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# Governing coastal risks as a social process – Facilitating integrative risk management by enhanced multi- stakeholder collaboration

*Birgit Gerkenmeier, Beate M.W. Ratter*

## **Abstract**

Scientific literature calls for a shift from exclusively technical towards enhanced social processes in risk management to cope with the challenges of increased complex governance regimes wherein different interests of contrasting institutions need to be considered, balanced and negotiated. However, practical implementation of this integrative perspective is still a major challenge – underlined amongst others by the recently published Sendai Framework for Disaster Risk Reduction 2015-2030.

By proposing an Integrated Risk Management Approach (IRMA) we contribute to simplified conditions in the transfer from scientific debates into practical implementation. Looking in particular on coastal regions, IRMA focus the user's view on the essential challenges in terms of enhanced multi-sectoral structures and improved social and flexible processes, as much as it gives advice on its methodical realization. Using our practical experiences in the trilateral Wadden Sea Region, we disclose IRMA's contribution on enhanced consideration of historical framing, risk perceptions, risk awareness and enhanced multi-stakeholder participation. Multi-stakeholder participation, institutionalized in multi-stakeholder partnerships, makes an essential contribution towards enhanced collaborative processes between scientists, policy-makers and affected communities.

## **Keywords**

Integrative Risk Management Approach; social processes; multi-stakeholder participation; stakeholder partnerships; coastal region

## **Highlights**

- Implementing integrative risk management in practice is a major challenge
- Enhanced multi-sectoral structures and improved social and flexible processes are needed
- The presented framework stresses consideration of historical framing, risk perceptions and risk awareness
- Benefits of multi-stakeholder collaboration for integrative risk management policy-making are marked

## 31 **1. Introduction**

32 How to successfully manage risks arising from natural hazards and socio-economic and technological  
33 developments is a subject of multiple and intense debates. In coastal regions, effective risk  
34 management is a particular challenge on account of the close interaction of environmental, social  
35 and economic factors, strong pressures of use and increasing conflicts between uses. In such  
36 situations scientists, policy-makers and the affected communities all face the challenge of developing  
37 solutions for effectively managing environmental, social and economic issues in response to societal  
38 demands. Often, the above challenges are further compounded by risks arising from climate change,  
39 changing economic developments and requirements and demographic change (Ballinger, 2015;  
40 Nicholls et al., 2012; Wong et al. 2014). The resulting impacts often affect different spheres of  
41 (economic) life; moreover they influence each other leading to cascading effects – a phenomenon  
42 known as multi-risk situations. Against a multi-layered governance environment in coastal areas,  
43 comprising different interests, institutions, legislation and policy, these complex feedback  
44 mechanisms provide major challenges in their own right (Ballinger, 2015; Moser et al., 2012).

45 Traditional, mostly technical measures of coastal risk management often fail to fully address these  
46 challenges. There is a need for enhanced and integrated coastal risk management which brings  
47 together all relevant sectors, but also the different rationalities, concerns and interests of the various  
48 institutions and the public at large. A balance needs to be struck between private interests and the  
49 common good as well as national and local interests (Ballinger, 2015; Stallworthy, 2006). Integrated  
50 risk management also needs to include knowledge from different sources in order to understand,  
51 evaluate and decide on coastal risk management measures and strategies. Conceptually, integrated  
52 coastal risk management is no longer just a technical, but above all a social process. Science is  
53 already discussing this in various risk management communities, and different concepts and  
54 frameworks have become available as a basis. The research gap, therefore, does not present itself  
55 with respect to scientific concepts and frameworks, but with respect to their transfer to practice.  
56 Integration and linking stakeholder processes at different scales (local, regional, national) still  
57 represents a major challenge, as well as coping with the limited knowledge and understanding of  
58 these types of processes (McFadden, 2007). The recently published Sendai framework underlines the  
59 topicality of this challenge, calling for the development of broader and more people-centred  
60 approaches in risk management and highlighting multi-stakeholder participation as playing an  
61 important role since the commitment, goodwill, knowledge, experience and resources of  
62 stakeholders will be required to successfully deal with and reduce risks (United Nations ISDR, 2015).

63 Against the background of coastal risk management, this paper aims to contribute to the debate by  
64 highlighting how an integrative risk management perspective can be transferred from science to  
65 practice. Based on the existing literature, we firstly highlight the essential requirements of an  
66 integrated risk management perspective as a basis for its practical implementation (sections 2.1-2.3).  
67 We bring together these requirements in the form of an Integrative Risk Management Approach  
68 (section 3), based on which we discuss its translation from science into practice. We present a  
69 stepwise methodological approach for implementing the framework and underpin this discussion

70 with experiences gained in a case study in the trilateral Wadden Sea Region (sections 3.1-3.3).  
71 Building on this promising case study we then present conclusions on how the Integrated Risk  
72 Management Approach and methodological framework presented can improve risk management  
73 (section 4).

