

**Boundary organisations in the Wadden Sea:
what works when, where and how?**

Van Enst, Wanda*, Peter Driessen, Hens Runhaar

COPERNICUS Institute of Sustainable Development, Utrecht University,

PO Box 80115, 3508 TC Utrecht, the Netherlands

*Corresponding author:

Wanda van Enst, Tel: +31 30 253 5763, E-mail address: W.I.vanEnst@uu.nl

Abstract:

Strategic issues, including political (mis)use of knowledge, selective production of knowledge and a misfit of demand for and supply of knowledge are often mentioned as problems in the interactions between science and policy. Scientific literature suggests science-policy interfaces as ‘solutions’. Boundary organisations are known to be organisations which provide such solutions by acting as a bridge between science and policy. In order to enhance the process of political decision-making, these organisations are supposed to enable a more effective use and production of knowledge in the often contested boundary area between the two domains, increasing its legitimacy and credibility.

But how do these organisations work? In which situations is their added value needed? And how do they position themselves between the dynamic demand for and supply of knowledge? It appears that after presenting boundary organisations as the solution, literature comes to an end point due to the lack of empirical analysis and the often high level of abstraction literature uses to explain this type of interface.

This paper will present a framework of the concept ‘boundary organisation’ where the focus will lie on the (participating) actors, the (presupposed) goals and their strategies. With the use of empirical research on three case studies of boundary organisations, the aim of the paper is to provide a better understating of the strategies by which the organisations aim to promote the selection, production and use of credible, legitimate and/or salient knowledge. The focus area of these organisations will be the Wadden Sea – a shallow estuarine sea where ecological interests compete with economic and social interests (such as gas mining, shipping and tourism), resulting in various problems with the interaction between science and policy.

1. Introduction

Problems with the interaction between science and policy is an often discussed subject within the environmental governance debate. In short, you can distinguish three ‘meta level’ problems; 1) the strategic use of knowledge by policy, 2) the strategic production of knowledge by science, and 3) the operational misfit between the demand for, and supply of knowledge (Van Enst et al., 2013). Each of these three problems should be considered as a collection of issues regarding the behaviour of scientists, policy-makers and/or stakeholders. To be more concrete, examples of the problem of strategic use of knowledge by policy can be that knowledge is deliberately ignored by policy makers (e.g. Owens et al., 2006), or the use of counter-expertise in order to disqualify contested knowledge (leading to so called ‘report wars’) (e.g. Van Buuren and Edelenbos, 2004, Fenger and Kok, 2001). The same comes to show for the strategic production of knowledge by science, were issues such as scientists joining competing knowledge-coalitions (e.g. Van Buuren and Edelenbos, 2004) and scientists selectively present knowledge (becoming ‘Issue Advocates’) (e.g. Pielke, 2007; McCool and Stackey, 2004) can be found. With regards to the operational misfit between demand for and supply of knowledge, problems with for example stakeholders employing different timeframes and levels of abstraction (e.g. Wiltshire, 2001) and policy-makers insufficiently developing clear research questions (e.g. Sarewitz and Pielke, 2007) can be distinguished. An important explanation for (especially) the misuse and mis-production of knowledge can be ascribed to the lack of legitimacy, credibility and/or salience of the (scientific) knowledge (Cash et al., 2003).

Within the debate surrounding the problems with the interaction between science and policy, so called ‘science-policy interfaces’ are often mentioned as solutions to these problems, and thus increase the level of legitimacy, credibility and/or salience of knowledge. These interfaces can have – according to the scientific literature – a variety of meanings and shapes, ranging from an interface being a process, an organisation, an individual or a collective understanding (e.g. Van Buuren and Edelenbos, 2004; Huitema and Turnhout, 2009; Pielke, 2007). Van den Hove (2007) explains science-policy interfaces as being “social processes which encompass relations between scientists and other actors in the policy process, and which allow for exchanges, co-evolution, and joint construction of knowledge with the aim of enriching decision-making”. From this definition, three variables can be derived which make up the arrangement of a science-policy interface: initiating and participating actors, presupposed goals and strategies for steering the involved actors towards this goal. When reviewing the literature on the concept of science-policy interfaces and these three variables, we have identified three specific – theoretical – interfaces: boundary organisations, individual science-policy mediators and processes of participatory knowledge development. Literature, however, presents little empirical evidence regarding these interfaces, leaving us with the question “what works when, where and how”.

