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Deliverable DT2.4.1

“Guidelines on environmental management for sustainable MSP”

ABSTRACT

Title: Deliverable DT2.4.1 "Guidelines on environmental management for sustainable MSP"

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Abstract:

The MSP Directive 2014/89/EU establishes a framework for maritime spatial planning aimed at promoting the sustainable growth of maritime economies, the sustainable development of marine areas, and the sustainable use of marine resources. The MSP Directive defines the MSP as a process, by which the relevant Member State's competent authorities analyse and organize human activities in marine areas to achieve ecological, economic, and social objectives within the context of environmental, economic and social aspects applying an ecosystem-based approach including preservation, protection and improvement of the environment as well as resilience to climate change.

According to ISO 31000, the risk management process systematically applies management policies, procedures, and practices to a set of activities intended to establish the context, communicate and consult with stakeholders, and identify, analyse, evaluate, treat, monitor, record, report, and review risk. The *ecosystem risk management framework* developed along the lines of the ISO 31000 risk management standard is enabling the practical implementation of the ecosystem approach to management and is setting the ecosystem-based management context that integrates the risk assessment function within the scope of the implementation of a risk management plan by including the consultation and communication activities as well as reviewing and monitoring requirements as key supporting functions of the ecosystem risk management processes.

Ecosystem-based management of any MSP related environmental issue requires the application of *management measures* designed to eliminate, control, mitigate, or compensate for pressures related to the drivers of human activities to avoid potential environmental effects and targeting in practice the driver-specific pressures to reduce the risk of environmental effects and subsequent impacts on vulnerable ecosystems and environmental services. The objective of ecosystem risk management in the context MSP is to reduce the uncertainties of achieving environmental, social and economic objectives.

The marine ecosystems are increasingly threatened by cumulative effects of multiple human pressures and the Cumulative Effect Assessments (CEAs) are needed to inform environmental policy and guide the *ecosystem risk management* by decreasing complexity, allowing for the transparent treatment of uncertainty and streamlining the uptake of scientific outcomes into the science-policy interface by bridging the gap between science and decision-making in *ecosystem risk management*.

The "Guidelines on environmental management for sustainable MSP" is a general guidance document to planners, decision makers and stakeholders with the aim to improve the *ecosystem risk management* competitiveness and effectiveness of activities existing within the national and transboundary marine jurisdiction while maintaining and improving marine ecosystems resilience, conserving biodiversity and restoring degraded habitats to achieve the MSP related environmental policy objectives. The Guidelines is targeted especially to MSP planners, decision makers and stakeholders with the aim to establish ISO 31000 risk management standard based common understanding and language for evaluating cross-border *ecosystem risk management* options by referring to all phases of MSP - the visioning, planning and implementation including review, monitoring, evaluation, and adaptation.

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1 INTRODUCTION

The MSP Directive 2014/89/EU (EU, 2014) establishes a framework for maritime spatial planning aimed at promoting the sustainable growth of maritime economies, the sustainable development of marine areas, and the sustainable use of marine resources. The MSP Directive defines the MSP as a process, by which the relevant Member State's competent authorities analyse and organize human activities in marine areas to achieve ecological, economic, and social objectives within the context of environmental, economic and social aspects applying an ecosystem-based approach including preservation, protection and improvement of the environment as well as resilience to climate change.

According to Cormier & Kannen (2019) the MSP is about the allocation of spatial and temporal measures to achieve development objectives, the MSP policy context according to ISO 31000 is the development of objectives for the various sectors while the risk assessment is subsequently used to identify the impediments to achieving those objectives. It is proposed (Cormier *et al*., 2015) to structure the MSP process along the various steps of risk assessment ranging from risk identification and risk analysis to risk treatment, with the latter being the step to define the measures (regulatory or technical) to deal with the risks identified and recognized as relevant in the specific planning context.

It is stated (Cormier *et al.*, 2015) that the *ecosystem risk management framework* is developed along the lines of the ISO 31000 risk management standard for the practical implementation of the ecosystem approach to management and setting the ecosystem management context that integrates the risk assessment function within the scope of the implementation of a risk management plan. It is further added that the framework also describes consultation and communication activities as well as reviewing and monitoring requirements as key supporting functions of the ecosystem risk management process.

Referring to ISO 31000 risk management standard it is explained (Cormier & Kannen 2019) that "In summary, 'establishing the context' sets the purpose for the planning process, as well as competencies, capabilities and best practices that will support the planning process. The role of 'risk identification' and 'risk analysis' is to provide clarity and understanding to the perceptions of the risks as to what are the causes that may have an effect on achieving objectives. Based on the 'risk analysis', the role of 'risk evaluation' is to gain an understanding of the severity of risks using criteria and identify which are the risks that are unacceptable in relation to achieving objectives and that will require management guided by precautionary principles. Based on the 'risk evaluation', 'risk treatment' is the selection of management measures in the development and implementation of a management plan to achieve the objectives". It is further specified that the role of 'monitoring and review' and 'communication and consultation' activities will be required to generate the information that will be needed to evaluate the effectiveness of the plan in the future, enabling improvements to the plan adhering to adaptive management principles while the successful environmental management can only be achieved by environmental and compliance monitoring and review.

It is stated (Stelzenmüller *et al*., 2018) that the marine ecosystems are increasingly threatened by cumulative effects of multiple human pressures and the Cumulative Effect Assessments (CEAs) are needed to inform environmental policy and guide ecosystem risk management by decreasing complexity, allowing for the transparent treatment of uncertainty and streamlining the uptake of scientific outcomes into the science-policy interface by bridging the gap between science and decision-making in ecosystem risk management.

The "Guidelines on environmental management for sustainable MSP" is a general guidance document to planners, decision makers and stakeholders with the aim to improve the *ecosystem risk management* competitiveness and effectiveness of activities existing within the national and transboundary marine jurisdiction while maintaining and improving marine ecosystems resilience, conserving biodiversity and restoring degraded habitats to achieve the MSP related environmental policy objectives. The Guidelines is targeted especially to MSP planners, decision makers and stakeholders with the aim to establish ISO 31000 risk management standard based common understanding and language for evaluating cross-border *ecosystem risk management* options by referring to all phases of MSP - the visioning, planning and implementation including review, monitoring, evaluation, and adaptation.

2 ECOSYSTEM RISK MANAGEMENT FRAMEWORK FOR MSP

According to ISO 31000 (2018) the “Risk management refers to a coordinated set of activities and methods that is used to direct an organization and to control the many risks that can affect its ability to achieve objectives. The term risk management also refers to the programme that is used to manage risk. This programme includes risk management principles, a risk management framework, and a risk management process. … a risk management process systematically applies management policies, procedures, and practices to a set of activities intended to establish the context, communicate and consult with stakeholders, and identify, analyse, evaluate, treat, monitor, record, report, and review risk”.

Referring to Cormier and Kannen (2019) the objective of managing the risks in the MSP under development is to reduce the uncertainties of achieving environmental, social and economic objectives once implemented. It is specified further that in risk management, the spatial and temporal allocations of a MSP should reduce the uncertainties of achieving development and conservation objectives.

