

Appendix. Example of the method used

In this Appendix, we provide an example of the methods used in our paper. We extensively discuss how we built Table 5, concerning the ambiguity about the effects of the Safety Buffer nourishment on oyster beds. Regarding this particular ambiguity, the project team and the representatives of the oyster sector have different frames. For both actors, we show how we identified their frame regarding the Safety Buffer's effects and the actor attributes associated to this frame, by assessing the research questions posed in Table 1 using our research material (such as transcripts of interviews and meetings we attended, project documents and even a media publication). Table 1 can be found in the Methods section of the paper. Table 5 is presented in the Case study II: Safety Buffer Oyster Dam section.

Project team frame and attributes

The project team's **frame** regarding the Safety Buffer is that it is an innovative and socially acceptable pilot project, that is vital to learn about possibilities for future dike maintenance and dealing with the effects of the Sand Hunger. The project team consists of employees of the governmental and non-governmental institutions that proposed the Safety Buffer initiative. Such institutions initiate and support an initiative if they are convinced of its innovative potential and the opportunities it can provide. They would not initiate or support an initiative if it is socially unacceptable, e.g. because there is a considerable risk that stakeholders will be harmed. More specifically, the project team will not execute the project if they frame the Safety Buffer as an unacceptable initiative with regard to the oyster sector. As a representative of the municipality where the oyster beds are located remarked:

"We cannot imagine that [the project team] will dump a pile of sand there without looking at the consequences. That is not how Rijkswaterstaat works... Rijkswaterstaat [observed] that [problem] with the oyster sector. So they immediately indicated: well, we will perform the [sand] mining and nourishment very carefully. We will monitor very well. We will [monitor] if there is [damage] or no damage. So I got the feeling: they are really on top of it and will not [perform the project] just like that. No, it is really a process that has been [done] carefully from the beginning until the end."

During the meeting of the Safety Buffer knowledge team we attended – several project team members are also part of this team – the following statements illustrate how those responsible for the Safety Buffer project frame the initiative and the positive intentions they have towards the stakeholders:

"[The Safety Buffer] is viewed as a unique project to yield knowledge about the Sand Hunger... We want to learn from this... How can I slow down [or] reduce the Sand Hunger with this [concept]." *"The fact that you create a Safety Buffer at all, with the idea: it extends the maintenance period of such a dike... [By doing this project, we can] provide insight about that and make that reasoning transparent. And that is a very complicated [issue]... What does [the Safety Buffer concept] mean for [flood] safety?"* *"If we want to enter that [participatory] process with the stakeholders, then we need to be open and say: [stakeholders], how do we [feel] and what puts [you] into trouble? Or are their opportunities? How are we going to make something out of [this project] that makes everyone stronger?"*

Following Table 1, we identified the main **interest** of the project team by answering the research question 'what are the main ambitions or goals of the actor?'. For the project team,

we identified that their main interest is to learn about how to improve dike maintenance, while simultaneously aiming to improve the Eastern Scheldt estuary's natural, recreation and user quality. We identified this actor attribute from our interviews with those associated with the project team. For instance, the following was stated:

“Which interests play a role? It just started, very basically, with [dike] strengthening... [Additionally], we would, by [nourishing] sand, do something about the Sand Hunger, restore the natural value to what it was 20 years ago... And then additionally the combination with some recreation and of course [some benefits for] the mussel and oyster sector.” “An important reason why the project team eventually did not choose the first design we had, was because we wanted to learn from [the project]... And then we entered in discussion: yes, but how do we learn the most?”

Following Table 1, we identified the main **values** of the project team by answering the research questions ‘which moral principles does the actor hold as important regarding the topic? which criteria or boundary conditions are used to evaluate the topic?’. For the project team, we identified that an important value is their social responsibility for the well-being of the Eastern Scheldt estuary. Interviewees said the following about this:

“The higher goal. The higher goal: the Eastern Scheldt has to stay well. And we all want to get money out of it and enjoy it. But how do we do that?” “We very much want that [the Safety Buffer] is a step in working towards a sustainable Eastern Scheldt” “Whoever wants to join should pull up a chair, in order to jointly attempt to develop the Eastern Scheldt sustainably.”

An important value of the project team with regard to stakeholders in general – and hence with regard to the oyster sector in specific – is that they view it as their responsibility not to harm the interests of stakeholders. This value was an explicit boundary condition for the design process. During a sounding board meeting on 18 November 2011, this was explicitly communicated by a project team representative to all stakeholders present. In the minutes of that meeting, the following is reported:

During the development of the final design, the following 4 design criteria will be applied: (1) the users [i.e., stakeholders] and functions must not be damaged by either the dredging [i.e., sand mining] or sand nourishment... (3) if there is unexpected damage – in contradiction to the scientific insights – then this will be compensated according to the common claim settlements.

