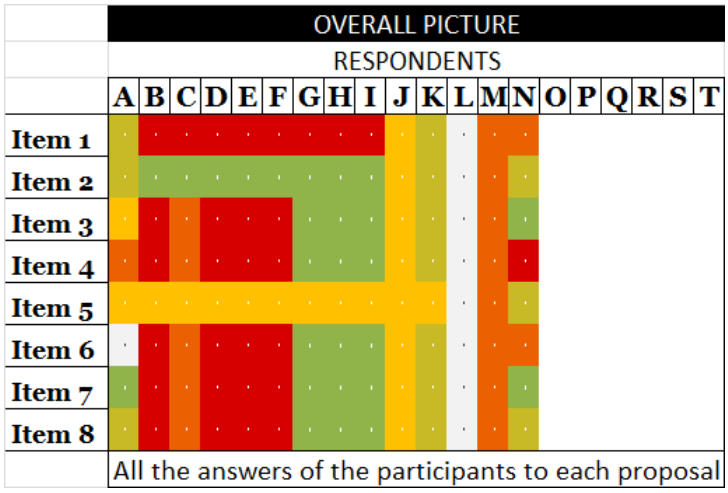
An average is calculated for each item in order to identify and help agree the issues or possible changes that are likely or unlikely, and the issues or possible changes on which there is no consensus.

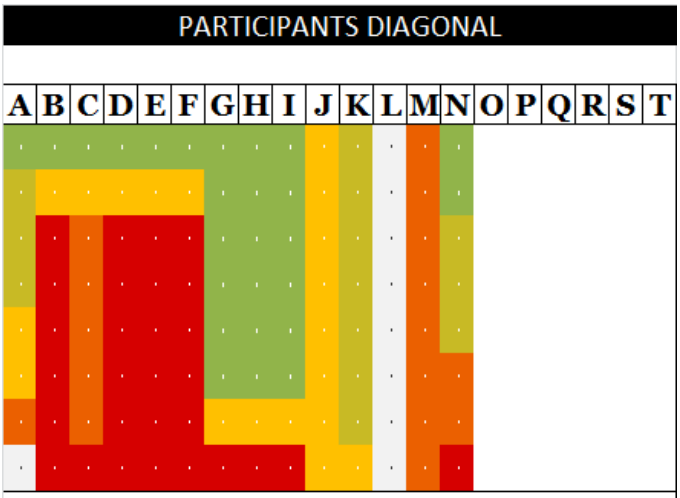
A colour scale can be used to make the results more visual.

Item	Colour
Very likely	
Light likely	
Mixed opinions	
Unlikely	
Very unlikely	
No opinion	

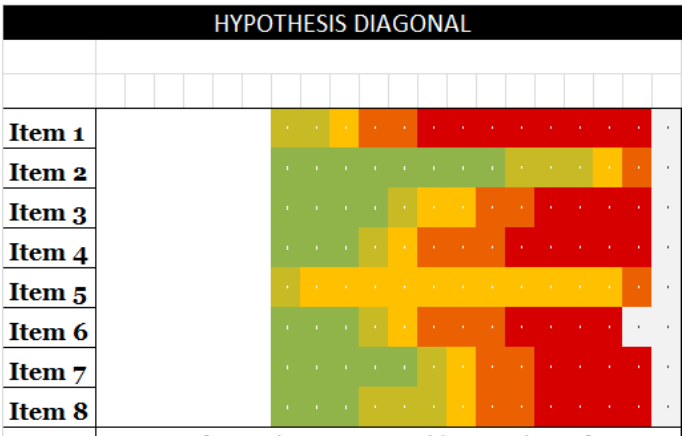
It is possible to use different visual representations to reveal:

- ✓ An overall picture of the votes;
- ✓ The proportion between participants who have judged the majority of items as very likely and the ones who have judged the majority of items as very unlikely (participants diagonal)
- ✓ The proportion between the items judged as more likely, and the ones judged as the more unlikely (hypotheses diagonal)





Answers of the participants sorted by number of answers from "totally agree" (green)" to "do not agree"(red) + don't know (grey). [not sorted by items]

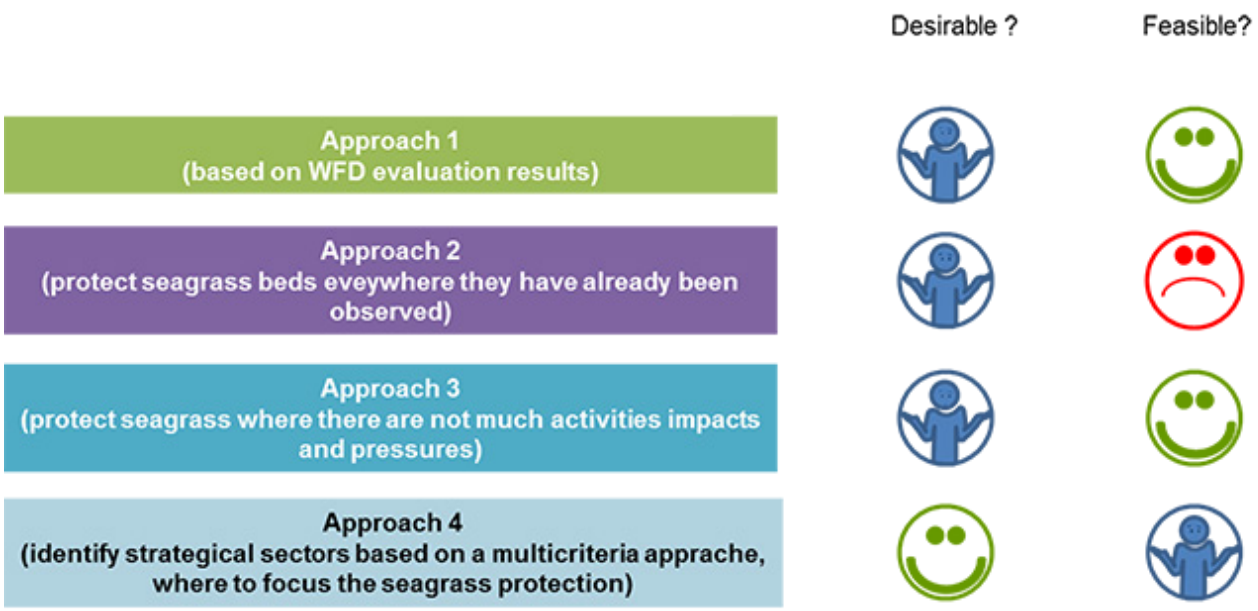


Answers for each item sorted by number of answers from "totally agree" (green)" to "do not agree"(red) + don't know (grey). [not sorted by participants]

A dominant colour means a consensus while opposite colours indicate a lack of consensus.