Based on analysis of various ecosystem risk assessment and risk management frameworks, the ISO 31000:2009 was recently linked to the ecosystem risk management approach (Cormier *et al.* 2013) (Figure 2.1).

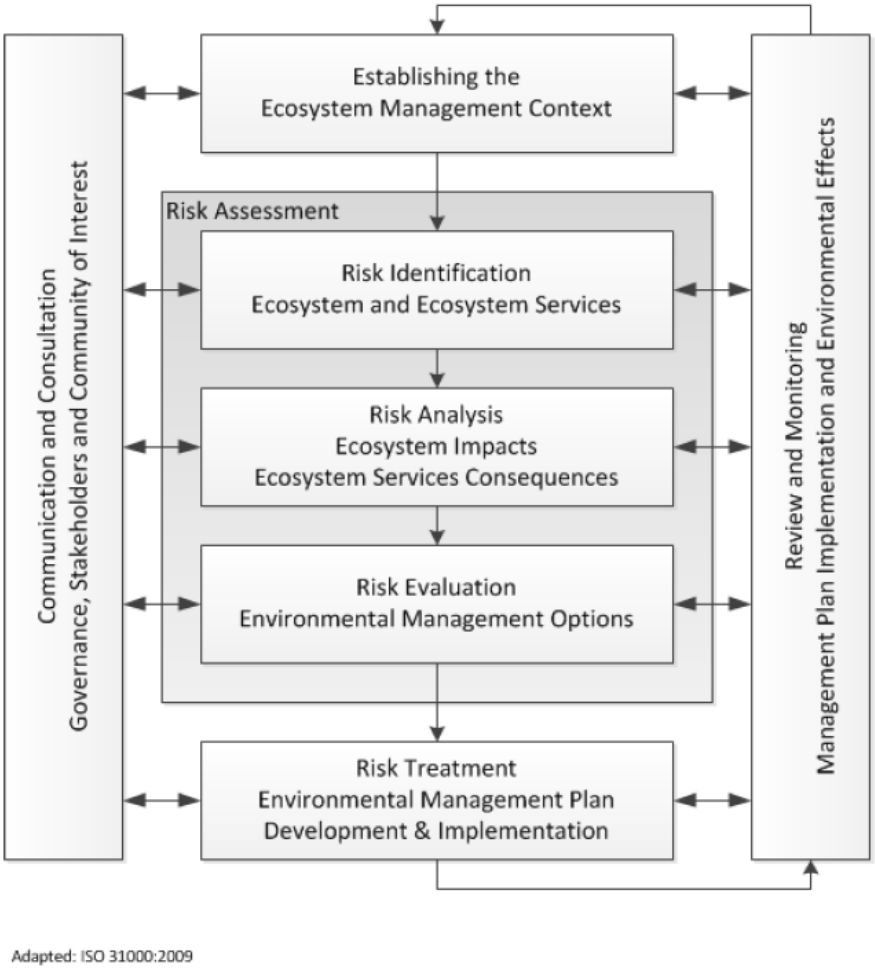

Figure 2.1. Ecosystem risk management framework adapted from ISO 31000:2009 risk management standard (Cormier *et al*., 2013).

2.1 Establishing the ecosystem risk management context

Rationale

ISO 31000 (2018) stipulates that "To establish the context means to define the external and internal parameters that organizations must consider when they manage risk. An organization's external context includes its external stakeholders, its local, national, and international environment, as well as any external factors that influence its objectives. An organization's internal context includes its internal stakeholders, its approach to governance, its contractual relationships, and its capabilities, culture, and standards".

It is stated (Cormier *et al*., 2015) that "In MSP, the *external context* starts with the public policy agendas that scopes or frames present and future economic development aspirations and ecosystem protection and conservation goals. Based on the public policy agenda, it establishes the competent authorities that have relevant legislative and policies needed for the planning process, industry stakeholders that will be implicated in the design of the spatial and temporal management measures of the plan as well as the communities that have vested interest in the protection and conservation of the environment or valued ecosystem services. The current public policy context ensures that the scope and objectives of the planning initiative is in line with public development and environmental aspirations and goals." It is further added that the geographical boundaries of the ecosystem and zone of influence of the drivers are used to define the management area and the scope of the potential environmental effects to be assessed and the *risk criteria* to be established when the planning process is initiated.

The management area defines the type of governance structure required to address the multijurisdictional partnership management requirements as well as affected stakeholders and public policy communications (Cormier *et al*., 2013). It is further specified that the *external context* is also considered in terms of key drivers and trends that affect the planners and stakeholders, as well as cultural, social, political, financial, technological, and economic factors that can affect the assessment, whereas the *ecosystem risk management internal context* includes the planners' capacities and culture.

Implementation

- Provide inventory of the public policy agendas that scopes or frames present and future economic development aspirations and ecosystem protection and conservation goals.
- Identify the scope and objectives of the planning initiative and establish the ecosystem risk criteria.
- Identify the competent authorities that have relevant legislation and policies needed for the planning process.
- Identify the industry stakeholders that will be implicated in the design of the spatial and temporal management measures of the plan.
- Identify the communities that have vested interest in the protection and conservation of the environment or valued ecosystem services.
- Define geographical boundaries of the ecosystem and zone of influence of the drivers.
- Define the management area and the scope of the potential environmental effects to be assessed.
- Define the key drivers and trends that affect the planners and stakeholders, as well as cultural, social, political, financial, technological, and economic factors that can affect the assessment.

2.2 Ecosystem risk assessment

ISO 31000 (2018) stipulates that "*risk assessment* is a process that is made up of three separate processes: risk identification, risk analysis, and risk evaluation".

Referring to Cormier & Kannen (2019) in planning, assessments have to be conducted to identify the concerns that can be addressed by a marine spatial plan and the concerns that should be addressed by other management regimes to inform the planner and the stakeholders as to their concerns. It is further stated that the outcomes of the spatial and temporal allocations being considered also has to be assessed to evaluate which can best address the objectives of the plan.

It is specified (Cormier *et al.*, 2013) that in environmental management context the risk assessment characterizes the likelihood of an environmental effect event, the severity of the ecological, social, cultural, and economic impacts, and the legislative and policy implications being the key to informing management of the need to implement management strategies and measures. It is added that risk assessment does not make the decision, but sets the risks within the context of potential consequences and management options for consideration to achieve the policy objectives.

2.2.1 Ecosystem risk identification

Rationale

Referring to ISO 31000 (2018) the risk identification is a "… process that involves finding, recognizing, and describing the risks that could influence the achievement of objectives. It is used to identify possible sources of risk in addition to the events and circumstances that could influence the achievement of objectives. It also includes the identification of possible causes and potential consequences".

It is stated (Cormier *et al.*, 2013) that risk identification sets the ecosystem basis for the risk management process in terms of ecological vulnerabilities that support significant environmental services and the key output of risk identification is an *environmental vulnerability profile* that is then used to prioritize the activities of the risk analysis. It is further added that not predicting where or when effects and impacts would occur, it establishes the spatial and temporal degree to which ecosystem components and environmental services are vulnerable to an environmental effect event, given the co-occurrence of the driver and pressures in the zone of influence.

As an example, the *environmental vulnerability spatial profiles* are presented in the Figure 2.2.1.