Following Table 1, we identified the **beliefs** of the project team by answering the research question ‘which propositions or premises does the actor hold to be true regarding the topic (even if there is no or contradictory evidence)?’. Regarding the ambiguity about the effects of the Safety Buffer on the oyster beds, the project team clearly believes that the project will not have adverse effects on shellfish beds. During the sounding board meeting of 20 April 2012, which we attended, this belief was explicitly communicated to those present. In the minutes of the meeting, it is reported that the risk of damage for the mussel and oyster sector is minor for the preferred design alternative. During the interviews, project team members avoided direct statements concerning the oyster sector, but the following quote – although an implicit statement – clearly supports the belief we identified:

“In [the oyster sector’s] way of thinking, it was about damage and so forth. Because that was their major concern: ‘there comes the sand’. Because [the Safety Buffer] was in the center [of the estuary] and of course, there are all those oysters. But those are very far away [from the Safety Buffer].”

Furthermore, the propositions that the project will not have adverse effects on shellfish beds was based on the belief that the judgments of experts involved in the project yield trustworthy predictions. We observed that no modeling studies were present among the project documentation, which points at the key role of experts in predicting the effects of the project. An interviewee remarked the following on this:

“[The design process was done] particularly with expert knowledge. And thus hardly based on data and that sort of things or models... I think that [any of the designs] will not really give any trouble for those [oyster] beds nearby, as long as some [precautions] are taken. And that has to do with the construction...[more than] with the spreading of the sand after [construction].”

Following Table 1, we identified the **background** of the project team by answering the research questions ‘which expertise, education or specific knowledge does the actor have regarding the topic? is the actor an expert or a layman regarding the topic?’. Several members of the project team – some of which we have interviewed – are an employee of Rijkswaterstaat, the state water authority of the Netherlands. Obviously, these are individuals with extensive expertise and knowledge regarding water management issues in general and sand nourishments in specific. Furthermore, an interviewed project team member – who is not an employee of Rijkswaterstaat – stated the following:

“[Regarding] the expertise there is [at Rijkswaterstaat] in Middelburg and their commitment...[Currently], it is more about contract management...the advanced engineering... Yes, Rijkswaterstaat is just immensely experienced with that... My admiration and respect for Rijkswaterstaat has grown [due to this project].”

Following Table 1, we identified the **experiences** of the project team by answering the research question ‘from which (personal) historical situations does the actor draw to interpret the topic?’. Regarding these experiences, the project team regularly points at the positive results of other nourishment pilots in recent years to strengthen their argument and to justify the development of the Safety Buffer. For instance, during the interviews, the following was stated:

“Then, we were busy with the Sand Hunger Survey in the Eastern Scheldt. And we were looking for the next pilots or experiments after the Galgeplaat [and the] Schelphoek [nourishment] pilot. Because those were all well on track. But now [we were looking for] something bigger... Galgeplaat went well.” “[The Safety Buffer provides the opportunity] to extend the experience that we have gained with sand nourishments in the Eastern Scheldt.”

Additionally, the success of previous pilots is often referred to in project documents, such as the so-called Execution Plan Safety Buffer Oyster Dam. This plan includes statements about the Galgeplaat nourishment, such as:

The results of this small-scale experiment are promising... However, in order to work on the strengthening of the tidal flats on a larger scale, [both] more knowledge and pilot projects on a larger scale are required... This Safety Buffer Oyster Dam project can contribute regarding this knowledge requirement.

Following Table 1, we identified the **actor position** of the project team by answering the research question ‘what is the societal or political position of the actor regarding the topic compared to other relevant actors, in terms of power or influence?’. We uncovered that the

actor position of the project team regarding the specific ambiguity we are addressing in this Appendix is ambivalent. Although the project team is a powerful actor supported by the government, they claim to be unable to overrule the economically vital oyster sector. Moreover, this claim was supported by several stakeholders we interviewed. A selection of quotes from our interview material illustrates this:

“Could you potentially be able to overrule the shellfish sector?... That will not work. You cannot just overrule the shellfish sector. Just to be clear, we don’t even want that.” (interviewed project team actors) *“If you have that entire sector against you, they can just block such a plan. They have that power.”* *“If the entire oyster sector becomes obstructive, [the project] will get into trouble.”* (interviewed stakeholders)