With this article, we will focus on the concept of *boundary organisations*. With the use of both literature and empirical research we aim to provide a better and more thorough understanding of this interface – in the case of which type of problems are boundary

organisations used and do these problems occur due to a lack of legitimacy, credibility and/or salience? Through the use of which strategies do they (tempt to) solve these issues and how do external factors (such as the structuredness of the policy problem and the presence of legal frameworks) influence the choice for a boundary organisation as a science-policy interface. In short: When, where and how do boundary organisations work?

2. *Boundary organisations*

Based on the three previously mentioned variables of a science-policy interface – actors, goals and strategies – we reviewed the scientific literature on the topic of boundary organisations in order to develop a clear definition. Interestingly enough, there appear to be only a few authors who attempt to provide a clear definition. Osmond et al. state that “Interface organisations are groups created to foster the use of science in environmental policy and environmental management, as well as to encourage changes in behaviour, further learning, inquiry, discovery or enjoyment” (2010: 306). Cash argues that boundary organisations are “organisations that ‘straddle the shifting divide between science and policy’, mediating between science and policy and facilitating the interaction between actors on either side or who cross the boundary” (2001: 432).

Various other authors, however, use definitions for the concept of boundary organisations, whereby it appears that they focus on just one or two of the three variables mentioned earlier.

Miller states that boundary organisations are “those social arrangements, networks, and institutions that increasingly mediate between the institutions of “science” and the institutions of “politics” – understood by labels for distinct forms of life in modern society” (2001: 482). Schneider describes them as “a form of network, but a particular form that typically is created by a government agency not only to bridge agency boundaries but also to bring scientific information into the policy arena.” (2009: 60). Gulbrandsen assumes that “all boundary organisations are hybrids” (2011: 219), with which he means applied research institutes with direct relations with companies, policy-makers and other users of scientific information (2011: 215, 216). Finally, Huitema and Turnhout describe such an organisation as an organisation that employs a group of scientists (2009). These descriptions focus foremost on the *initiating and participating actors*. The initiating actors appear to be, predominantly, scientists or research institutes. Participating actors can be found in policy-makers and the private sector. When spoken of the form – ‘network’, ‘institution’, ‘agencies’ – a certain degree of embeddedness into legal frameworks is insinuated. Further elaboration on these possible legal frameworks in which these organisations operate is not given, however. A point of critique on the more established idea of the form of a boundary organisation is given by Boezeman et al. (2013), when they argue that literature mostly focusses on standing organisations, rather than on more short-term, ad hoc organisations.

With regards to the *goal* of a boundary organisations, Guston claims that they are meant to facilitate the transfer of usable knowledge between science and policy and “give both the

producers and the consumers of research an opportunity to construct the boundary between their enterprises in a way favourable to their own perspectives” (2001: 405). Or, to make it more specific, they are “supposed to enable a more effective use of knowledge in political decision-making by providing stability in the often contested boundary area between the political and the scientific domain” (Pesch et al., 2012, 487). Also, they can “help improve the end-to-end process of knowledge co-production and application by enabling scientists and decision-makers to increase mutual understanding of capacities and needs while remaining within their respective professional boundaries” (Tribbia and Moser, 2008: 317). The focus of these and other authors lays with boundary organisations having a facilitating role by supporting the transfer of knowledge (Osmond et al., 2010; Cash, 2001; Biesbroek et al., 2010). On the other hand, scientific literature discusses boundary organisations as to “function as an intermediary between science and policy by producing scientifically valid and policy-relevant knowledge” (Huitema and Turnhout, 2009: 579). They and others argue that these type of hybrid organisations not only communicate but also conduct knowledge themselves (Gulbrandsen, 2011). Concluding from this, although there appears to be consensus on the goal of boundary organisations to have an intermediary role between science and policy, the way in which the scientific knowledge is produced (by other (scientific) organisation/institutions or by the boundary organisation itself) stays contested. Miller phrases this well, when he states that “boundary organisations appear to need the approval of science for the *credibility* of their knowledge claims as well as the approval of political institutions for the *legitimacy* of their policy orientations” (2001: 483). Furthermore, Clark et al. (2011) add to this the component of *salience*, meaning that the output of the boundary organisation needs to be relevant and timely for decision makers. Boezeman et al. refer to these three goals as internal social arrangements and practices. They argue that “upholding an image of salience, credibility and legitimacy is by no means self-evident” (2013: 169). A certain degree of external back stage positioning of the advice, through active interactions and negotiations with the actors in order to recruit support for the ideas of the boundary organisation is needed (ibid.).