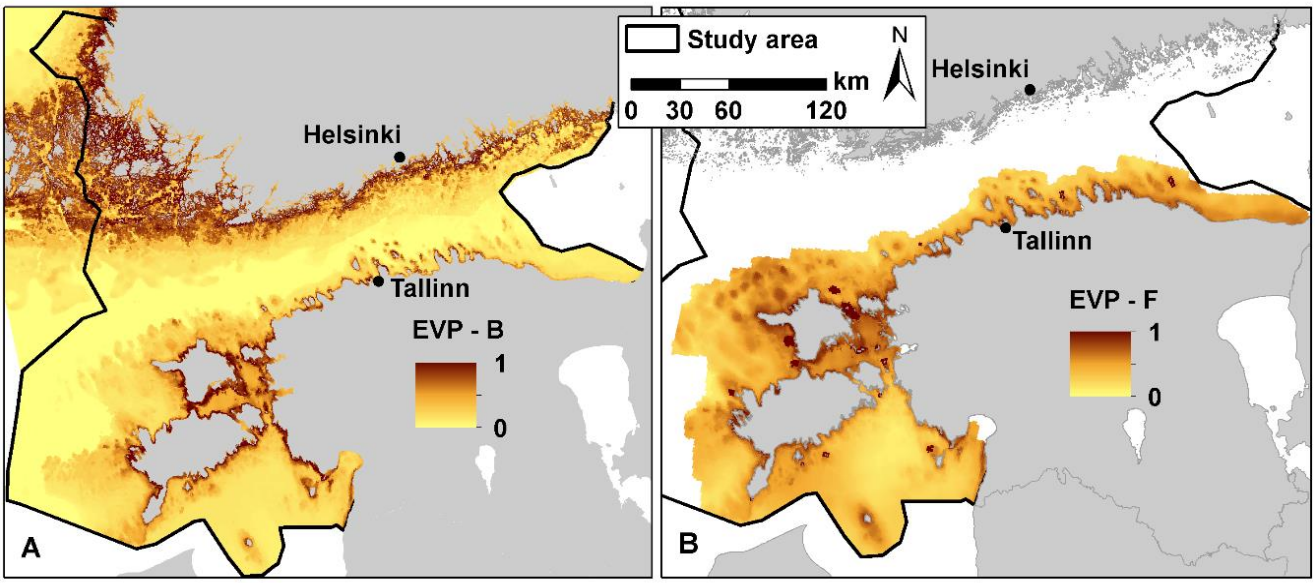

Figure 2.2.1 Environmental vulnerability spatial profile based on benthic nature values (EVP-B) and B – environmental vulnerability profile including benthic nature values, birds and seals (EVP-F) in Estonian sea waters. Values vary between 0 and 1, where 1 expresses the highest vulnerability (Aps *et al.*, 2018)

According to (Cormier *et al.*, 2015) the MSP process has to identify all relevant *risk sources* and related *events* resulting from the activities of the drivers operating in the management area in terms of operational events (e.g., encroachment, health and safety), and environmental events (e.g., changes in sedimentation, nutrient, pollution effects). It is added that based on the risk *sources*, the *causes* of the *event* and the resulting *consequences* are also identified in terms of ecological, cultural, social, economic *consequences* and legal repercussions in terms of operational and environmental management expected outcomes and objectives. It is further specified that the results of the risk identification is the *environmental cumulative risk spatial profile* which is the input to the *risk*

analysis that will estimate likelihoods and magnitudes for all risks identified. As an example, the environmental *cumulative risk spatial profiles* are presented in the Figure 2.2.2.

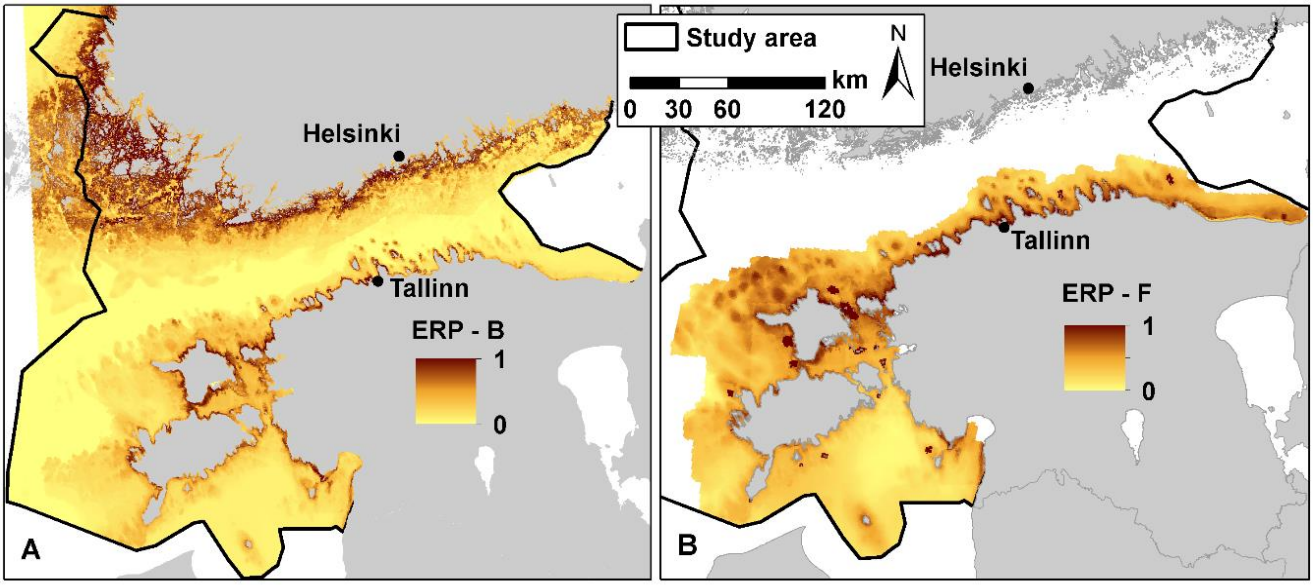

Figure 2.2.2 Environmental cumulative risk profile based on benthic nature values (ERP-B) and B – environmental risk profile that including benthic nature values, birds and seals (ERP-F) in Estonian waters. Risk values vary between 0 and 1, where 1 expresses the highest risk value (Aps *et al.*, 2018)

Implementation

- Identify all relevant *risk sources* and related *events* resulting from the activities of the drivers operating in the management area in terms of operational and environmental events.
- Identify the *causes* of the *events* and the resulting *consequences* in terms of ecological, cultural, social, economic *consequences.*
- Identify the *causes* of the *event* and the resulting *consequences* legal repercussions in terms of the operational and environmental management expected outcomes and objectives.
- Establish the scientific and technical advisory processes as well as communication and consultation processes with stakeholders.
- Compile for the management area the *environmental vulnerability profile* and *environmental cumulative risk profile* as an input to the *ecosystem risk analysis* estimating likelihoods and magnitudes for all risks identified.