## 74 **2. Requirements for an integrative coastal risk management process**

75 An integrative risk perspective endeavours to anchor coastal risk management within society. This  
76 endeavour is grounded in a sociological understanding of risk which regards risks as social constructs,  
77 or more specifically, mentally constructed undesired events (Luhmann, 1993; Renn, 2008). Against  
78 this background societal risk construction and negotiation are crucial elements of integrative risk  
79 management, requiring participative, transparent and flexible processes for the implementation of  
80 such discursive practices (Renn, 2008, p. 2417). Including all members of society in a discussion and  
81 negotiation process is a difficult challenge, which is why several frameworks overcome this by  
82 concentrating on stakeholder rather than public participation (Folke, 2006; IRGC, 2005; Newig and  
83 Fritsch, 2009). From our point of view stakeholders are seen as - and act as - representatives of  
84 different interest groups (institutionalised public, organised interest groups) or institutions that are  
85 directly affected, have an interest in the decision, or with legal responsibility and authority relative to  
86 a decision (Mitchel, 2002, p. 189). For integrative risk management processes, the concentration on  
87 multi-stakeholder processes is also a practicable point of departure. In this context, the term “multi-  
88 stakeholder” emphasises the multiple sectors and institutions that come together in an integrated  
89 risk management approach.

90 However, the successful organisation and implementation of integrative risk management in the  
91 form of multi-stakeholder processes cannot be reduced to simply bringing together stakeholders  
92 around a table. Fundamental changes are required in management *structures* and *processes* to  
93 internalise a shift towards more social processes in coastal risk management. Existing concepts in the  
94 literature already address these changes in theory. In the following we give an overview of these  
95 essential requirements, and bring them together in an integrated risk management approach (IRMA)  
96 which then provides a solid basis for considering how its *practical* implementation should be  
97 organised.

### 98 **2.1. Multi-sector and multi-scale structures in risk management**

99 The increase of highly interlinked risks and cascading effects affecting different sectors and fields of  
100 actions are a challenge to current coastal risk management structures which are characterised by a  
101 high degree of differentiation of functions and services amongst governmental departments and  
102 agencies (Ballinger, 1999). Currently sectors and associated administrations work in relative isolation  
103 from each other (Ballinger et al., 2002). Single authorities dealing with single problems, however, is  
104 an approach that no longer matches multi-risk and multi-scale situations, requiring adaptation of  
105 management, governance and decision-making structures. The governance concept can offer a  
106 theoretical framework here as it discusses precisely these types of adaptation to societal processes

107 of change and changing political frameworks within management and decision-making structures  
108 (Grande, 2012). Governance is understood as the institutionalised modes of social coordination of  
109 action, leading to the agreement and implementation of collectively binding regulations (policies)  
110 (Börzel, 2006).

111 The concept of risk governance translates the general principles of governance into the context of  
112 risk management (Renn, 2008). It emphasises the need for, and benefits of, horizontal expansion of  
113 management structures by means of a different distribution of competencies, supporting stronger  
114 interaction between state and private bodies (Grande, 2012; Renn et al., 2011; Schuppert and  
115 Folkert, 2008). These include traditional governmental bodies and agencies as well as new  
116 institutions, NGOs and actors from civil society (Renn et al., 2011).

117 To translate such expansion into practice, attention must be paid to the mutual interdependencies  
118 that exist between elements of the societal system (horizontal), various territorial spheres of action  
119 (vertical) and different policy fields. The importance of including multiple scales, i.e. the various  
120 vertical spheres of action, is underscored by complexity theory, which emphasises that in non-linear,  
121 dynamic and complex coastal risk management situations, interaction of single agents at the micro-  
122 level leads to emergence within society at the macro-level (Ratter, 2013). Horizontal (multi-sector)  
123 and vertical (multi-scale) expansion of coastal risk management structures increases the need for  
124 cooperation and coordination between very different actors (Grande, 2012). What matters here is  
125 the diversity of actors, their roles, their logic of action, the manifold relationships between them and  
126 the dynamic networks emerging from these relationships (Renn et al., 2011). This increased  
127 cooperation between the state, the private sector, citizens and non-governmental organisations  
128 stimulates greater focus on negotiation processes between society and government in order to  
129 mediate between values, norms and regulative structures and to facilitate the effective  
130 implementation of socially acceptable allocation and regulation (Hill, 2013; Jordan, 2008; Renn,  
131 2008). This made obvious that enhanced participation and communication between the various  
132 stakeholders is key for the practical implementation of this risk governance rationale (Renn, 2008).