Finally, in terms of ways which boundary organisations undertake to reach these goals, a range of strategies are discussed. The first is that “all stakeholders collaborate to produce mutually instrumental *boundary objects* and standardized packages” (Guston, 2001: 402). The concept of these boundary objects is an often mentioned one, originally developed by Star, and entails “those scientific objects which both inhabit several intersecting social worlds and satisfy the informational requirements of each of them” (Star and Griesemer, 1989: 393). The objects have a certain aspect of interpretive flexibility, which means that an object can have different uses and interpretations (Star, 1989; Star and Griesemer, 1989; Star, 2010). According to Carlile, the capacity of a boundary object is two-fold: “both practical and political. Practical because it must establish a shared syntax or a shared means for representing and specifying differences and dependencies at the boundary. Political because it must facilitate a process of transforming current knowledge so that new knowledge can be created to resolve the negative consequences identified” (2002: 453). Literature on boundary organisations, however, provides us with little insight in how and when these boundary objects can be used in order to enhance the interactions between science and policy.

Other strategies of boundary organisations, discussed in the scientific literature are “synthesizing, ‘translating’, and taking scientific results directly to decision makers, through targeted documents, presentations and small meetings” (Osmond et al., 2010: 312) and “inform([ing] political and social actors on what is known about a specific topic, hoping they will henceforth refer to the same body of literature” (Pesch et al., 2012: 496). The MNP¹ for example tried to achieve this through the organisation of a symposium among stakeholders (ibid). Finally, Hanger et al. discuss the criteria Hoppe (2010) developed for an effective organisation: 1) double participation, people from both domains need to be involved; 2) dual accountability, work needs to conform to both scientific and policy standards; 3) use of boundary objects, such as scenarios, assessment reports, models; 4) boundary management/coproduction, communication, translation and mediation between science and policy; and 5) meta-governance, orchestration of knowledge across jurisdictional levels (Hanger et al., 2012: 2). This last set of criteria, seems to include and combine a large part of the strategies of boundary organisations scientific literature describes. Whether or not all criteria need to be met in order for this type of organisation to be effective, appears to be left in the middle.

Examples of boundary organisations other scholars have researched, include the MNP (Pesch et al., 2012; Huitema and Turnhout, 2009), the IPCC (Humphreys, 2009) and the Dutch Delta Committee (Boezeman et al., 2013). Through the use of (mainly) content analyses of documents and (semi-) structured interviews with representatives of the organisations and stakeholders surrounding these organisations, empirical research was conducted. Interesting conclusions that were drawn from these researches can be of contribution to the existing (more theoretical) understanding of boundary organisations and in the development of our own definition. Pesch et al. (2012) show with their MNP case that boundary organisations are constantly subjected to a changing environment, resulting in constant adjusting to its role orientation. Humphreys states that without political commitment from governments, boundary organisations will have difficulties in succeeding their goals. He argues that if boundary organisations are initiated by scientists only, improving interactions becomes difficult (2009). Cash, who discusses the case of CSREES² describes additional functions: they help define the scale of a problem by negotiating the boundaries between levels and they mediate multidirectional information flows across levels (2001: 442).

When reviewing the literature on boundary organisations, it can be concluded that – in terms of definitions – often one side of the concept (actors, goals or strategies) is explained, but hardly ever all three of them. By developing a definition which includes all three aspects a science-policy interface consists of (*Van Enst et al., 2013*), the step from theoretical research to empirical research becomes more easily, since the objects of research are explicitly defined. Based on the previous, we formulate our definition as follows: a boundary organisation is a hybrid, ad hoc or institutionalised network with direct relations and interactions with scientists, policy-makers, the private sector and other stakeholders, aiming

¹ MNP is the Netherlands Environmental Assessment Agency: an expertise institute that advises the Dutch government in environmental politics

² Cooperative State Research, Education, and Extension Service

to increase the legitimacy, credibility and salience of knowledge in order to enable a more effective use of this knowledge in decision-making processes, through acting as a dynamic intermediary by stimulating multiple participation and accountability, the use of boundary objects, boundary management and meta-governance.

3. Research design and methodologies

In order to research when, where and how boundary organisations work, we have identified three boundary organisations, all with (strong) links to the Dutch Wadden Sea area. The Wadden Sea is a shallow estuarine sea, north of the Netherlands, where ecological interests often compete with other, economic and social interests (such as gas mining, shipping and tourism). In (recent) history, these different interests have led to multiple disputes and difficulties with the interactions between science and policy (e.g. gas mining and cockle fisheries). Issues with the (lack of) legitimacy, credibility and salience of the knowledge used in these disputes often appear to be at the basis of the problems. Among other science-policy interfaces, organisations that aim to act as boundary organisations on local and national scale are in place to resolve or prevent problems with the production, use, and supply of and demand for knowledge.