2.2.2 Ecosystem risk analysis

Rationale

ISO 31000 (2018) defines the risk analysis as "… a process that is used to understand the nature, sources, and causes of the risks that you have identified and to estimate the level of risk. It is also used to study impacts and consequences and to examine the controls that currently exist". It is further defined that "A consequence is the outcome of an event and has an effect on objectives. A single event can generate a range of consequences which can have both positive and negative effects on objectives. Initial consequences can also escalate through cascading and cumulative effects".

It is specified (Cormier *et al.*, 2015) that in MSP, risk analysis is used to determine the likelihood of the *operational events* and the magnitude of the *consequences* resulting from the conflicts of the activities of the drivers operating in the management area as well as the likelihood of the *environmental events* and the magnitude of the *consequences* resulting from the activities of the drivers operating within the boundaries of the ecosystem. It is argued that depending on the availability of data and information, *risk analysis* can be qualitative (based on "best professional judgement"), semi-quantitative or quantitative, or a combination of these depending on the risk sources, the *events* they may *cause*, and the *consequences* of the *events*. Finally, it is further added that building upon the *risk profile*, the results of the *environmental cumulative risk analysis* are presented as the *environmental*

cumulative risk matrix which is the input to *risk evaluation* that will ascertain the severity of the risks and determine if they are either managed adequately or need enhanced or additional management.

According to an example of *environmental cumulative risk matrix* implementation (ICES, 2014), a scientific review panel would conduct an ecological risk assessment to estimate the likelihood and magnitude of a cumulative effect and their impacts related to the existing management measures (I), of the preventive management option (P) and of the mitigation management option (M) being considered (Figure 2.2),

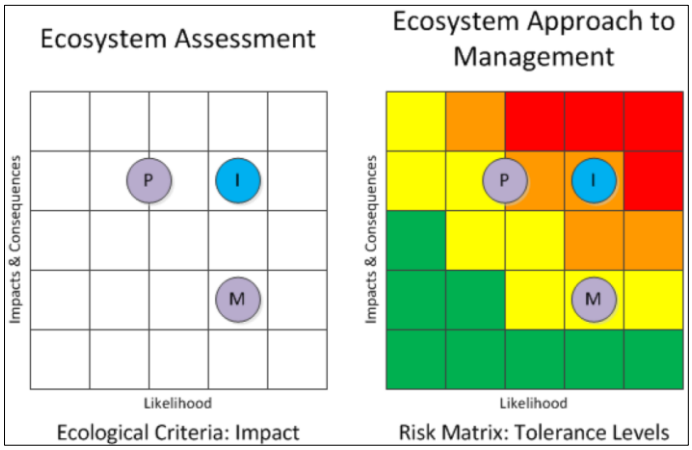

Figure 2.2.3 Risk criteria to defining the resulting severity of the management options under considerations versus the environmental cumulative risk matrix showing the management options against the tolerance criteria for decision-making (ICES, 2014).

Implementation

- Determine the likelihood of the *operational events* and the magnitude of the *consequences* resulting from the conflicts of the activities of the drivers operating in the management area.
- Determine the likelihood of the *environmental events* and the magnitude of the *consequences* resulting from the activities of the drivers operating within the boundaries of the ecosystem.
- Building upon the *environmental cumulative risk profile*, present the results of *environmental cumulative risk analysis* as an *environmental cumulative risk matrix* which is the input to *risk evaluation* that will ascertain the severity of the risks and determine if they are either managed adequately or need enhanced or additional management.

2.2.3 Ecosystem risk evaluation

Rationale

Risk evaluation is defined by ISO 31000 (2018) as "… a process that is used to compare risk analysis results with risk criteria in order to determine whether or not a specified level of risk is acceptable or tolerable".

It is argued (Cormier *et al.,* 2013) that the risk evaluation is a key decision step of risk assessment where the competent authority has to make a decision regarding the need for management action in consultation with jurisdictional partners, stakeholders, and public policy direction in light of public perception whereas the *environmental risk profile* provides the most up-to-date knowledge of the risks of environmental effects, causes, and consequences, and plays a key role in informing the decision-making process.

The purpose of the risk evaluation in MSP is to inform and support the consultation and decision-making processes in deciding which risks will need to be addressed by the marine spatial plan including the implementation priorities and comparing the level of risk found during the *environmental risk analysis* with risk criteria established when the planning process was initiated (Cormier *et al.,* 2015). At that the *Bowtie analysis* (Figure 2.2.4) and the *environmental cumulative risk matrix* (Figure 2.2.3) are used as the tools to evaluate the *environmental cumulative risk management measures* and make decisions as to risks that should be managed as well as to risks that cannot be managed. It is added further that the *Bowtie* and the *risk matrix* become the *risk register* of those

management measures related decisions showing which risk should be managed and how should it be managed in the marine spatial plan. Finally, the *risk evaluation* can identify the need for further analysis as well as further consultation or advisory processes.

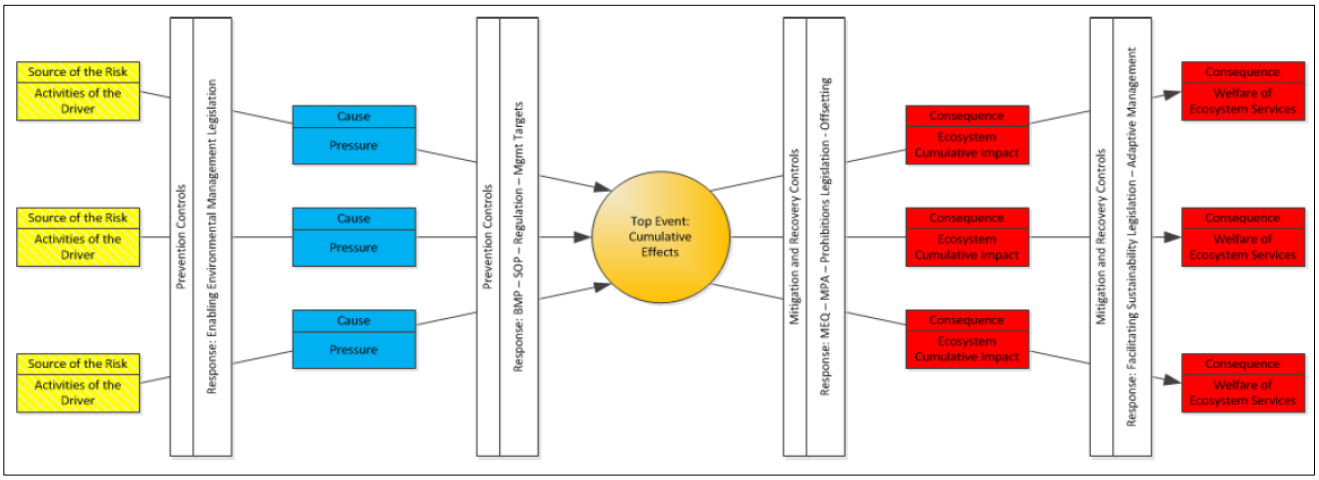

Figure 2.2.4 Bowtie analysis conceptual framework (ICES, 2014).