133 Existing frameworks such as the Integrative Risk Governance Framework (IRGC, 2005) already  
134 address stakeholder participation as a central element, but do not include it in all elements of the  
135 approach, for example in risk analysis. The importance of involving stakeholders and interested  
136 parties to regional or national decision-making processes is also reflected in some political  
137 commitments, e.g. the proposed Directive on Integrative Coastal Zone Management (ICZM).  
138 However, although ICZM has been implemented on a voluntary basis in some European countries,  
139 there are still large gaps in implementation as responsibilities are not shared between sectors and  
140 horizontal cooperation is not yet up and running. Considering these developments, an integrative  
141 coastal risk management approach should enhance risk governance structures to foster  
142 communication and negotiation and should encourage improved steering and decision-making  
143 processes through an expansion of horizontal (multi-sector) and vertical (multi-scale) management  
144 structures.

## 145 **2.2. Enhanced social processes in risk management**

146 Including multiple actors in the risk management process means the coming together of different  
147 rationalities, interests and concerns. An integrated risk perspective requires that these rationalities  
148 are laid open in order to integrate them in the risk management approach. A pioneering study by  
149 White (1974) first showed the importance of human perception in risk management. Risk perception  
150 research emphasises that different risk perspectives initially emerge at the individual level<sup>1</sup>. Risk  
151 perception thus represents an individual, internal reconstruction of the external world that is pieced  
152 together out of numerous different impressions and that is influenced, among other things, by  
153 personal experiences and collected knowledge (Schachter et al., 2012). Douglas and Wildavsky (1982)  
154 have made evident that individual risk perception is bounded and influenced by social, political,  
155 economic and cultural contexts and judgments. Cultural Theory underlined that individuals are  
156 embedded in a social structure and that the social context of individuals shapes their values,  
157 attitudes, and world views (Douglas and Wildavsky, 1982; Rippl, 2002). The decision on what is  
158 considered a risk is therefore always relative to “way of life” (Douglas and Wildavsky, 1982;  
159 Thompson et al., 1990), meaning that there is no value-free process for choosing between risky  
160 alternatives (Fischhoff et al., 1980). Moreover Socialized cognitive schemata play a role here as they  
161 work like a filter in evaluating information (Rippl, 2002). In the multi-stakeholder context of  
162 integrated coastal risk management, the inclusion and evaluation of different perspectives is  
163 essential in order to create a comprehensive, complementary and accepted grounding of the risk  
164 management process.

## 165 **2.3. Participative and flexible risk management processes**

166 The two previous subsections implied the need for enhanced participatory processes to ensure  
167 sufficient space for communication, discussion and negotiation, in order to encourage improved  
168 steering and decision-making processes. Moreover, the relevance of participative processes is  
169 underlined by a comprehensive body of literature from the field of public and stakeholder  
170 participation. In addition to the normative demand of including all relevant agents in a democratic  
171 process (Stringer et al., 2006; Wesselink et al., 2011), participatory processes might improve  
172 decisions (Beierle, 2002), in particular with regard to improving the quality of decisions by gaining  
173 and including local lay knowledge as much as sectoral knowledge (Beierle, 2002; Newig and Fritsch,  
174 2009; Pellizzoni, 2003; Reed et al., 2009). Participatory processes are beneficial since stakeholders  
175 can “learn about the character and trustworthiness of other group members through their  
176 interactions and learn to appreciate the legitimacy of each other’s view (Reed 2008, p. 2420)”; they  
177 can also foster the empowerment of potentially marginalized groups (Adger et al., 2003).  
178 Furthermore, multi-stakeholder processes may trigger social learning amongst the participants which  
179 can stimulate the development of innovative options and solutions in risk management (Stringer et  
180 al., 2006). Apart from requiring increasingly participative processes, the complex and dynamic