The empirical research will be conducted using two methodologies. There will be an in-depth document analysis, aiming to analyse the background and history of the organisations as well as their formulated goals and strategies. The focus lies on the question why these organisations were created and with what purpose and aim. Following this desk research, semi-structured interviews will be held with various stakeholders surrounding the organisations and the specific cases we will select. In selecting these respondents, we will develop a network of the researched organisation with its surrounding stakeholders and institutions, after which a selection will be made, based on level of interaction and involvement with the organisation and the science-policy relationship.

In terms of the level of analysis, first an analysis of the individual boundary organisations will be made, after which a comparing analysis of all three organisations will be done. Resulting from these two analyses, we should be able to draw up conclusions and recommendations towards our research question, “When, where and how do boundary organisations work?”.

4. Contextualisation cases

4.1 Wadden Academy

The establishment of the Wadden Academy finds its foundation in the report developed by the Commission Meijer, as a result of the cockle fishery and gas exploitation controversies in

the Dutch Wadden Sea. Up until the 2000's the events and decisions of both cases were independent from each other. In 2002 however, the consultancy company IMSA Amsterdam became a mediator in the controversy on gas exploitation in the Wadden Sea. During these mediating activities, "IMSA connected the cockle fishery – which was perceived as major threat to the ecological quality of the Wadden Sea – to possibilities for new gas exploitations" (Floor et al., 2012: 2). Ecological experts even concluded that the negative ecological impact of cockle fisheries was much larger than with the gas exploitation.

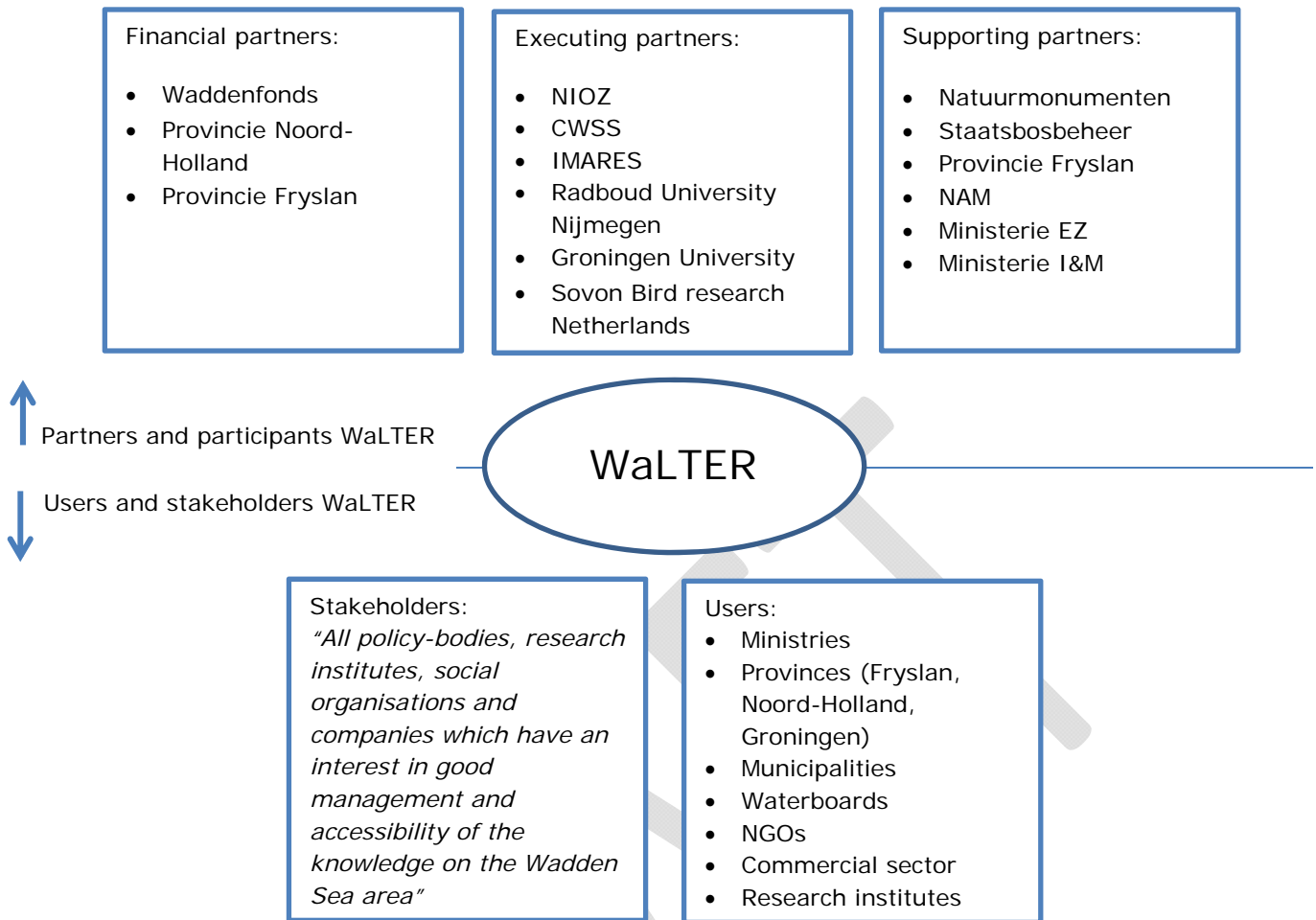
Following the workshops and interventions the IMSA undertook, the Dutch government installed the Commission Meijer which was given the task to explore possible policies for gas exploitation, shellfish fishing and conservation of the Wadden Sea nature. Their advice was presented in a final report, "Room for the Wadden", in 2004. Their conclusions were that the administrative structure at the time was far from decisive and transparent, resulting in defencing policy and administration and hindering the development and improvement of nature, but also of economic development of the Wadden area (Meijer et al., 2004). They identify one of the causes of these problems to lie with the lack of knowledge management. Although the amount of research and knowledge on the ecosystem of the Wadden Sea is impressive, it is problematic that all this knowledge is scattered. The wide range of research- and knowledge institutes and the variety in stakeholders with their own points of view do not always see, or want to see, possibilities to come to integrated knowledge development.