4. At the end of the workshop, participants discuss the average of each item and more particularly on the ones for which no consensus has been found. This is a good way to create links between stakeholders who can then discuss and exchange arguments. The facilitator must ensure that the discussion is constructive.

Example of visual result collected in the context of a scenario workshop about seagrass management approaches in the Gulf of Morbihan (France. More information about the case study on this web site: https://participatory-assessment.eu/case-studies/.



Visual result of a Regnier abacus result (Manuelle Philippe)

Time: 4 hours to 1 day
Technical level: 2/4
Advantages: easy method with visual outputs; allows debate between stakeholders.
Limits: need a good organisation and time management.
Resources needed: a facilitator; a computer with Excel software.
Advice: schedule time during the workshop to enter and analyze the stakeholder's votes.

Tools to represent the system, present and combine information, synthesize knowledge

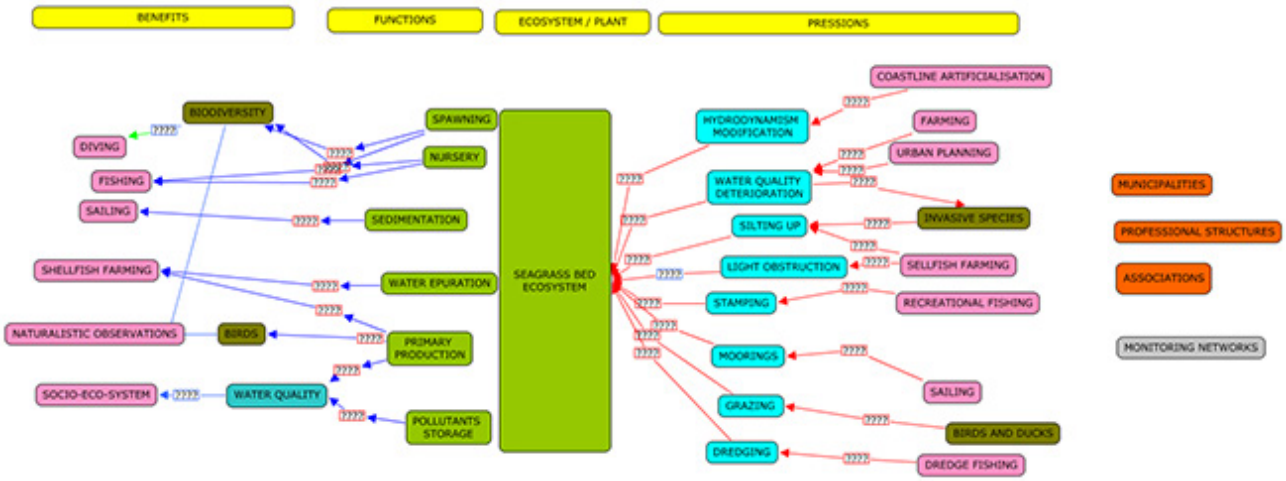
At different steps of the VALMER approach (ecosystem service assessment and scenarios building process), it can be useful to find a way to visually represent the information collected in order to organise and share them with stakeholders.

Many tools can be used to complete diagrams; some are simple while others are of a higher technical level. Nevertheless, depending on the experience and resources of the teams, they can be very useful tool.

Time: many weeks to many months
Technical level: 1 /4
Resources needed: CMAP or Mindjet Mind Manager software

CMAP tools ®

This software can be freely downloaded from the Internet. It will be helpful to work in a cooperative way from an early stage, either alone or in small groups to draw diagrams of a system. It is easy to use and can be seen as a way to organise 'post-its' on a computer.



Mindjet Mind Manager ®

This is commercial software that helps to represent the system hierarchically.

The 2 software tools represented are useful for internal work on phase 1 but it is essential to think about how to present the information collected and how to make it available for stakeholders, decision makers and policy makers, because the type of information collected during the work

can be of many types (qualitative, quantitative, texts, maps (images and GIS), photos, films, and even modelling in some cases).

Most of these elements can be presented on websites and it seems to be a good way to make the information available for decision makers. However, web designers need to be mindful about some aspects of presentation in order to make it clear.

Thought needs to be given to:

- ✓ Different levels of knowledge from the very simple to scientific or technical articles, guidelines and reports.
- ✓ Different approaches: by a question ("As a manager, how can I engage stakeholders in a process of ecosystem service assessment?"); by location with examples ("The Poole Harbour experience and lessons learned by implementing such methodology") or by a technical approach (scenarios building, ecosystem service assessment...).

The designer needs to be very careful to identify the target audience so that, the content of the site is appropriate and then explain how that audience can reach their objective, using the information presented on the site.

What cannot be done through the tools presented above is mathematical modelling of natural and social processes. Modelling is useful in order to build an understanding of a complex system in which the relationships cannot be illustrated by simply. An assumption has to be made that there is knowledge about the level of interaction between the different elements of a system. If necessary, tools such as ExtendSIM¨ can be used (see below).

ExtendSim®

One way to combine the needs of collecting and presenting different kinds of information and perform mathematical modelling is to use the ExtendSim® software which was originally designed for modelling but can be used for different purposes. It uses a hierarchical organisation of the information and presents it in independent blocks. The software includes some ready to use examples, however it is also possible for an

advanced user to build their own blocks according to their needs, with graphical interfaces, a dialog box for parameters and a "help" box for comments and documentation [Balle-Beganton et al., 2010].