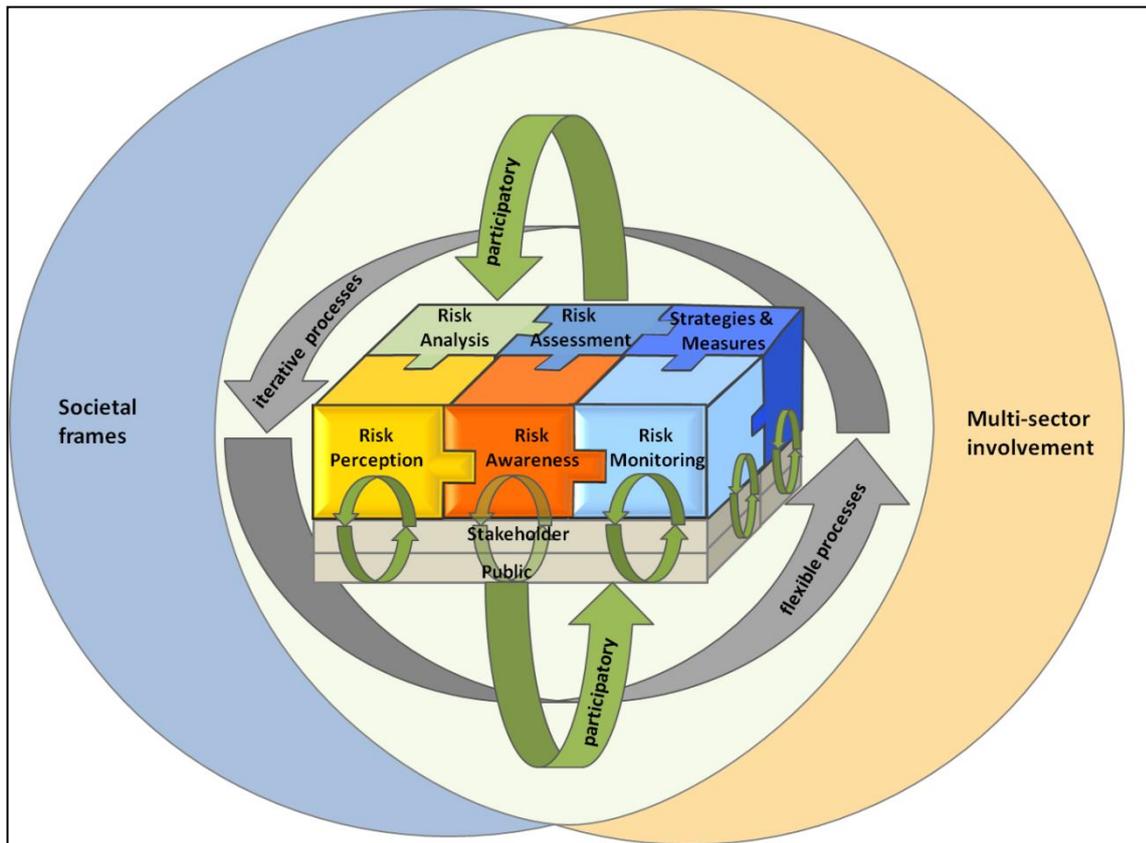
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<sup>1</sup> Within risk perception research these processes are primarily addressed through the psychometric paradigm which concentrates on the cognitive factors that influence risk perception (Slovic, 1992; Rippl, 2002).

181 character of multi-risk situations also require integrative risk management processes to be flexible  
182 and adaptive as these reduce the likelihood of lock-in. In the context of complex multi-risk situations  
183 lock-in describes phases where the learning processes within the system have become stagnant. The  
184 system stays in a state with partly inefficient patterns of behaviour and lack of innovation (Weig,  
185 2016), leading to greater vulnerability as sources of novelty have been eliminated and functional  
186 diversity and cross-scale functional replication are reduced (Allison and Hobbs, 2004). A state of lock-  
187 in therefore hampers the development of new and innovative measures of risk management.  
188 Adaptive processes are thus necessary to be able to adapt to changing conditions and to be open to  
189 feedback, implying the use of a monitoring system to check whether one is still on the desired system  
190 trajectory (Ratter, 2013). This requirement also implies that integrative risk management processes  
191 are to be regarded as iterative since they demand ongoing checks against the current situation.  
192 Flexible in this context means that strategies and measures are not limited to linear planning leading  
193 from a current to a future target state, but that changes of the trajectory can be considered.

### 194 **3. The Integrative Risk Management Approach (IRMA)**

195 In order to foster a transfer of the conceptual requirements (discussed above) into practical  
196 implementation we propose an Integrated Risk Management Approach (IRMA). The IRMA links the  
197 requirements of enhanced multi-sector and multi-scale structures to improved social and flexible  
198 processes. It achieves this kind of integration by adapting elements of the risk management cycle,  
199 supported by enhanced methods for their implementation. Figure 1 gives an overview of the  
200 approach which takes into account social, cultural and historical frames and where implementation is  
201 anchored within a multi-sector environment.