In order for policy and administration to become more effective, the commission Meijer advises that the knowledge on the ecological and social-economic development of the Wadden Sea should be integrated and enhanced, through the establishment of a Wadden Academy. This organisation is officially founded in June 2008, with the ambition to:

"(...) develop the Wadden Sea Region into an incubator for widely applicable integrated knowledge of sustainable development of a coastal area, in which natural values are a key element and form the foundations of the local and regional economy. The region is a meeting place for scientists from the Netherlands and elsewhere, administrators, policy makers and management agencies. Together, they develop sustainable and innovative solutions based on interdisciplinary knowledge. By 2020, the trilateral Wadden Sea Region will be the best monitored and best understood coastal system in the world."

4.1.1 WaLTER project (Wadden Sea Long-Term Ecosystem Research)

One of the projects initiated by (amongst others) the Wadden Academy is the WaLTER project. With this project the aim is to not only to carry out long-term measurements and research in the Wadden Sea, but also to collect and combine existing research and data in order to improve research and monitoring programs, identify gaps of information in the current monitoring networks and programs and make all this information more accessible to all who want to use it (policy-makers, scientists, NGOs, commercial sector etc.).



4.2 Netherlands Commission for Environmental Assessment (NCEA)

In 1987, the NCEA was established as an independent advisory body of experts by decree. The NCEA is able to, or has to give advice at two points in time. First of all, at the start of an environmental assessment procedure; which information needs to be included into the EIA. This advice concerns the scope and level of detail of the EIA. Secondly, after the report is produced, the EIA is tested whether or not the information is enough to include the environmental stakes into the decision-making process. The NCEA thus advises governments on the quality of environmental information in EIA or SEA reports. These reports are not written by the NCEA itself, but (usually) by consultancy bureaus, private initiators, local or provincial authorities and central government. Furthermore, the NCEA is not involved in decision making or political considerations based on these reports. With each procedure, the Commission established an independent workgroup, consisting of experts from various fields. Besides the NCEA itself, one can understand these independent workgroups to be (temporary) boundary organisations as well. These groups however issue advisory reviews, where the NCEA also focusses on sharing and disseminating knowledge on environmental assessments.

What makes the NCEA to be an interesting case, is the fact that it is established by decree and therefore their advices have certain compellingness to them. How does this influence the

strategies of the Commission and their workgroups and what is the influences of this compellingness to the effectiveness of the strategies? These questions will be researched in the case of salt mining underneath the Wadden Sea by Frisia.

4.2.1 Salt mining by Frisia

In 2008 the company Frisia asked the NCEA for advice on salt mining underneath the Wadden Sea. An environmental impact assessment was conducted, and the Commission based their advice on this report. As with the mining of gas, salt mining causes subsidence. In order for Frisia to get approval to mine, the report of the Commission should state that this subsidence would have limited impact on the Wadden Sea soil. *(to be continued)*

4.3 IMSA Amsterdam

IMSA Amsterdam is an “independent think tank and consultancy & research firm committed to the environment, sustainability and innovation, operating on the interface between industries, governments, NGOs, science and the critical outside world to develop together with our clients innovative solutions to sustainable development”³. They played a key role in the cockle fishery and gas exploitation controversies in the Dutch Wadden Sea (Floor et al., 2012). In 2003 IMSA sent a letter to all the Dutch political parties, advising them to: “allow gas mining; use part of the revenues to create a Wadden fund for solving the main environmental problems; commission research on the ecological impacts of shell fisheries and prepare decision-making for the continuation of this activity; and install a Commission to elaborate and advise on these issues. The letter was supported by 20 stakeholders, including the Wadden Society and the NAM.” (Runhaar and Van Nieuwaal, 2010: 243). This advice meant a breakthrough in the discussions surrounding these contested issues. This is in line with IMSA’s aim to not only deliver a report containing an advice, but also achieve support for the advice.