In addition to the boxes, it is possible to include links to different type of documents (images, videos, pdf, etc.) by making ExtendSim® use other software. Nevertheless, the use of this software supposes a certain level of technical understanding.

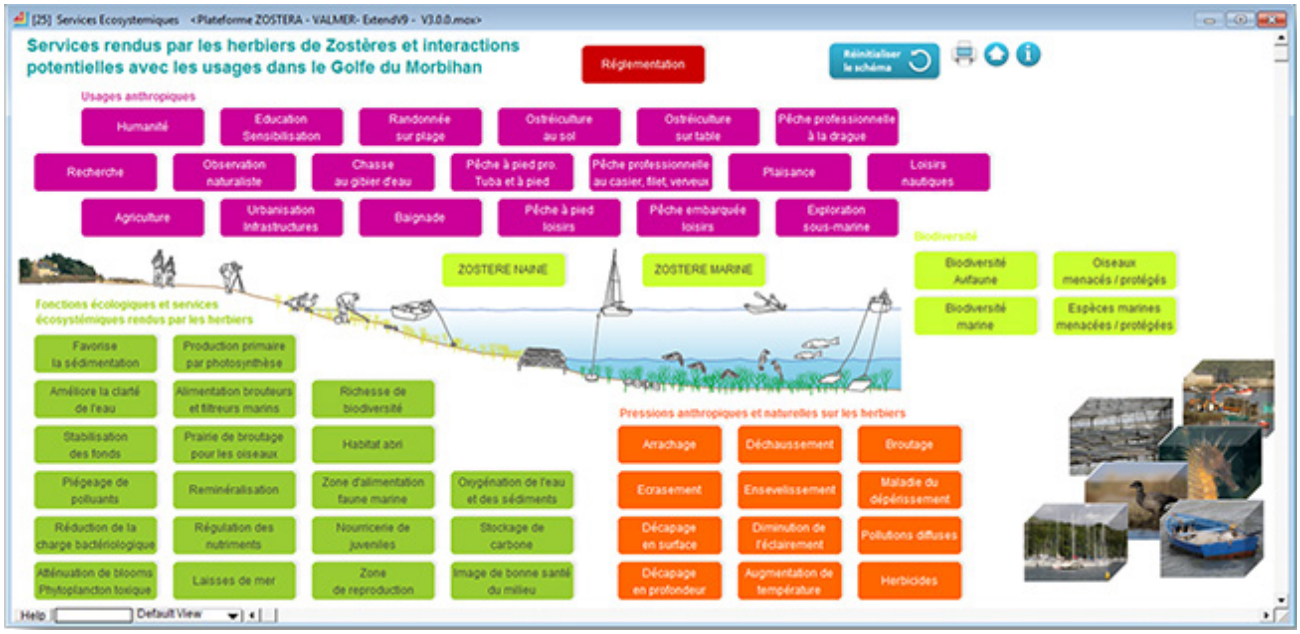
By using this software, we are aiming to build platforms to communicate knowledge integration. The objective is to facilitate group sharing of knowledge [Balle-Beganton et al., 2012]. The development of the platform commences at the start of the project and it is used for the discussions with stakeholders and modified through the project in order to make a version so that end-users understand the processes, find information (classified according to different scientific and technical levels), and help them to implement a decision process for management.

Time: at least 6 months
Technical level: 4/4
Resources needed: ExtendSim¨ software

Links

The System Approach Framework using ExtendSim® deve`loped under the SPICOSA project (AMURE team, UBO, France)

Presentation of the ExtendSim¨ platform built for the VALMER project dealing with the seagrass beds in the Golfe du Morbihan in France (draft version, design by J.Beganton, UBO).



Elements of the ExtendSim¨ platform built for the VALMER project dealing with the seagrass beds in the Golfe du Morbihan in France. Presentation of the seagrass beds system (ecosystem services, interaction with activities, impacts, pressures. Draft version, design by J.Beganton, UBO, January 2015).

ARDI method

This method is very useful to create a graphical representation of how the stakeholders perceive the system functions. It focuses on co-construction of the meaning and the sharing of information and understanding regarding a particular context that is to be managed and helps to create a shared representation of the whole system using a common structural framework that might help to improve the management of natural resources [Mathevet, 2011].

The ARDI method requires a description of the site or location under question, the formulation of the question to be addressed (clear, precise and easily understood) and identification of facilitator(s).

The ARDI method (Actors, Resources, Dynamics, and Interactions) allows the progressive emergence of a shared representation of the system by identifying the key stakeholders, the resources, the processes, and the interactions between them according to an overarching question [Etienne, 2011].

The facilitator's role is to:

- ✓ Ensure clarity and general agreement of the terms or concepts used to avoid confusion
- ✓ Take care to ensure that each participant has the opportunity to voice their opinion
- ✓ Amend the participant's input if needed
- ✓ Observe and record the exchanges between participants (attitudes / arguments / choices/ changes)

The ARDI method can be achieved in 4 steps:

Step 1: Identifying key actors

First of all the participants list all the stakeholders that they consider to be associated with the question. The facilitator adds each input on the computer or flip-chart by using a new label and colours to distinguish the stakeholder categories (professionals, associations, elected members, etc.). Next, the facilitator asks the participants to specify the links that exist between the identified stakeholders to clarify the relationships. Arrows are then added according to suggestions made by the participants. The facilitator progressively shapes the diagram by bringing closer together stakeholders who have many relations and moving those apart that do not have any [Etienne, 2011].

Step 2: Identifying key resources

The second stage consists of listing the relevant resources (goods or products) of the site or location according to the key stakeholders previously identified.

Step 3: Identifying key dynamics / processes

The third stage of the ARDI process consists of listing the main processes that drive changes in the territory in relation to the question (ecological / economic / social dynamics). If the list is large, the facilitator asks the participants to rank the 10 main processes by assigning '10' to the most important one and '1' to the least. The facilitator then sums up the scores given by each participant and selects the five processes that get the highest score [Etienne, 2011].