Referring to ICES (2014) the "Bowtie analysis appears to be a helpful method and instrument for structuring varied and multi-faceted information. It coherently brings together information from different disciplines and different levels into a transparent, logical and defendable framework. This is important in the MSP context which necessitates the cooperation of different disciplines operating at different scales and levels (e.g. local-regional-international-ecosystem scales; operational-tactical-strategic levels)". It is added that the Bowtie analysis can be used to identify scientific and technical knowledge gaps and research needs as well as to provide the basis for environmental monitoring and compliance surveillance.

The Bowtie analysis is a part of the ISO 31000 risk management standard which includes frameworks and vocabulary and integrates the risk assessment function within the context of the risk management process, supported by communication and consultation as well as monitoring and review.

The cumulative effects assessment (CEA) is defined (Judd *et al*. 2015) as a "systematic procedure for identifying and evaluating the significance of effects from multiple sources/activities and for providing an estimate on the overall expected impact to inform management measures". It is further specified that the analysis of the causes (source of pressures and effects), pathways and consequences of these effects on receptors is an essential and integral part of the process.

It is stated (Stelzenmüller *et al.,* 2018) that the marine ecosystems are increasingly threatened by the cumulative effects of multiple human pressures and CEAs are needed to inform environmental policy and guide ecosystem-based management. It is argued further that the risk-based approach to CEAs decreases complexity, allows for the transparent treatment of uncertainty and streamlines the uptake of scientific outcomes into the science-policy interface by bridging the gap between science and decision-making in ecosystem-based management.

Implementation

- Compare, based on *environmental cumulative risk matrix*, the level of risk found during the *environmental cumulative risk analysis* with *risk criteria* established when the planning process was initiated.
- Evaluate the *environmental cumulative risk management measures* and make decisions as to risks that should be managed as well as to risks that cannot be managed.
- Create and use the Bowtie and the *environmental cumulative risk matrix* based *risk register* of those management measures related decisions showing which risk should be managed and how should it be managed in the marine spatial plan.
- Based on *environmental cumulative risk evaluation* identify the need for further analysis as well as further consultation or advisory processes.
- Identify potentially significant impacts of the MSP related individual *environmental cumulative risk management measures* in combination or cumulatively with other *environmental cumulative risk management*

measures concerned in order to assist marine planners and stakeholders in ensuring that environmental capacity will not be exceeded.

2.3 Ecosystem risk treatment

Rationale

ISO 31000 (2018) stipulates that the "Risk treatment is a risk modification process. It involves selecting and implementing one or more treatment options. Once a treatment has been implemented, it becomes a control or it modifies existing controls". It is specified further that "A control is any measure or action that modifies or regulates risk. Controls include any policy, procedure, practice, process, technology, technique, method, or device that modifies or regulates risk. Risk treatments become controls, or modify existing controls, once they are implemented".

In MSP, risk treatment involves the review of the *environmental cumulative risk management measures* identified in risk evaluation and documented in the *risk register* (Cormier *et al.,* 2015). At that, it is the processes of developing spatial and temporal management measures considering the costs, benefits and feasibilities of implementation. It is added that the *environmental cumulative risk management measure* can eliminate the risks by controlling a driver's access to the management area, can change the likelihood of the events by controlling the activities of the drivers operating in the management area, or, can change the magnitude or extent of the impacts, consequences or repercussions by mitigating the effects of the event, if it occurs. It should be noted that there could be cases that management measures other than spatial and temporal measures may be needed to address some of the risks.

For each option, *environmental cumulative risk management measures cost–benefit analysis* is conducted to identify the most effective measures for reducing the risk of environmental effects events, whereas remaining feasible to implement under existing legislation, technological knowledge, economic-sector capacity, and stakeholder engagement including governance and economic-sector implementation, administration, and operations (Cormier *et al.,* 2013). It is argued further that the benefits include the effectiveness of the *management measure* to eliminate, control, or mitigate the risks of environmental effects whereas the m*anagement measure* analysis also plays an important role in simulating potential impacts of management options in relation to the ecosystem management outcomes.

Given that a *cost-benefit assessment* of the environmental management has to indicate viability and sustainability, there are communities of interest that depend on ecosystem services that provide resources for their economic viability and their participation and feedback provides insight and advice as to the protection and access related to the ecosystem services of concern (Cormier *et al*., 2015). It is added that a cost-benefit assessment of the environmental management has to indicate viability and sustainability while the economists and policy analyst contribute knowledge and advice as to the costs and benefits of the management measures as well as the potential economic losses resulting from the risks to economic ecosystem services and the potential conflicts between the drivers that should be considered during the planning process.

According to DEFRA (2007) the use of ecosystem services as a framework for valuation presents important opportunities to incorporate a wider range of environmental impacts in policy appraisal work in the future. It is further suggested that in the context of *cost-benefit analysis*, typically, the changes in the value of ecosystem services between the baseline option (no change) and the other policy options would be assessed focusing on identifying changes in ecosystems and the provision of ecosystem services resulting from policy options and valuing these changes rather than giving an assessment of all services currently provided by the ecosystems in question. In a regulatory implementation context, a regulatory impact assessment may also be needed as stipulated by the OECD (https://www.oecd.org/regreform/regulatory-policy/ria.htm).

It is suggested (Cormier *et al.,* 2015; Cormier & Kannen, 2019) to use the *10-tenets of adaptive environmental management and sustainability* (Barnard & Elliott, 2015) as the MSP related environmental management Quality Objectives. Accordingly, the environmental management measures should be: *1) Environmentally / ecologically sustainable, 2) Technologically feasible, 3) Economically viable, 4) Socially desirable/tolerable, 5) Legally permissible, 6) Administratively achievable, 7) Politically expedient, 8) Ethically defensible, 9) Culturally inclusive, and 10) Effectively communicable*. The environmental management Quality Objectives are addressed by the maritime spatial planning process in consultation with competent authorities, industry stakeholders and communities of interest with aim to ensure the adequate integration of the ecological and socio-economic objectives and legislative requirements.

As stated by Barnard & Elliott (2015) initially the sustainability of a proposed development may be assessed by considering how well the tenets are addressed by the *activities* associated with the proposed development and, subsequently, proposed management measures (*responses*) can be assessed against the tenets. It is further specified that more objective and practical application of the 10-tenets requires the development of a quantitative scoring system for recording value judgements of compliance against each tenet to provide a composite assessment of the overall level of sustainability associated with a given development.

Implementation

- Review the *environmental cumulative risk management measures* identified in risk evaluation and documented in the *risk register*.
- Conduct the *cost–benefit analysis* of the *environmental cumulative risk management measures* concerned to identify the most effective measures for reducing the risk of environmental effects events, while remaining feasible to implement under existing legislation, technological knowledge, economic-sector capacity, and stakeholder engagement including governance and economic-sector implementation, administration, and operations.
- In the context of *cost-benefit analysis* assess the changes in value of significant ecosystem services between the baseline option (no change) and the other management options to ensure that the ecosystem features and functioning and the fundamental and final ecosystem services are safeguarded.
- Apply the *10-tenets of adaptive environmental management and sustainability* as the Maritime Spatial Planning related environmental management Quality Objectives by assessing against the tenets the *activities* associated with the proposed development and, subsequently, proposed management measures (*responses*).
- Develop and apply a quantitative scoring system for recording value judgements of compliance against each *tenet of adaptive environmental management and sustainability* to provide a composite assessment of the overall level of sustainability associated with a given development.