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*Figure 1: Setting and elements of the Integrative Risk Management Approach (IRMA)*

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The major steps of IRMA are shown as pieces of a jigsaw. Implementation of these interlocking pieces takes place through participative, flexible and iterative processes and activities; these key characteristics are emphasised by the green and grey arrows. The following sections will explain the elements and discuss methodological approaches that can be used to translate the conceptual IRMA into practice. The latter is supported by insights derived from our practical experience from a case study in the trilateral Wadden Sea Region (WSR), a coastal area along the Dutch, German and Danish North Sea coast. The WSR is a multi-risk area that is increasingly affected by natural hazards (mainly storm surges) and socio-economic risks (first and foremost consequences arising from demographic change and impacts of conflicting spatial uses on land and sea). In addition to the following discussion Table 1 presents a detailed overview of the individual terms of the multi-method approach and its implementation in the WSR.

Table 1: Overview of the methodical steps used to implement the IRMA in the Wadden Sea Region

		<b>Methodological approach</b>		<b>Implementation in the Wadden Sea Region (WSR)</b>		
		<b>Method used</b>	<b>Justification for use</b>	<b>Scope of application</b>	<b>Setting</b>	<b>Number of participants</b>
<b>Risk Perception</b>	Placemat technique	Structuring a balanced group discussion by combining individual and group responses, foster discussion of different positions and a constructive reflection of the topic discussed	Identifying risks and uncertainties perceived by stakeholders based on their individual and sectoral experience	Workshops together with Multi-Stakeholder Partnership (MSP) focusing on multi-risk situation in the WSR	16	
	Online survey based resilience assessment	Qualitative method capable of including different perspectives and concerns; allows assessment of different rationalities	Collect and emphasize different rationalities of storm surge risk management from different sectors	Beyond MSP, online survey after personal contact (by phone/email)	174 responses (return rate 60 %)	
<b>Risk Awareness</b>	Placemat technique	Structuring a balanced group discussion by combining individual and group responses, foster discussion of different positions and a constructive reflection of the topic discussed	Investigate stakeholders level of contentment with current management strategies and measures	Workshops together with MSP focusing on multi-risk situation in the WSR	16	
	Online survey based resilience assessment	Qualitative method which allows assessment of different rationalities and views of partner responsibilities on currently applied measures, strategies and risk management process	Analyse stakeholder perceptions and concerns with respect to major consequences of storm surge risks	Beyond MSP, online survey after personal contact (by phone/email)	174 responses (return rate 60 %)	
<b>Risk Analysis</b>	Bow-tie analysis	Enhance stakeholder understanding of risks and risk management processes, foster structured discussion on risk pathways	Increase awareness of the complexity of risk pathways in a multi-risk situation	Workshops together with MSP	21	
	Compiling state-of-the-art of quantitative research	Insights on storm surge damage modelling can offer support for decision-making processes, mainly by assessment of the cost-benefit ratio which is able to monetarily compare different measures	Include available qualitative storm surge damage and risk analyses in participatory risk analysis activities	Beyond MSP, desktop study, supplemented by expert opinions	/	

<b>Risk Assessment</b>	Bow-tie analysis	Foster qualitative assessment, focusing on different rationalities and concerns with regard to risks, providing a complementary approach to qualitative assessment	Provide stakeholders with the opportunity to give feedback on the performance and efficiency of actual management processes	Workshops together with MSP focusing on multi-risk situation in the WSR	21
	Future Search Method (Scenarios)	Provide space for a visionary dialogue to anticipate possible outcomes of actual discussions	Joint development of future societal visions, anticipating threats and impacts for society and the region	Workshops together with MSP focusing on the multi-risk situation	15
	Compiling state-of-the-art of quantitative research	Quantitative assessment, provides estimates of potential monetary damage and losses; should be combined with the other qualitative risk assessment techniques	Include available quantitative results on storm surge damage modelling	Beyond MSP, desktop study, supplemented by expert opinions	/
<b>Strategies &amp; Measures</b>	Bow-tie analysis	Foster involvement of multiple future pathways in strategic risk management processes as this keeps risk management processes open to different adaptive responses	Jointly determine the most urgent needs for improved management processes in the multi-risk situation	Workshops together with MSP	21
	Online survey based resilience assessment	Enable opinions to be collected regarding enhanced collaboration schemes and potential additional measures	Identify potential measures to adapt and reduce consequences of storm surges and indicate responsibility for those	Beyond MSP, online survey after personal contact (by phone/email)	174 responses (return rate 60%)
	Future Search Method (Scenarios)	Development of future scenarios that closely approximate the diverse interests and concerns of society; strengthen stakeholders' commitment in risk management processes	Jointly define the new role of the Multi-Stakeholder-Partnership (Wadden Sea Forum) in risk management	Workshops together with MSP focusing on multi-risk situation in the WSR	15
<b>Monitoring</b>					

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### 2           **3.1.Enhanced multi-sector environment: structural improvement by a** 3           **Multi-Stakeholder-Partnership**