Step 4: Eliciting interactions

The last stage of the ARDI method consists of synthesizing answers to the three preceding questions by stressing the interaction between users and resources. This phase generally takes one half-day for a simple diagram (3-4 direct actors, 3-4 resources), and one day for a more complex diagram (5-8 direct actors, 5-10 resources).

The group must then answer the following central question: How does each stakeholder use the resources and modify the processes?

Time: the ideal is to conduct all the workshops over a period not exceeding one month. The meetings may be held in one of the following formats: (a) in a two-and-a-half-day workshop, (b) during one half-day per week, or (c) over three separate days. Ideally, the choice should be negotiated with the participants.
Technical level: 2/4
Advantages: strengths in understanding stakeholders' perspectives and values / effective way to get to a shared representation of a complex system.
Limits: stakeholder's availability
Resources needed: skills in facilitation / skills to anticipate unexpected reactions
Advice: pay special attention to the composition of the working group: the choice of partners and meeting place (neutral and easily accessible), the periodicity of the workshops, and the method of invitation / invite a scientist to benefit from their expertise / keep a record of the process

DPSIR

The DPSIR framework has been adopted by the European Environment Agency. It is a general framework for organising information about state of the environment by identifying:

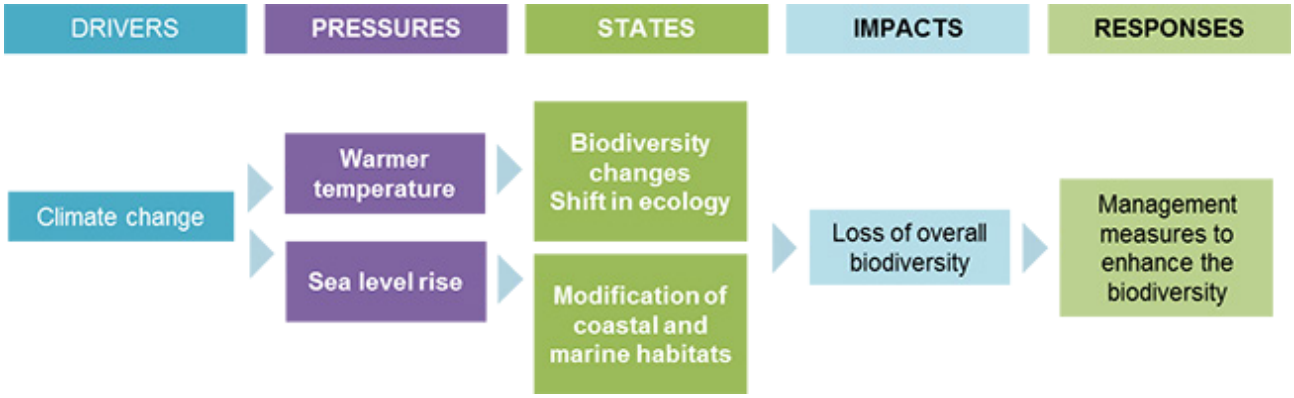
- ✓ **Driving forces** elements that have an influence on the system and that we cannot easily change (e.g. climate change, growth population)
- ✓ **Pressures** Human activities (e.g. urban development, tourism)
- ✓ **State** of the environment Changes actually observed (e.g. shift in ecology)
- ✓ **Impacts** Direct and indirect consequences of the pressures (e.g. loss of biodiversity)
- ✓ **Responses** actions or measures implemented to avoid the negative impacts or take advantage of new opportunities (e.g. new management measures)

Time: many weeks to many months
Technical level: 1 /4

Drivers	Pressures	State	Impacts	Responses
Climate change	Warmer temperature	Shift in ecology	Loss of overall biodiversity	Management measures to enhance the biodiversity
Growth in population	Sea level rise	Biodiversity change	Decrease of water quality	Agreement to preserve landscapes
Financial resources	Urban development	Modification of coastal and marine habitats	Decrease of water's pH	
	Tourism	Landscape's modification	Decline of health and well-being	

Example of DPSIR identified on a marine site

Once the DPSIR elements are identified, they need to be linked. Thereby, the DPSIR is a useful tool to represent the cause-effect relationships between interacting components of social, economic, and environmental systems. This framework can encourage and support decision-making by pointing to the steps where it is possible to act to improve the situation (e.g. take new management measures, create partnerships).

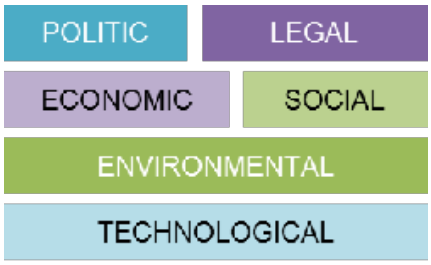


Link

Publication in the International Journal of Sustainable Development & World Ecology

PESTLE and matrices to classify the possible changes

PESTLE analysis



This analysis can be condcuted during a stakeholder workshop or internally to help you to implement the analysis of the system studied. A PESTLE analysis can be useful to:

- ✓ Identify the links between environment and human activities
- ✓ Identify possible changes in the future that can be used to build scenarios

If you use a PESTLE analysis for scenario building, you will need to discuss a common focus with participants, as well as the system studied, 'What possible changes or trends could happen in the future, concerning the political, economic, social, technological, legal, and environmental aspects?'.

A PESTLE analysis is a means to organize the ideas, trends or possible changes in the future into different categories: Political, Economic, Social, Technological, Legal, and Environmental.

If you aim to build exploratory scenarios, there is no limit to the imagination of participants whereas if you build normative scenarios, the participants are limited in their options by the fact that they have to reach the objective to achieve a result.

A PESTLE analysis describes a framework of macro-environmental factors used in helping to identify the different driving forces in play in a particular situation.

Sometimes this is also represented as PEST (without the Legal and Environmental). It is a very useful and widely employed tool as it offers a wide-ranging framework from which to build scenarios [While, 2010].