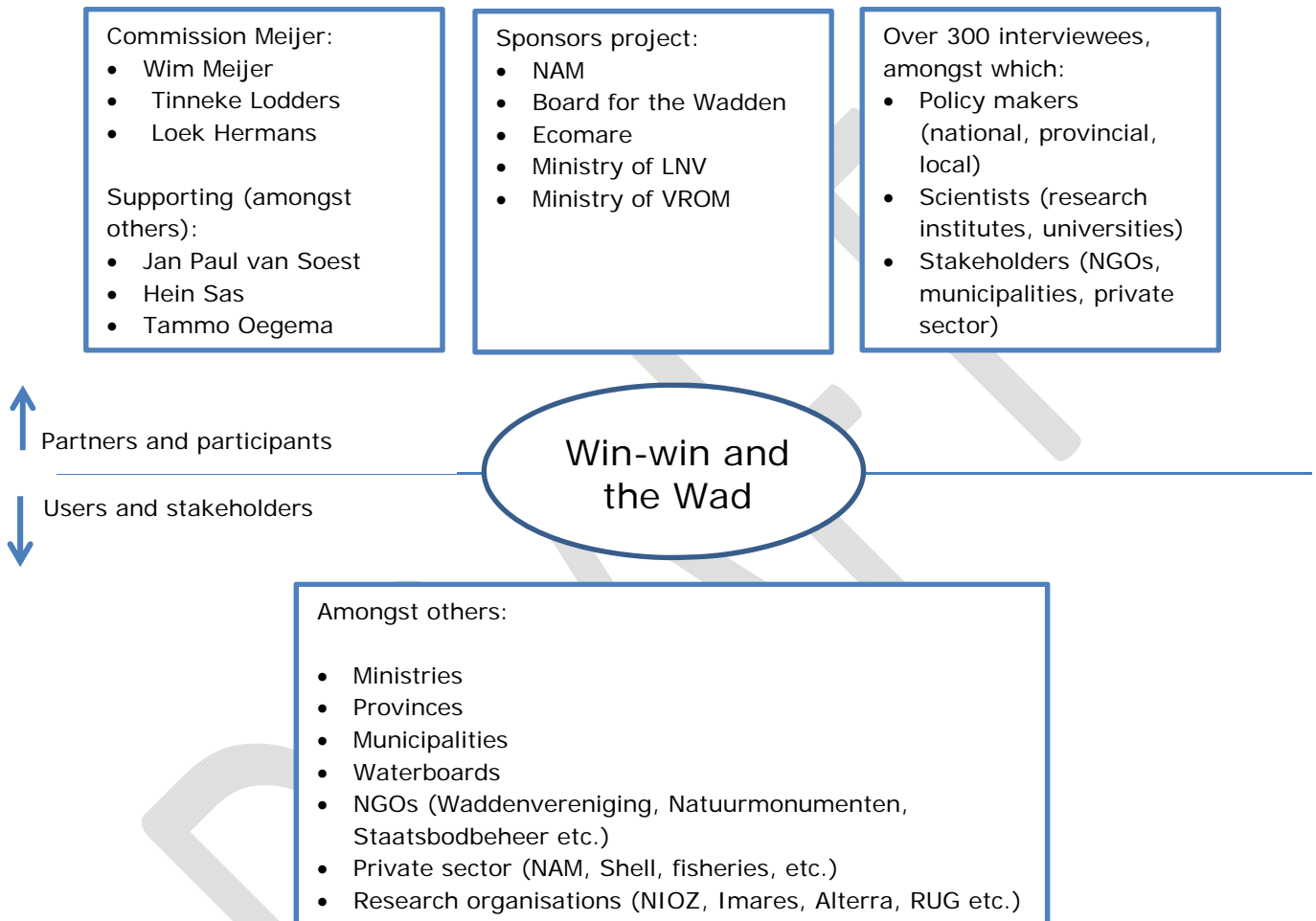
How IMSA reaches this goal, however, appears to be less clear. Little is known on how boundary organisations with a more private character develop and execute their strategies in order to enhance the interactions between science and policy. By researching the Wadden Sea project (“Win-win and the Wad) in which IMSA played a consulting and mediating role, we aim to uncover these strategies.