4   Following one of the most urgent demands in practice, which is looking for ways of organising and  
5   designing participatory multi-stakeholder processes in order to facilitate new governance  
6   arrangements, a multi-stakeholder partnership (MSP) is proposed as a promising structural  
7   improvement here. An MSP should be understood as “voluntary but enforceable commitment[s]  
8   between partners from different sectors (public authorities, private services/enterprises, and civil  
9   society), which can be temporary or long-lasting [...] [and is] founded on sharing the same goal in  
10   order to gain mutual benefit, reduce risk, and increase resilience” (ENHANCE 2016, p. 15). An MSP  
11   has the potential to support stakeholders from various sectors, authorities and administrations  
12   across national borders coming together in an institutionalised setting; as such, an MSP creates the  
13   conditions of a “multi-sector environment”, thus fulfilling one of IRMAs’ major requirements.

14   In the WSR decision-makers, politicians and scientists had already recognised some years ago that  
15   cross-national exchange of experience, discussion and joint strategic development within a multi-  
16   stakeholder environment is necessary in order to meet the challenges of sustainable development.  
17   As a result an MSP was established in 2002 in the form of the Wadden Sea Forum (WSF), an  
18   independent platform of stakeholders from Denmark, Germany and the Netherlands<sup>2</sup> who represent  
19   the sectors of agriculture, energy, fisheries, industry and ports, nature conservation, tourism, as well  
20   as local and regional governments from the three Wadden Sea countries; national governments are  
21   represented as observers (Wadden Sea Forum, 2010). Building on the WSF long-lasting experiences  
22   and trust among the participating stakeholders, the IRMA was implemented jointly with this existing  
23   MSP.

### 24           **3.2.Elements of the IRMA and their transfer into practice – insights from** 25           **implementation in the trilateral Wadden Sea Region**

#### 26           **3.2.1. Risk Perception & Awareness**

27   Within the IRMA, stakeholder risk perception is the foundation for defining risk since it determines  
28   society’s readiness for taking preventative measures and for engaging with a risk management  
29   strategy (Sjöberg, 2000). Stakeholder awareness not only of risk, but also of management needs and  
30   current structures of responsibilities, further adapt the risk management process to society’s specific  
31   concerns and needs. The central significance of both elements, Risk Perception und Risk Awareness,  
32   is emphasised by anchoring them in the “classic” risk management cycle as additional elements as  
33   they provide the fundamental conceptual basis for the additional risk management steps. The IRMA  
34   thus differs from existing frameworks such as the Risk Governance Framework (IRGC, 2005) or  
35   adaptive management (Stringer et al., 2006) in that these approaches mostly consider risk perception

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<sup>2</sup> The WSF is an advisory stakeholder forum which has no normative power in decision-making outside the forum.

36 and awareness as preparatory work but rarely consider their direct influence on the risk  
37 management process. From a methodological perspective we suggest a setting to facilitate  
38 discussion, for example stakeholder workshops, ensuring there is active inclusion and consideration  
39 of cultural and social frames brought in by stakeholders as part of their individual and sectoral  
40 experience. Facilitated group work is also suitable, for instance using the placemat technique (Reich,  
41 2006). The placemat technique provides the opportunity for stakeholder to record their individual  
42 perspectives on risks and uncertainties on placemat made of paper (first step); after sharing and  
43 discussion, in a second step, the group records agreed-upon responses in the centre of the placemat.

44 Applied this way in the WSR (see table 1), a workshop with the WSF members as stakeholders made  
45 clear that storm surge events are ranked first in terms of perceived risks. This will come as no  
46 surprise, since the WSR has long-standing tradition of systematic dyking and drainage of the coastal  
47 marshes. As a result, almost all risk management strategies in the three WSR countries have long  
48 since focused on highly developed technical construction measures, creating a feeling of security  
49 among the affected population and the responsible actors (González-Riancho et al., 2017). However,  
50 the workshop discussion clearly showed that the perception of storm surges as a major risk is not  
51 linked to a perceived need for improved management. Stakeholders perceive storm surge risks to be  
52 well managed at present and do not see any urgent need for improving current management  
53 strategies. It is risks associated with socio-demographic changes that are associated with the most  
54 immediate need for action. Stakeholders also see an urgent need to avoid any risks associated with  
55 imbalances between nature conservation and socio-economic development in the WSR.

56 Methodologically we suggest to supplement such group work activities on risk perception and risk  
57 awareness by individual work e.g. by using surveys or interviews, as this allows the assessment of  
58 different rationalities and views as well as views of currently applied management measures. For the  
59 WSR we tested this by conducting an online stakeholder survey for the in-depth analysis of storm  
60 surge risks; with the result that the survey underpinned the insights from the stakeholder workshop  
61 (for more details see González-Riancho et al., 2017).