2.4 Review and monitoring

Rationale

Referring to ISO 31000 (2018) “A review is an activity. Review activities are carried out in order to determine whether something is a suitable, adequate, and effective way of achieving established objectives. In general, ISO 31000 2018 expects you to review your risk management framework and your risk management process. It specifically expects you to review your risk management policy and plans as well as your risks, risk criteria, risk treatments, risk management controls, residual risks, and your risk assessment process”. The ISO 31000 2018 stipulates that “… to monitor means to supervise and to continually check and critically observe. It means to determine the current status and to assess whether or not required or expected performance levels are being achieved”.

Scientific and policy–advisory processes *play a key review role* in setting risk criteria, defining the ecological basis for management, and assessing the risks and management options including the functions of the competent authority and the operational aspects of managing the process and management plan implementation (Cormier *et al.,* 2015). It is further explained that in MSP, the *review and monitoring* processes should encompass all aspects of the maritime spatial plan implementation, objectives, scientific assumptions, and expectations of the competent authorities, industry stakeholders, and communities of interest whereas periodic reviews and evaluations are needed to analyse the information and knowledge being generated by the various monitoring activities to determine if changes are needed to the maritime spatial plan.

It is stated (Cormier *et al.*, 2015) that each of the *10-tenets of adaptive environmental management and sustainability* should have some form of monitoring as a means to tracking changes in objectives or policies, changes in the industry sectors operating within the management area, changes in the values that communities may have as well as new knowledge being generated by scientific research. It is further elaborated that from the management perspective of the specific spatial and temporal management measures of the maritime spatial plan, monitoring activities should be designed to ascertain the performance of the plan in terms of the compliance of implementation, operational feasibility of the measures and effectiveness of the plan in achieving both development and environmental objectives (Cormier & Kannen, 2019).

Implementation

- Establish the *review and monitoring* processes that are encompassing all aspects of the maritime spatial plan implementation, objectives, scientific assumptions, and expectations of the competent authorities, industry stakeholders, and communities of interest.
- Conduct periodic reviews and evaluations to analyse the information and knowledge being generated by the various monitoring activities to determine if changes are needed to the maritime spatial plan.
- Apply the *10-tenets of adaptive environmental management and sustainability* as a means to tracking changes in objectives or policies, changes in the industry sectors operating within the management area, changes in the values that communities may have as well as new knowledge being generated by scientific research.
- Conduct monitoring activities designed to ascertain the performance of the plan in terms of the compliance of implementation, operational feasibility of the measures and effectiveness of the plan in achieving both development and environmental objectives.

2.5 Communication and consultation

ISO 31000 (2018) stipulates that "Communication and consultation is a dialogue between an organization and its stakeholders. This dialogue is both continual and iterative. It is a two-way process that involves both sharing and receiving information about the management of risk. However, this is not joint decision making. Once communication and consultation is finished, decisions are made and directions are set by the organization, not by stakeholders. Discussions could be about risks, their nature, form, likelihood, and significance, as well as whether or not risks are acceptable or should be treated, and what treatment options should be considered".

Referring to Elliott (2014) the governance and decision-making in MSP relies on *extensive communication and consultation processes* carried out throughout the entire planning process and also after implementation of the plan. Risk communication is primarily the engagement and consultation function of the ecosystem-based, risk management process developed early in the planning stages and being the key quality assurance step ensuring that regulators, stakeholders, and the public are informed and consulted as the process moves forwards (Cormier *et al.*, 2013).

As suggested by Barnard and Elliott (2015) the *10-tenets of adaptive environmental management and sustainability* provide one holistic framework and criteria for understanding and managing the socio-ecological system. Importantly, these tenets outline the *type of stakeholder consultation and feedback* as well as scientific and technical advice needed to ensure that any maritime spatial plan addresses the objectives, concerns and expectation of the parties involved and is implementable along existing legislative and administrative realities (Cormier & Kannen, 2019).

Newton and Elliott (2016) suggest the following inclusive definition that is relevant in a marine management context: "… a stakeholder is a person, organisation or group with an interest (professional or societal) or an influence on the marine environment or who is influenced directly or indirectly by activities and management decisions." It is further specified that "Those creating the pressures in the sea are the '*inputters*' (of pollution, infrastructure, sediment, etc.) and '*extractors*' (of fish, water, space) who then are regulated by the '*regulators'*, those statutory bodies with a legislative competency, supported by administrative bodies and given that competency by a very large number of legal instruments (e.g., Boyes & Elliott, 2014; 2015). Those who take or receive advantage of those uses and materials provided by the seas or even who get advantage by reducing their costs due to putting wastes into the seas, are termed '*beneficiaries'*, a group that contains most if not all of society. Next, there is a large group of stakeholders that are affected, possibly adversely, by those using and managing the seas, for want of a better term and in keeping with the labels for the other types the sea are called '*affectees'*. Finally, there are the '*influencers'*, those politicians, non-governmental organizations, media, academics, and educators who play a part in directing the nature of marine use". It is further argued that stakeholder engagement and involvement is the basis of a participatory process and is fundamental to acceptance of management actions and by definition the process is not participatory if stakeholders are not involved (Cormier *et al*., 2019).

It is stated (Cormier *et al.*, 2013) that the risk communication is primarily the engagement and consultation function of the ecosystem risk management process taking into account the audience involving the scientific experts to ensure credibility of the sources and analysis of information and differentiating between science-based facts and value judgments, and puts the risks into perspective to address the perceptions of risk.

External communication and consultation should take place throughout the planning process to acquire an understanding of the inherent risks of the management area, including an understanding of the causes, the consequences, and the measures to manage those while external participants such as other competent authorities, industry stakeholders, and communities of interest have to ensure that those accountable for implementing the maritime spatial plan understand the sustainable development basis upon which decisions were made during the planning process and the reasons for particular management measures of the maritime spatial plan being implemented (Cormier *et al*., 2015). It is added that internal participants such as planning staff, scientific personnel, and technical advisory bodies must also have the same understanding of the risks involved to ensure that advisory processes are timely and relevant to the questions at hand.

Implementation

- Establish *extensive communication and consultation processes* carried out throughout the entire planning process and also after implementation of the plan.
- Develop and apply the *engagement and consultation* processes of the ecosystem risk management taking into account the audience involving the scientific experts to ensure credibility of the sources and analysis of information while differentiating between science-based facts and value judgments.
- Apply the *10-tenets of adaptive environmental management and sustainability* to define the *type of stakeholder consultation and feedback* as well as scientific and technical advice needed to ensure that any maritime spatial plan addresses the objectives, concerns and expectation of the parties involved and is implementable along existing legislative and administrative realities.

As stipulated by ISO 31000, all these implementation activities generate the information that will be needed to evaluate the effectiveness of the plan in the future, enabling improvements to the plan adhering to adaptive management principles while the successful environmental management can only be achieved by environmental and compliance monitoring and review (Cormier & Kannen, 2019).