Time: ½ day to 1 day
Technical level: 2/4
Advantages: permits the organisation of ideas, not forgetting any category. Involves participants in analyzing the system or the options for scenarios. Contributes to creating a common understanding of a subject. Creates debate.
Resources needed: a facilitator, materials (pencils, brown-paper, flip-charts etc).
Advice: the facilitators should be prepared for the potential results (complete the exercise yourself before the workshop).
Some ideas can be prepared before the workshop as 'starters' to be kept or not by the participants, in order to initiate the working groups.

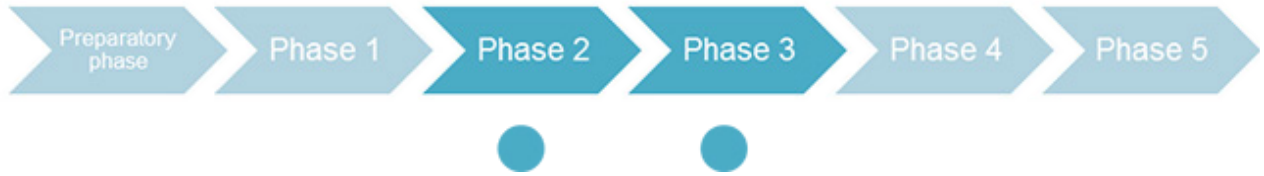
Example of a PESTLE analysis realized to develop exploratory scenarios concerning the adaptation of coastal populations under climate change (IMCORE project developped in the Gulf of Morbihan).

During a workshop, the participants were divided into 3 groups to identify:

- ✓ Group 1: the possible environmental and social changes
- ✓ Group 2: the possible political and legal changes
- ✓ Group 3: the possible technological and economical changes

For each possible change, participants must give a clear indication of the meaning, such as the trend (increase / decrease) or a movement. After about an hour the participants in the working groups share their ideas by writing them on posts-it notes. The facilitator then combines similar proposals and facilitates the discussion to explain the meaning of each idea. The next step is to identify the possible changes as stakeholders classified them on an 'importance/uncertainty' matrix.

BAYESIAN analysis



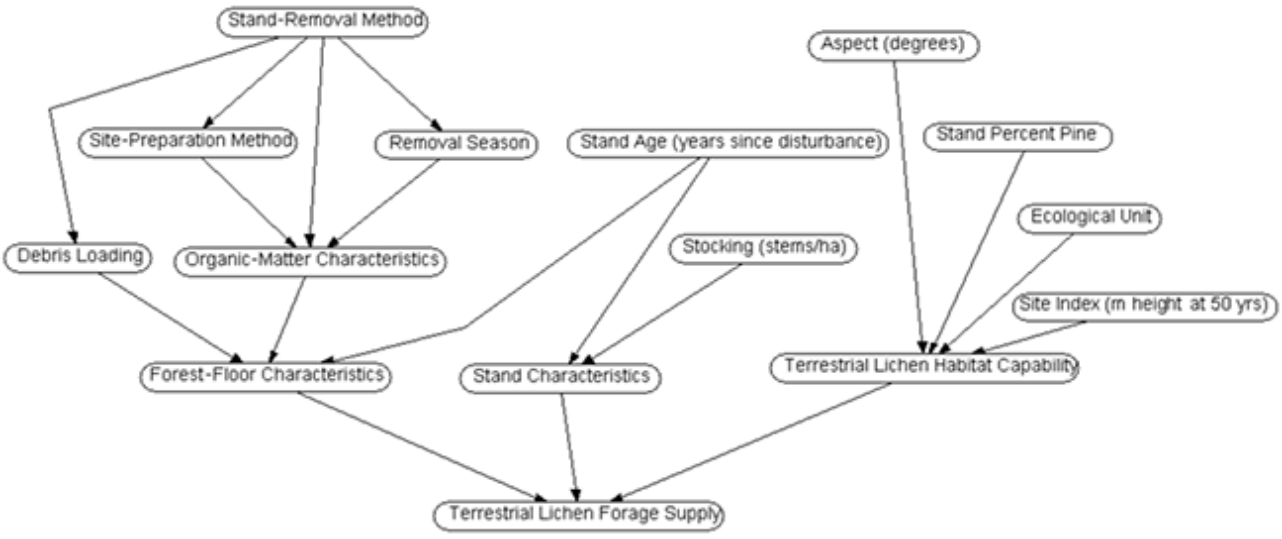
Bayesian belief networks can display correlative linkages and explore causal relations among variables, such as actions on system components and alternative outcomes [Nyberg et al., 2006]. By identifying the system variables or 'nodes', bayesian belief networks can be used to identify those variables that have the greatest influence on outcomes, thus they can focus research or action by decision makers within their management decisions and strategies.

Their ability to represent and communicate different potential outcomes of management options makes them valuable analytical tools for managers.

They have been applied in ecological modelling and natural resource management, for example, to represent species-habitat relationships and population viability and to depict the influence of alternative management activities on key ecological variables to help support researchers and managers, respectively [McCann et al., 2006].

The diagram below depicts various environmental factors and forest management measures upon lichens in British Columbia [Nyberg et al., 2006]:

Bayesian Belief Networks are diagrams depicting influence, constructed graphically as networks of variables and their interactions, referred to as nodes linked with arrows representing a wide range of influences on the system being examined.



Bayesian belief networks allow the structuring of the internal logic of scenarios by using conditional probabilities on the relationships between variables (logical and strength). These conditional probabilities can be gathered through empirical data, stakeholder input, expert judgement or model output. Such networks thus offer a way of combining both quantitative and qualitative data within a single framework, and of expressing the uncertainties associated with the underlying assumptions and the impacts that appear to follow from them.