### 62 **3.2.2. Risk Analysis & Risk Assessment**

63 Analysing and assessing causes and consequences of disastrous events is crucial in order to identify  
64 options for action and to evaluate the suitability, feasibility and effectiveness of risk management  
65 measures. From our integrative perspective, both elements are mainly driven by competing interests,  
66 highlighting the fact that both should be seen as socio-political and ethical questions for society as a  
67 whole rather than just a technical or scientific one.

68 As a consequence, we recommend a combined application of quantitative and qualitative  
69 approaches. Quantitative risk assessment helps to analyse potential exposure to the physical effects  
70 of a risk and to estimate the monetary vulnerability of the community when subjected to the physical  
71 effects of the event, taking into account the potential damage to goods, values and human life. In the  
72 WSR quantitative results were exemplarily included via a desktop study on quantitative damage  
73 estimation of storm surge events. The result showed that if adequate information is available

74 damage modelling can offer support to decision-making, especially if modelling includes the  
75 assessment of the cost-benefit ratio and is able to monetarily compare different measures.

76 Qualitative methods are able to emphasize the intent behind an action, the perceived fairness of  
77 decisions, the perceived equity of opportunities and outcomes embedded in a decision process and  
78 its results (Cox, 2009). Participatory risk analysis and risk assessment methods in particular enable  
79 insights into social, ethical, and political values that cannot be gained by quantitative approaches  
80 (Middendorf and Busch, 1997) and foster the involvement of perspectives and knowledge from a  
81 range of sources, contributing to a more complete and robust overview of the multi-risk situation  
82 (Stringer et al., 2006). Applying participatory risk analysis and risk assessment methods sets apart the  
83 IRMA from other frameworks, most of which do not include stakeholder participation in risk analysis  
84 (e.g. the integrated approach of the International Risk Governance Council (2005)). In practice we  
85 recommend a bow-tie process as a useful approach to facilitate a participative risk analysis and  
86 assessment process. The bow-tie process should be understood as a slightly modified version of the  
87 traditional bow-tie analysis, which as a common risk assessment technique analyses cause-and-effect  
88 pathways of risks by facilitating and supporting the differentiation between the causes of a risk, the  
89 damaging event, and its resulting consequences (IEC, 2009). As demonstrated in the application in  
90 the WSR, the bow-tie process have enabled collaborative identification, comprehension and analysis  
91 of the cause-effect pathways and the current management system in a multi-risk context. From an  
92 organisational perspective the bow-tie process fosters structured discussion of risk pathways while  
93 still being open to multiple future pathways. This keeps strategic risk management processes open  
94 different adaptive responses (Gerkenmeier and Ratter, 2016).

95 Apart from the workshop activities, risk analysis and risk assessment in the WSR was further  
96 supported by the qualitative online survey-based resilience assessment among the experts involved  
97 in storm surge risk management (Table 1). Stakeholder assessments and expectations with respect to  
98 further economic measures in storm surge risk management, for example, clearly indicate that  
99 stakeholders reject insurance as an effective instrument in storm surge management (González-  
100 Riancho et al., 2017). This stakeholder assessment is to a high degree contrasting to the positive  
101 assessment of economic instruments given by the economic scientific literature.

### 102 **3.2.3. Measures & Strategies and Monitoring**

103 Strategies and measures include the development of adequate risk strategies or measures to adapt  
104 to the causes and reduce the consequences of risks, as well as facilitating discussions on the roles  
105 and responsibilities of different actors. Monitoring processes on the coast could help to identify  
106 potential problems before they arise, allowing adaptive responses to be planned (Brown et al., 2014,) and  
107 therewith ensuring the constant adjustment of measures and strategies to society's needs and  
108 concerns. In practice, discussing and including multiple future pathways in the risk management  
109 processes can provide a strategic contribution within these elements since multiple pathways keeps  
110 open different adaptive responses (Brown et al., 2014).

111 In practice, the Future Search Method (Weisbord and Janoff, 2008) is a promising approach to jointly  
112 develop future scenarios that closely approximate the diverse interests and concerns of society.

113 Applied in the WSR within a stakeholder workshop setting (Table 1), stakeholders were asked to  
114 develop future scenarios for 2030 by focusing on the major risks of storm surges, demographic  
115 change and conflicting spatial uses and anticipating threats and impacts of the crisis for the society  
116 and the region (see supplementary material). The activity's results underpinned the requirement for  
117 future strategies to pay more attention to the multiple interlinkages between risks and their impacts  
118 across different sectors and spatial dimensions in practice. Furthermore, the discussion highlighted  
119 that apart from enhanced institution-specific tasks it is primarily communication and exchange  
120 between stakeholders that need to be strengthened in the WSR. The WSF is emphasized to make an  
121 important contribution here in its format of a multi-stakeholder partnership.