4.3.1 Win-win and the Wad project

In 2002 IMSA Amsterdam started the Win-win and the Wad project as a reaction to the on-going mantra that an area of unspoiled nature like the Wadden Sea should have as little human interventions as possible. As long as this mantra was repeated, IMSA claims, policy kept being adjusted to it. IMSA concluded from their first round of interviews with an array of stakeholders that the image on an ‘unspoiled nature’ was false. They even concluded that the policies which were based on this idea, led to deterioration of nature, rather than

³ www.imsa.nl

improvement. The aim of IMSA Amsterdam with this project was to develop a new model for the Wadden Sea nature, with the inclusion of economic activities. This case will examine in what way IMSA acted as a boundary organisation, how they brought about the change that happened in the administrative arena of the Wadden Sea and what effect they had on the use of scientific knowledge in decision-making processes.



4.4 Three organisations compared

Although the aim of the three organisations appears to be similar (they all focus on the relationship between science and policy, and aim to enhance this relationship by functioning as a mediating organisation), they also differ in many aspects. These differences do not only lie in the strategies used to reach their goals, they are also at the foundation of the organisations. It is of importance to take these differences into account in this research, since the identity of these organisations are of explanation to the way they work – part of the ‘how’ question in this research. In order to create a quick overview of the differences and similarities, the following table was developed:

	Wadden Academy	NCEA	IMSA Amsterdam
Goal	<i>Develop sustainable and innovative solutions based on interdisciplinary knowledge</i>		<i>Develop innovative solutions and sustainable development</i>
Background employees	<i>Scientists</i>	<i>Scientists and policy-makers</i>	<i>Consultants/experts</i>
Funding	<i>Wadden Fund and provinces</i>	<i>Government</i>	<i>Private</i>
Conducting own research	+/-	--	-
Legal status/ formal compellingness advices	+/-	++	--
Unasked/asked for advice	<i>Both</i>	<i>Asked for</i>	<i>Both</i>

With regards to these differences, we will research to what extent these different characteristics affect the strategies used and how effective these strategies are. It is however not our aim to develop a judgement on which organisation is a ‘better’ boundary organisation. In the following paragraph we will present the results of our empirical research, explaining when, where and how these organisations work, which strategies they use, how effective they have been, their influence on the legitimacy, credibility and/or salient character of the scientific knowledge used, and which science-policy interaction problems they focus on.

In order to give provide this research with more guidance, we developed the following table, in which we (shortly) state our hypothesis regarding the involved actors, types of problems the organisation focusses on, which aspect of knowledge they tent to enhance, the expected strategies, the pitfalls which could undermine the goals and strategies of the organisations and pre-conditions which could be set to intercept these pitfalls.

	Actors	Type of problems	Aspect of knowledge	Expected strategies	Pitfalls	Pre-conditions
Waddenacademie	scientists	strategic use	credibility and salience	development and publication of own reports	dominant scientific focus	administrative advisory board
IMSA Amsterdam	consultants	strategic use	legitimacy and salience	create consensus with focus on clients interest	commercial focus	scientific advisory board
Commissie m.e.r.	policy-makers and scientists	strategic use and production	credibility and legitimacy	use of their legal obligation	only advise on given information	customize advise