Bayesian modelling is probabilistic, and therefore, can include data and other sources of information even though either may be incomplete [McNay R.S. et al., 2006]. In general, bayesian belief networks consist of nodes and linkages, where nodes represent environmental correlates, disturbance factors, and response conditions. All nodes are linked by probabilities. Input nodes (the range and environmental prediction variables) contain marginal ('prior') probabilities of their states determined from actual existing conditions; intermediate nodes (e.g., describing attributes of caribou range) contain tables of conditional probabilities based on empirical studies and (or) expert judgment; and output nodes (caribou range values) are calculated as posterior probabilities. Some input nodes, which we refer to as 'management levers,' can represent correlations to the environment that are dynamic either through unmanaged or managed disturbance. These levers can be adjusted based on scenario simulations to estimate management effects during bayesian belief networks applications. [McNay R.S. et al., 2006]

Bayesian belief networks can serve many purposes, from illustrating a conceptual understanding of system relations to calculating joint probabilities for decision options and predicting outcomes of management policies. Nevertheless, when properly used, Bayesian networks can benefit most adaptive-management teams by promoting a shared understanding of the system being managed and encouraging the rigorous examination of alternative management policies. [Nyberg et al., 2006].

Time: this depends on the need or not to develop the network of interactions before running the survey and the choice to run the survey during workshop(s) or on line. Starting from the building of the network of interdependencies for a specific issue and going through an online survey may require 6 to 8 months. The short version: a small expert group to adapt a pre-existing view of the issue and one large workshop to run and interpret the survey can be done in 3-4 months including writing the narrative.
Technical level: 4/4
Advantages: inclusive in terms of engaging experts into the definition of the problem; provides quantitative estimates (probability chains) that can be used to explore alternative pathways towards a given future.

Bayesian belief networks as a tool for researchers and managers can be considered to have considerable merit, in summary they can [McCann et al, 2006]:
- Represent and combine empirical data with experts' understanding of ecological systems;
- Graphically express complex relationships and problems in resource management;
- Address, in a structured way, uncertainties within systems;
- Structure and evaluate alternative decisions within the system;
- Be created and amended with ease;
- Allow flexible use of information, and can be used in both data-rich and data-poor situations, however in the latter case, caution is advised;
- Present complex systems through graphical representation that can be easily understood by various stakeholders, who may not have training in the underlying scientific disciplines, and facilitate important management-related discussions.

Limits: requires some mastering of the approach and methodology to be seriously implemented. Some temporal dynamics and relationships can be difficult to illustrate within a bayesian belief networks; similarly feedback functions cannot always be represented within these models. Models can be easily developed entirely from expert judgement, with an unknown degree of bias and inaccuracy. Where this is the case, judgements need to be recorded to validate the basis for the model's structure. Nodes in the model, for example, should be empirically observable, quantifiable or defensible [McCann et al., 2006].

Resources needed: organize 2 or 3 meetings of small "expert" groups to develop the structure of the problem and questionnaire. The resources required are a meeting facilitator and statistician with knowledge in Bayesian approach; a meeting or online survey to complete the questionnaire; a meeting to run the scenarios. Time must then be allocated for writing the narratives, which will be based on results of the scenarios.

Advice: work with somebody familiar with developing questionnaires for Bayesian statistics and a facilitator familiar with running scenario discussions.

Example of the North Devon case study use of the Bayesian belief networks

Link

https://participatory-assessment.eu/north-devon/

Carnegie Mellon University, Research Showcase, department of Statistics. Bayesian Environmental Policy Decision: two case studies.

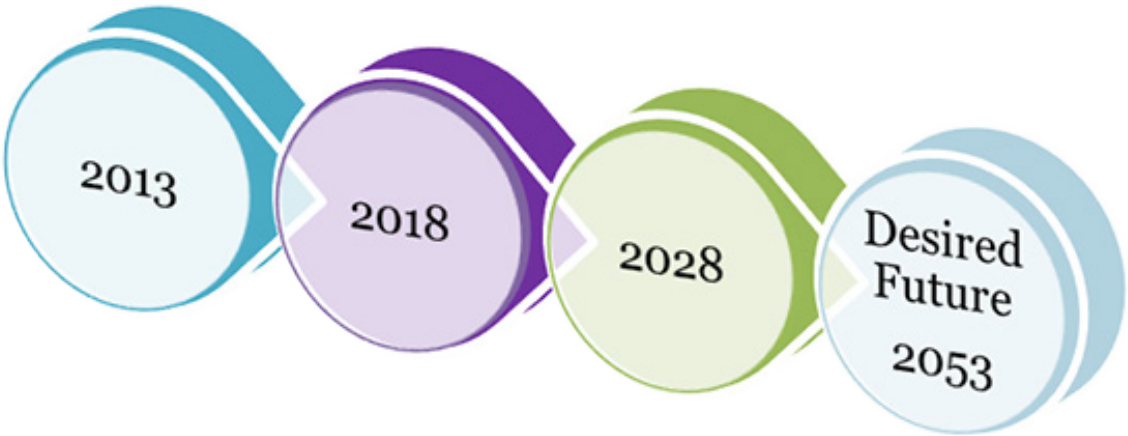
BACKCASTING

The backcasting technique is very useful to develop a normative scenario.

Instead of starting as is usual from the present situation, the backcasting approach takes its starting point from a future situation and designs possible paths back to the present to achieve the desired future. This desired future is described by a text with qualitative and/or quantitative goals.

To do this, the time period until the point in time identified in the future is divided, ideally, into 3 time units of 2, 5 or 10 years. Each time unit corresponds to a step for which it is necessary to identify those things that could prevent reaching the desired future state.

Here, the term 'scenario' covers both the images of the future and the trajectory leading back to the present. The conditions needed to achieve the desired future can be defined during a workshop by asking to stakeholders **'what shall we do today to get there?'**. Thereby, backcasting can be used to test different combinations of policy options that can feature new future conditions. As a participatory process, backcasting can be used to generate debate over alternative and challenging futures [Holmberg and Robert, 2000].