#### 122 **4. Serving improved risk management – in the WSR and within** 123 **wider coastal risk management**

124 The IRMA addresses the challenges of coastal risk management from a social process perspective  
125 throughout the different risk management elements. In the light of our promising experiences in the  
126 WSR we are overall able to give clear recommendation for an MSP as a useful structure to implement  
127 an enhanced integrative coastal risk management approach. The WSF stakeholders are of the  
128 opinion that an MSP can serve as a communicator, ambassador and multiplier in risk management  
129 discussions, asking good questions of the responsible policy makers. Institutionalised as a long-  
130 standing supportive institution, the setting of an MSP is where close collaborative activities can  
131 enable stakeholders to formulate policy advice outside the traditional scientific and administrative  
132 environment.

133 Since we demonstrated the suitability of the presented mixed method scheme to implement the  
134 IRMA (see Table 1), we argue that the mixed method approach could be transferred to other multi-  
135 risk cases and enrich other MSP processes. However, we see a need to adapt the work steps to  
136 specific contexts in order to anchor the IRMA within the specific social, cultural and historical frames  
137 of each case. Closer analysis of the case study shows that the social process perspective has been an  
138 essential improvement, particularly in terms of broadening the range of perspectives involved. It has  
139 given greater weight and space for the discussion of perceptions, interests and conflicting concerns  
140 in the risk management processes. Enhanced and improved activities particularly within Risk  
141 Perception and Risk Awareness play a significant role here as they contribute to deducing the joint  
142 societal interests the MSP is going to address and anchor in integrative risk management. This, in  
143 turn, will contribute to a shift from top-down decision-making towards an inclusive overall  
144 governance perspective of coastal risk management. In the risk management cycle, which is mostly  
145 equal to a policy cycle (Cormier et al. 2017), a social process perspective mainly contributes to more  
146 closely aligned processes of identifying a problem and setting public policy priorities, goals, and  
147 objectives in line with societal needs.

148 Constraints are mostly apparent within the elements of Measures and Monitoring. Measures and  
149 controls are explicitly outside the role of an MSP and are hardly influenced by a social risk  
150 management perspective either as they are the responsibility of law-making bodies charged with

151 administering laws, regulations and directives as well as implementing and auditing organisations  
152 which are responsible for monitoring activities (compare the discussion in Cormier et al. 2017).  
153 Following this recognition we are able to render the contribution of a social processes perspective  
154 more precisely to establishing the context for risk management activities by improved and socially  
155 accepted definition of the targets of coastal risk management processes. This is mainly attributable  
156 to the facilitated processes of evaluating and diligently balancing stakeholder perceptions and local  
157 knowledge against available scientific knowledge within the risk assessment.

## 158 **5. Conclusion**

159 It has long been known that successful management processes are influenced by the social and  
160 cultural framing of society, take account of the perceptions of those affected, and depend on  
161 cooperation based on trust. In these circumstances, integrated management concepts have long  
162 been called for, but they still face difficulties in terms of practical implementation. The integrated risk  
163 management approach presented here contributes to the practical implementation of such concepts  
164 by highlighting important building blocks and requirements and presenting suitable methods for their  
165 implementation. Practical experience from the WSR has shown the implications of a shift towards  
166 governing risks as social processes in coastal regions and beyond. The WSR example demonstrates  
167 that historical framing matters, and that perception as well as awareness are essential for developing  
168 risk management strategies that match societal needs and concerns. Communication is decisive – not  
169 as a one-directional information channel but as open and trustful togetherness – in order to use  
170 stakeholders as multipliers and advocates. Our experiences underline that integrative risk  
171 management is firstly about trustful *listening* to stakeholders and society with respect to their needs  
172 and demands. Secondly, it is about *communication* with and between stakeholders and society, and  
173 thirdly, about a continuous and iterative *learning* process for stakeholders and decision-makers. This  
174 engenders mutual respect, which together with joint discussions form a solid foundation for  
175 developing risk management measures. The potential for these processes is already there, shown by  
176 the work with the multi-stakeholder partnership of the WSF. By mainly addressing horizontal  
177 cooperative activities, conceived as inclusive governance, multi-stakeholder participation,  
178 institutionalized in an MSP, makes an important contribution to rethinking coastal risk management  
179 as an inclusive and integrative perspective. It encourages those involved to overcome the barriers of  
180 the current approach of “one problem, one solution” by strengthening a multi-risk, multi-scale and  
181 multi-stakeholder perspective as a long-term prospect in coastal risk management processes.

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