3 EXECUTIVE SUMMARY

The MSP Directive 2014/89/EU (EU, 2014) establishes a framework for maritime spatial planning aimed at promoting the sustainable growth of maritime economies, the sustainable development of marine areas, and the sustainable use of marine resources. The MSP Directive defines the MSP as a process, by which the relevant Member State's competent authorities analyse and organize human activities in marine areas to achieve ecological, economic, and social objectives within the context of environmental, economic and social aspects applying an ecosystem-based approach including preservation, protection and improvement of the environment as well as resilience to climate change.

It is stated (Cormier *et al*., 2015) that the *ecosystem risk management framework* is developed along the lines of the ISO 31000 (2018) risk management standard for the practical implementation of the ecosystem approach to management and setting the ecosystem management context that integrates the risk assessment function within the scope of the implementation of a risk management plan. It is further added that the framework also describes consultation and communication activities as well as reviewing and monitoring requirements as key supporting functions of the ecosystem risk management process.

Referring to ISO 31000 2018 risk management standard it is explained (Cormier & Kannen, 2019) that "In summary, 'establishing the context' sets the purpose for the planning process, as well as competencies, capabilities and best practices that will support the planning process. The role of 'risk identification' and 'risk analysis' is to provide clarity and understanding to the perceptions of the risks as to what are the causes that may have an effect on achieving objectives. Based on the 'risk analysis', the role of 'risk evaluation' is to gain an understanding of the severity of risks using criteria and identify which are the risks that are unacceptable in relation to achieving objectives and that will require management guided by precautionary principles. Based on the 'risk evaluation', 'risk treatment' is the selection of management measures in the development and implementation of a management plan to achieve the objectives". It is further specified that the role of 'monitoring and review' and 'communication and consultation' activities will be required to generate the information that will be needed to evaluate the effectiveness of the plan in the future, enabling improvements to the plan adhering to adaptive management principles while the successful environmental management can only be achieved by environmental and compliance monitoring and review.

It is stated (Stelzenmüller, 2018) that the marine ecosystems are increasingly threatened by cumulative effects of multiple human pressures and the Cumulative Effect Assessments (CEAs) are needed to inform environmental policy and guide ecosystem-based risk management by decreasing complexity, allowing for the transparent treatment of uncertainty and streamlining the uptake of scientific outcomes into the science-policy interface by bridging the gap between science and decision-making in ecosystem-based risk management.

The "Guidelines on environmental management for sustainable MSP" is a general guidance document to planners, decision makers and stakeholders with the aim to improve the *ecosystem-based* risk management competitiveness and effectiveness of activities existing within the national and transboundary marine jurisdiction while maintaining and improving marine ecosystems resilience, conserving biodiversity and restoring degraded habitats to achieve the MSP related environmental policy objectives.

The Guidelines is targeted especially to MSP planners, decision makers and stakeholders with the aim to establish ISO 31000 risk management standard based common understanding and language for evaluating cross-border ecosystem-based risk management options by referring to all phases of MSP - the visioning, planning and implementation including review, monitoring, evaluation, and adaptation.

"Guidelines on environmental management for sustainable MSP" is structured according to ecosystem risk management framework adapted from ISO 31000:2009 risk management standard (Figure 3.1). The Guidelines is providing the users with "Rationale" of the ecosystem risk management framework interrelated elements and is suggesting the "Implementation" tasks for the practical realisation of the ecosystem approach to management by setting the ecosystem-based management context that integrates the risk assessment function within the scope of the implementation of a risk management plan by including the consultation and communication activities as well as reviewing and monitoring requirements as key supporting functions of the ecosystem-based risk management processes.

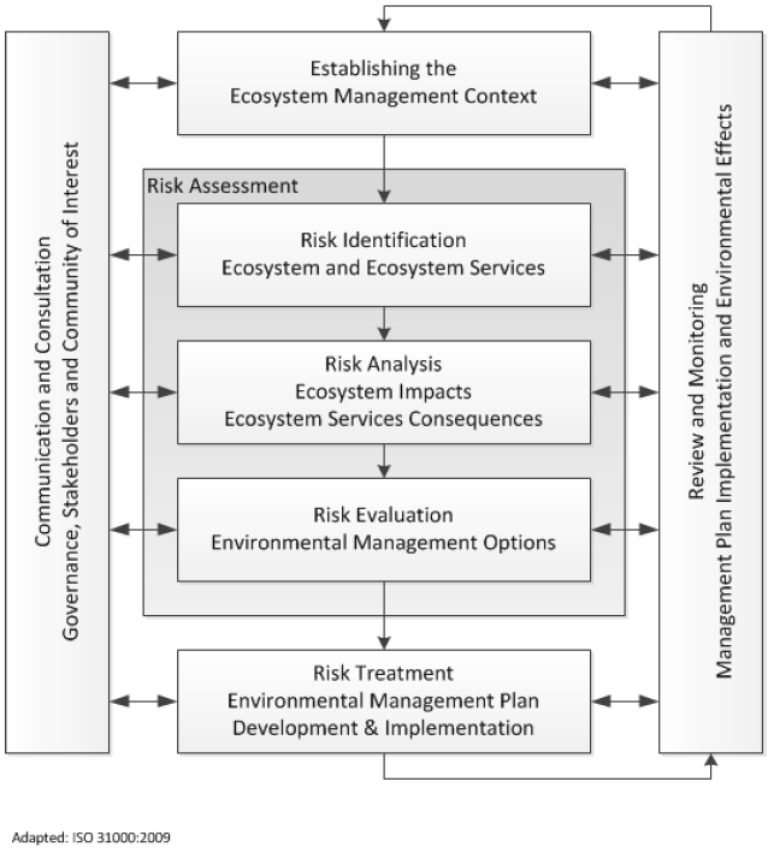

Figure 3.1. Ecosystem risk management framework adapted from ISO 31000:2009 risk management standard (Cormier *et al*., 2013).

Establishing the ecosystem risk management context

Rationale

ISO 31000 (2018) stipulates that “To establish the context means to define the external and internal parameters that organizations must consider when they manage risk. An organization’s external context includes its external stakeholders, its local, national, and international environment, as well as any external factors that influence its objectives. An organization’s internal context includes its internal stakeholders, its approach to governance, its contractual relationships, and its capabilities, culture, and standards”.

Implementation

- Provide inventory of the public policy agendas that scopes or frames present and future economic development aspirations and ecosystem protection and conservation goals.
- Identify the scope and objectives of the planning initiative and establish the ecosystem risk criteria.
- Identify the competent authorities that have relevant legislative and policies needed for the planning process.
- Identify the industry stakeholders that will be implicated in the design of the spatial and temporal management measures of the plan.
- Identify the communities that have vested interest in the protection and conservation of the environment or valued ecosystem services.
- Define geographical boundaries of the ecosystem and zone of influence of the drivers.
- Define the management area and the scope of the potential environmental effects to be assessed.
- Define the key drivers and trends that affect the planners and stakeholders, as well as cultural, social, political, financial, technological, and economic factors that can affect the assessment.

Ecosystem risk assessment

ISO 31000 2018 stipulates that "*risk assessment* is a process that is made up of three separate processes: risk identification, risk analysis, and risk evaluation".