8 steps of a Backcasting exercise employed to build a normative scenario:

1. Describe a desired future

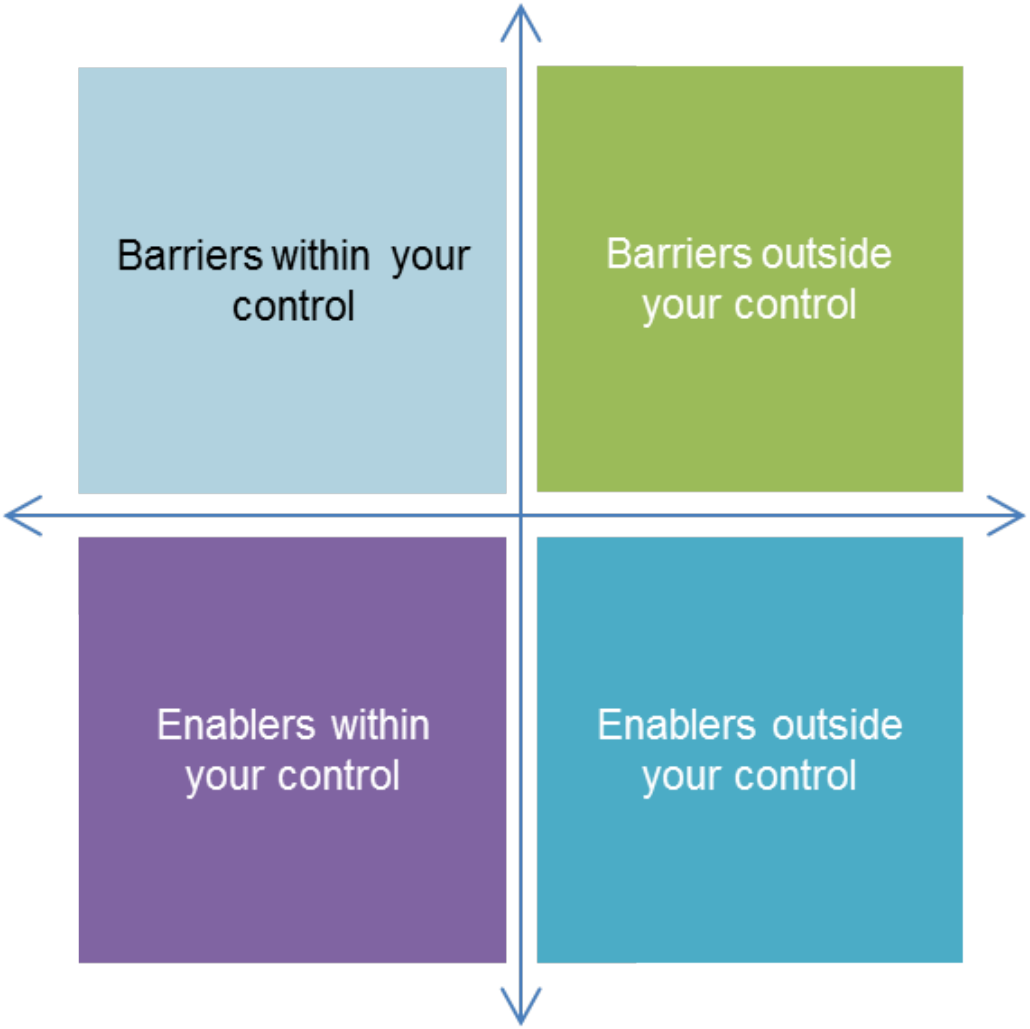
2. Define key differences between the desired future and today

3. Identify key steps and actions needed to achieve the desired future

4. Identify drivers and trends, which could impact on your ability to achieve the desired future

5. Map the drivers and trends onto a 2x2 matrix according to whether they are barriers (to achieving the desired future) or enablers (towards

achieving the desired future); and whether they are in your control or out of your control



6. Discuss what you need to do to ensure that barriers inside your control are minimised and that enablers inside your control are optimised

7. Explore how to get around barriers outside your control

8. Define performance indicators that will help you monitor progress towards your desired future

Time: 4 hours to 1 day
Technical level: 2/4
Advantages: good way to create strategic purpose.
Limits: it may be difficult for participants to plan for the future.
Resources needed: materials (pencils, brown-paper, flip-charts etc).
Advice: conduct a preliminary PESTLE analysis to identify the drivers of change.

Example of backcasting workshop's agenda [While, 2010]

TIME	ACTIVITY
9.30 (15')	Introduction Describe purpose and agenda Confirm the aim of the workshop
09.45 (45')	Describe with stakeholders the desired future through a discussion group What is our vision of success? Capture key points and issues and ensure that everyone agrees
10.30 (30')	Define key differences and describe the key differences between: The actual situation and the desired future Identify the external and internal environments now and in the desired future
11.00 (45')	Identify the key steps to achieving the future Build a timeline between now and the desired future Describe the key events and steps that need to occur to achieve the desired future Map them on the timeline
11.45 (60')	Split into breakout groups Explore the possible trends, drivers and events that might have an impact on the key steps towards delivering the future Capture trends, drivers and events on sticky-notes Map sticky notes on 2x2 matrix according to whether they are barriers (to achieving the preferred vision) or enablers (towards achieving the preferred vision); and whether they are in your control or out of your control
12.45 (60')	Lunch (could be served in the workshop rooms as a buffet to allow further flexibility of schedule and continuation of the drivers mapping)
13.45 (45')	Controlling the future: participants separate into 4 breakout groups: Group 1 focus on barriers in our control: What are they? How will they affect our ability to deliver the desired future? What steps do we need to take to remove them? Group 2 focus on enablers in our control: What are they? How will they affect our ability to deliver the desired future? How do we harness them to strengthen the strategy? Group 3 focus on barriers outside our control: What are they? How will they affect our ability to deliver the desired future? What can we do to minimise their impact? Group 4 focus on enablers outside our control: What are they? How will they affect our ability to deliver the desired future? How can we harness them to strengthen the strategy?
14.30 (30')	Feedback and discussion
15.00 (30')	Next steps / What are they? / To be done when? / By whom?
15.30	Close

Link

Article from the International Journal of Sustainable Development and World Ecology: Backcasting From Non-overlapping Principles – A Framework for Strategic Planning