5. Results

6. Conclusions

Literature

- Biesbroek, G.R., Swart, R.J., Carter, T.R., Cowan, C., Henrichs, T., Mela, H., Morecroft, M.D., Rey, D., 2010. Europe adapts to climate change: Comparing National Adaptation Strategies. *Global Environmental Change*. 20, 440-450
- Boezeman, D., Vink, M., Leroy, P., 2013. The Dutch Delta Committee as a boundary organisation. *Environmental Science and Policy*. 27, 162-171
- Buuren, A. van, Edelenbos, J., 2004. Conflicting knowledge. Why is Joint Knowledge Production such a Problem? *Science and Public Policy*. 31 (4), 289-299
- Carlile, P.R., 2002. A Pragmatic View of Knowledge and Boundaries: Boundary Objects in New Product Development. *Organization Science*. 13 (4), 442-455
- Cash, D.W., 2001. "In Order to Aid in Diffusing Useful and Practical Information": Agricultural Extension and Boundary Organizations. *Science, Technology and Human Values*. 26 (4), 431-453
- Cash, D.W., Clark, W.C., Alcock, F., Dickson, N.M., Eckley, N., Guston, D.H., Jäger, J., Mitchell, R.B., 2003. Knowledge Systems for Sustainable Development. *PNAS*. 100(14):8086-8091.
- Clark, W.C., Tomich, T.P., van Noordwijk, M., Guston, D., Catacutan, D., Dickson, N.M., McNie, E., 2011. Boundary work for sustainable development: natural resource management at the Consultative Group on International Agricultural Research (CGIAR). *Proceedings of the National Academy of Science*, <http://www.pnas.org/content/early/2011/08/11/0900231108>
- Fenger, M., Klok, P.-J., 2001. Interdependency, beliefs, and coalition behavior: A contribution to the advocacy coalition framework. *Policy Sciences* (34), 157-170
- Gulbrandsen, M., 2011. Research institutes as hybrid organizations: central challenges to their legitimacy. *Policy Science*. 44, 215-230
- Guston, D., 2001. Boundary Organisations in Environmental Policy and Science: An Introduction. *Science, Technology and Human Values*. 26, 399-408
- Hanger, S., Pfenninger, S., Dreyfus, M., Patt, A., 2012. Knowledge and information needs of adaptation policy-makers: a European Study. *Regional Environmental Change* (article in press)
- Hove, S. van den, 2007. A Rationale for Science-Policy Interfaces. *Futures*. 39, 807-826.
- Huitema, D., Turnhout, E., 2009. Working at the science-policy interface: a discursive analysis of boundary work at the Netherlands Environmental Assessment Agency. *Environmental Politics*. 18 (4), 576-594
- Humphreys, D., 2009. Working across boundaries: science-policy interfaces and international forest politics. *Journal of Integrative Environmental Sciences*. 6 (3), 163-174
- McCool, S.F., Stankey, G.H., 2004. Indicators of Sustainability: Challenges and opportunities at the interface of science and policy. *Environmental Management*. 33 (3), 294-305

- Miller, C., 2001. Hybrid Management: Boundary Organizations, Science Policy, and Environmental Governance in the Climate Regime. *Science, Technology and Human Values*. 26 (4), 478-500
- Osmond, D.L., Nadkarni, N.M., Driscoll, C.T., Andrews, E., Gold, A.J., Broussard Allred, S.R., Berkowitz, A.R., Klemens, M.W., Loecke, T.L., McGarry, M.A., Schwarz, K., Washington, M.L., Groffman, P.M., 2010. The role of interface organizations in science communication and understanding. *Front Ecol Environ*. 8 (6), 306-313
- Owens, S., Petts, J., Bulkeley, H., 2006. Boundary Work: Knowledge, Policy and the Urban Environment. *Environmental Planning C: Government and Policy*. 26, 633-643.
- Pesch, U., Huitema, D., Hisschemöller, M., 2012. A boundary organization and its changing environment: the Netherlands Environmental Assessment Agency, the MNP. *Environment and Planning C: Government and Policy* 2012. 30, 487-503
- Pielke, R.S., 2007. *The Honest Broker: Making Sense of Science in Policy and Politics*. Cambridge: Cambridge University Press.
- Runhaar, H., van Nieuwaal, K., 2010. Understanding the use of science in decision-making on cockle fisheries and gas mining in the Dutch Wadden Sea: Putting the science-policy interface in a wider perspective. *Environmental Science and Policy*, 13 (3), 239 – 248
- Sarawitz, D., Pielke, R.A., 2007. The neglected heart of science policy: reconciling supply of and demand for science. *Environmental Science and Policy*. 10, 5 – 16
- Schneider, A.L., 2009. Why do Some Boundary Organizations Result in New Ideas and Practices and Others only Meet Resistance?: Examples From Juvenile Justice. *The American Review of Public Administration*. 39 (1), 60-79
- Star, S.L., 1989. The structure of ill-structured solutions: Boundary objects and heterogeneous distributed problem solving. M. Huhns and L. Gasser, eds. *Readings in Distributed Artificial Intelligence*. Morgan Kaufman, Menlo Park, CA.
- Star, S.L., Griesemer, J.R., 1989. Institutional Ecology, ‘Translations’ and Boundary Objects: Amateurs and Professionals in Berkeley’s Museum of Vertebrate Zoology, 1907-39. *Social Studies of Science*. 19 (3), 387-420
- Star, S.L., 2010. This is Not a Boundary Object: Reflections on the Origin of a Concept. *Science, Technology and Human Values*. 35 (5), 601-617
- Tribbia, J., Moser, S.C., 2008. More than information: what coastal managers need to plan for climate change. *Environmental Science and Policy*. 2, 315-328
- Wiltshire, S., 2001. Scientists and policy-makers: towards a new partnership. *International Social Science Journal*. 170, 621-635