Ecosystem risk identification

Rationale

Referring to ISO 31000 (2018) the risk identification is a "… process that involves finding, recognizing, and describing the risks that could influence the achievement of objectives. It is used to identify possible sources of risk in addition to the events and circumstances that could influence the achievement of objectives. It also includes the identification of possible causes and potential consequences". It is further explained that "A risk profile is a written description of a set of risks".

Implementation

- Identify all relevant *risk sources* and related *events* resulting from the activities of the drivers operating in the management area in terms of operational and environmental events.
- Identify the *causes* of the *event* and the resulting *consequences* in terms of ecological, cultural, social, economic *consequences.*
- Identify the *causes* of the *event* and the resulting *consequences* legal repercussions in terms of the operational and environmental management expected outcomes and objectives.
- Establish the scientific and technical advisory processes as well as communication and consultation processes with stakeholders.
- Compile the *environmental cumulative risk profile* as an input to the *ecosystem-based risk analysis* estimating likelihoods and magnitudes for all risks identified.

Ecosystem risk analysis

Rationale

ISO 31000 (2018) defines the risk analysis as "… a process that is used to understand the nature, sources, and causes of the risks that you have identified and to estimate the level of risk. It is also used to study impacts and consequences and to examine the controls that currently exist". It is further defined that "A consequence is the outcome of an event and has an effect on objectives. A single event can generate a range of consequences which can have both positive and negative effects on objectives. Initial consequences can also escalate through cascading and cumulative effects".

Implementation

- Determine the likelihood of the *operational events* and the magnitude of the *consequences* resulting from the conflicts of the activities of the drivers operating in the management area.
- Determine the likelihood of the *environmental events* and the magnitude of the *consequences* resulting from the activities of the drivers operating within the boundaries of the ecosystem.
- Building upon the *environmental cumulative risk profile*, present the results of *environmental cumulative risk analysis* as *environmental cumulative risk matrix* which is the input to *risk evaluation* that will ascertain the severity of the risks and determine if they are either managed adequately or need enhanced or additional management.

Ecosystem risk evaluation

Rationale

Risk evaluation is defined by ISO 31000 (2018) as "… a process that is used to compare risk analysis results with risk criteria in order to determine whether or not a specified level of risk is acceptable or tolerable".

Implementation

- Compare, based on *environmental cumulative risk matrix*, the level of risk found during the *environmental cumulative risk analysis* with *risk criteria* established when the planning process was initiated.
- Evaluate the *environmental cumulative risk management measures* and make decisions as to risks that should be managed as well as to risks that will not be managed.
- Create and use the Bowtie and the *environmental cumulative risk matrix* based *risk register* of those management measures related decisions showing which risk should be managed and how should it be managed in the marine spatial plan.
- Based on *environmental cumulative risk evaluation* identify the need for further analysis as well as further consultation or advisory processes.
- Identify potentially significant impacts of the MSP related individual *environmental cumulative risk management measures* in combination or cumulatively with other *environmental cumulative risk management measures* concerned in order to assist marine planners and stakeholders in ensuring that environmental capacity will not be exceeded.

Ecosystem risk treatment

Rationale

ISO 31000 (2018) stipulates that the "Risk treatment is a risk modification process. It involves selecting and implementing one or more treatment options. Once a treatment has been implemented, it becomes a control or it modifies existing controls". It is specified further that "A control is any measure or action that modifies or regulates risk. Controls include any policy, procedure, practice, process, technology, technique, method, or device that modifies or regulates risk. Risk treatments become controls, or modify existing controls, once they are implemented".

Implementation

- Review the *environmental cumulative risk management measures* identified in risk evaluation and documented in the *risk register*.
- Conduct the *cost–benefit analysis* of the *environmental cumulative risk management measures* concerned to identify the most effective measures for reducing the risk of environmental effects events, while remaining feasible to implement under existing legislation, technological knowledge, economic-sector capacity, and stakeholder engagement including governance and economic-sector implementation, administration, and operations.
- In the context of *cost-benefit analysis* assess the changes in value of significant ecosystem services between the baseline option (no change) and the other management options to ensure that the ecosystem features and functioning and the fundamental and final ecosystem services are safeguarded.
- Apply the *10-tenets of adaptive environmental management and sustainability* as the maritime spatial planning related environmental management Quality Objectives by assessing against the tenets the *activities* associated with the proposed development and, subsequently, proposed management measures (*responses*).
- Develop and apply a quantitative scoring system for recording value judgements of compliance against each *tenet of adaptive environmental management and sustainability* to provide a composite assessment of the overall level of sustainability associated with a given development.

Review and monitoring

Rationale

Referring to ISO 31000 (2018) "A review is an activity. Review activities are carried out in order to determine whether something is a suitable, adequate, and effective way of achieving established objectives. In general, ISO 31000 2018 expects you to review your risk management framework and your risk management process. It specifically expects you to review your risk management policy and plans as well as your risks, risk criteria, risk treatments, risk management controls, residual risks, and your risk assessment process". The ISO 31000 (2018) stipulates that "… to monitor means to supervise and to continually check and critically observe. It means to determine the current status and to assess whether or not required or expected performance levels are being achieved".

Implementation

- Establish the *review and monitoring* processes that are encompassing all aspects of the marine spatial plan implementation, objectives, scientific assumptions, and expectations of the competent authorities, industry stakeholders, and communities of interest.
- Conduct periodic reviews and evaluations to analyse the information and knowledge being generated by the various monitoring activities to determine if changes are needed to the maritime spatial plan.
- Apply the *10-tenets of adaptive management and sustainability* as a means to tracking changes in objectives or policies, changes in the industry sectors operating within the management area, changes in the values that communities may have as well as new knowledge being generated by scientific research.
- Conduct monitoring activities designed to ascertain the performance of the plan in terms of the compliance of implementation, operational feasibility of the measures and effectiveness of the plan in achieving both development and environmental objectives.

Communication and consultation

ISO 31000 (2018) stipulates that “Communication and consultation is a dialogue between an organization and its stakeholders. This dialogue is both continual and iterative. It is a two-way process that involves both sharing and receiving information about the management of risk. However, this is not joint decision making. Once communication and consultation is finished, decisions are made and directions are set by the organization, not by stakeholders. Discussions could be about risks, their nature, form, likelihood, and significance, as well as whether or not risks are acceptable or should be treated, and what treatment options should be considered”.

Implementation

- Establish *extensive communication and consultation processes* carried out throughout the entire planning process and also after implementation of the plan.
- Develop and apply the *engagement and consultation* processes of the ecosystem risk management taking into account the audience involving the scientific experts to ensure credibility of the sources and analysis of information while differentiating between science-based facts and value judgments.
- Apply the *ten tenets of adaptive management and sustainability* to define the *type of stakeholder consultation and feedback* as well as scientific and technical advice needed to ensure that any marine spatial plan addresses the objectives, concerns and expectation of the parties involved and is implementable along existing legislative and administrative realities.

As stipulated by ISO 31000, all these implementation activities generate the information that will be needed to evaluate the effectiveness of the plan in the future, enabling improvements to the plan adhering to adaptive management principles while the successful environmental management can only be achieved by environmental and compliance monitoring and review (Cormier & Kannen, 2019).

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