INVEST

InVEST (Integrated Valuation of Ecosystem Services and Trade-offs) is a framework of 'open source' models for mapping and valuing ecosystem services developed by Natural Capital Project. It currently has 15 models:

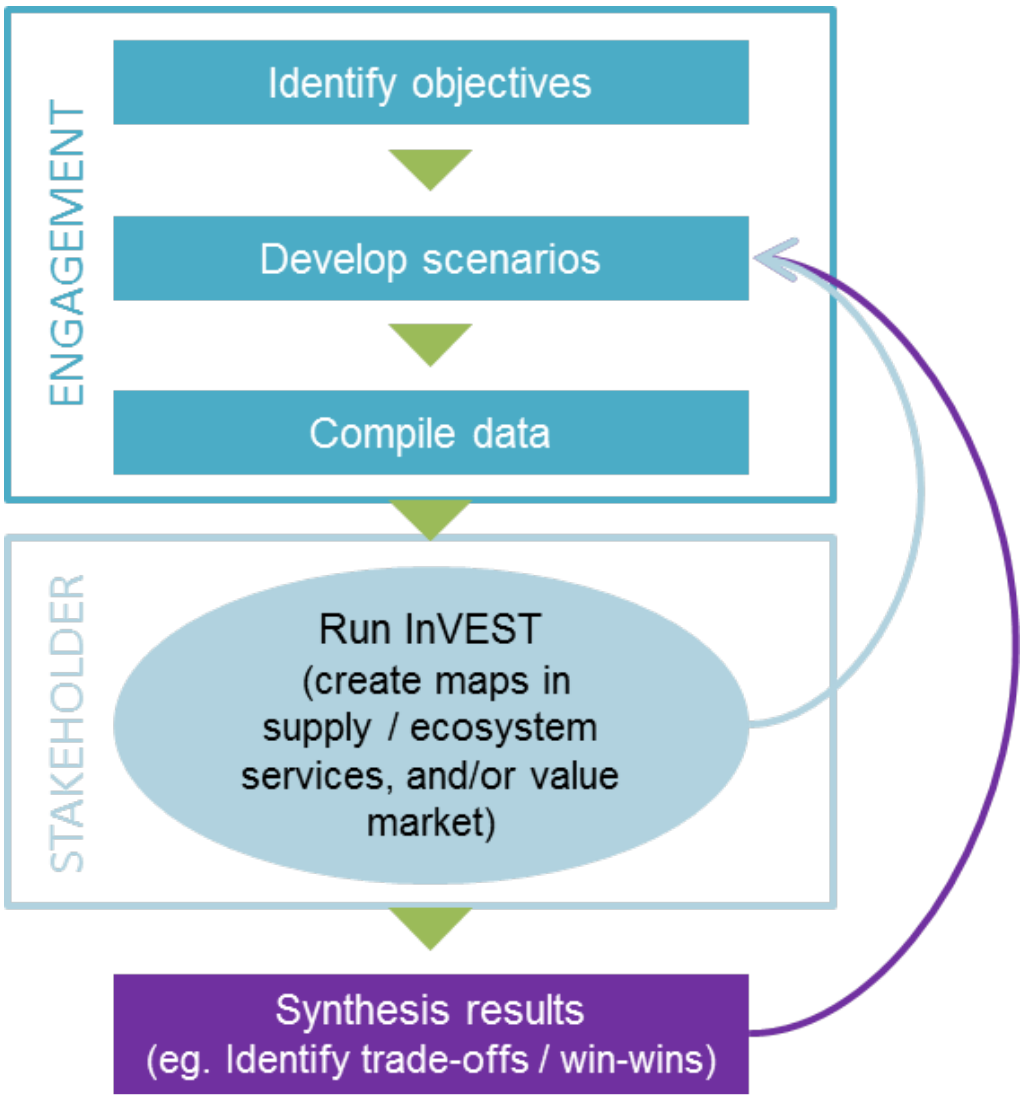
- ✓ Coastal vulnerability
- ✓ Habitat risk assessment
- ✓ Coastal protection
- ✓ Sediment retention
- ✓ Biodiversity
- ✓ Marine fish aquaculture
- ✓ Marine water quality
- ✓ Water quality
- ✓ Wave energy
- ✓ Overlap analysis
- ✓ Aesthetic quality
- ✓ Carbon
- ✓ Crop pollination
- ✓ Managed timber production
- ✓ Reservoir hydropower production

These models are based on production functions that define how an ecosystem's structure and function affect the flows and values of ecosystem services. This allows assessing economic and biophysical consequences of alternative scenarios. The models are coupled with a Geographic Information System (GIS) and produce different outputs: maps, balance sheets and tables. InVEST can be downloaded on: www.naturalcapitalproject.org/.

InVEST is designed to be used as part of a stakeholder engagement process, with stakeholders participating in every step of the process. Stakeholders identify a set of objectives and several alternative management scenarios that may help achieve stated objectives, and the InVEST models estimate the level of ecosystem services produced in each scenario.

The outputs of InVEST can be visualized as maps of ecosystem service delivery, trade-offs, or balance sheets.

After evaluating scenarios with respect to objectives and within the context of local social and cultural values, stakeholders may choose to reiterate the process with newly created scenarios [Guerry et al, 2012].



Time: at least 6 months
Technical level: 4/4
Advantages: downloadable tool; visual outputs.
Limits: availability and quality of data; limited number of models; understanding of the models; communicating model uncertainty.
Resources needed: data; ESRI's ArcGIS software; basic to intermediate skills in ArcGIS.
Advice: install the software and try it with demo data to have a good idea of what it is possible to do with InVEST.

For more information a user's guide is available on:

https://naturalcapitalproject.stanford.edu/software/invest **that explains how to install the software and run InVEST, provides the theory behind each model and describes the input data requirements and how to interpret output results.**

Example of implementation of the InVEST method:

P.Cabral et al, 2014. Marine habitats ecosystem service potential: A vulnerability approach in the Normand-Breton (SaintMalo) Gulf,France. Ecosystem services