Oyster sector frame and attributes

The oyster sector **frame** regarding the Safety Buffer project is that it is an unacceptable initiative due to its potential adverse impacts on the oyster sector. Nevertheless, the sector does acknowledge that the quality of the estuary is degrading due to the Sand Hunger. We identified this frame based on the following statements of a representative of the oyster sector we interviewed:

“We, [the] Dutch Oyster Association, acknowledge that there is a problem in that Eastern Scheldt, thus that there is Sand Hunger... We were absolutely not amused [about the project]; that is obvious... We do not pay for it, we didn’t ask for it, we will never ask for it at that spot. We are in fact against [the Safety Buffer] at that spot. Because we prefer not to see it [constructed]. Because we do not need it... Why do you have to do it exactly where our [oyster]beds are?... There always is a certain risk. So I am convinced that you can never give 100% watertight guarantees for the future.”

Following Table 1, we identified the main **interest** of the oyster sector by answering the research question ‘what are the main ambitions or goals of the actor?’. The oyster sector is represented, both in the Safety Buffer project and in general, by the Dutch Oyster Association (in Dutch: Nederlandse Oestervereniging). This organization consists of nearly all commercial oyster producers. As the main goal of a common commercial business is to be as profitable as possible within reasonable and ethical boundaries, we argue that it is reasonable to assume that the main interest driving the oyster sector is maximizing their profit. Consequently, the specific concern of the oyster sector regarding the Safety Buffer project is that it could endanger their profitability. As the interviewee stated:

“My interest is that there is no damage of course... What if those oyster die?... Then it is a natural disaster, they’ll say. Oyster producers: gone!... If it goes wrong here, then you have a significant [financial] loss.”

Following Table 1, we identified the main **values** of the oyster sector by answering the research questions ‘which moral principles does the actor hold as important regarding the topic? which criteria or boundary conditions are used to evaluate the topic?’. We identified that, despite their focus on their own business, both the oyster and mussel sector feel a social responsibility for the well-being of the Eastern Scheldt estuary in which they cultivate their shellfish. Several interviewees commented on this. For instance, the following was said:

“We, [the] Dutch Oyster Association, acknowledge that there is a problem in that Eastern Scheldt, thus that there is Sand Hunger” *“On the one hand, [the shellfish sector] constantly says: we commit ourselves, we want to contribute to it... But on the other hand, you have to realize that their interest is, of course, rather*

minor. It is a societal responsibility they feel which they bear there. So that is an interesting position of the [shellfish] sector. They have no obligation, it maybe isn't even in their own interest and nevertheless, they still do it... Yes, less tidal flats theoretically [means] more mussel cultivation beds or oyster cultivation beds. But they are not into it like that. Fortunately!" "We were able to experience the blessings of the Delta Works, in the sense that [those made it possible that] the shellfish culture in Zeeland [still] exists. But [now] we are confronted with the side effects. And that is, among others, the Sand Hunger... So we do not want to turn our back to the societal reality of what is going on and that that is experienced as a loss from [a] natural point of view."

Following Table 1, we identified the **beliefs** of the oyster sector by answering the research question 'which propositions or premises does the actor hold to be true regarding the topic (even if there is no or contradictory evidence)?'. Regarding the specific ambiguity discussed in this Appendix, we identified one essential belief: the Safety Buffer will almost certainly have negative effects on the oyster beds. The main representative of the oyster sector sharply communicated this belief in an interview with the regional newspaper in May 2011. It was actually due to this interview that the ambiguity between the project team and the oyster sector surfaced:

If this [nourishment] takes place, that means the deathblow for the [oyster] sector.

Furthermore, the oyster sector representatives expressed similar concerns in a letter sent to the members of the Provincial authority in August 2011:

The oyster sector is very worried about the [proposed] nourishment at the Oyster Dam... In case of an excess of sand transport, [the oysters] will be covered...and will suffocate. With major anxiety we await the execution of the project plan.

During the interviews, the bottom line of the concerns was expressed as follows:

"We are very concerned that, (a) during the sand mining... that sand will enter the oysters, causing the oysters to die... and (b) [similarly], at the moment that the sand nourishment has taken place at the Oyster Dam."

Following Table 1, we identified the **background** of the oyster sector by answering the research questions 'which expertise, education or specific knowledge does the actor have regarding the topic? is the actor an expert or a layman regarding the topic?'. This attribute was partly derived by using common sense. Obviously, both the representatives of the oyster sector – i.e., the Dutch Oyster Association – and the commercial oyster companies are not experts regarding water management or sand nourishments, as this is not their profession. Regarding the background of the oyster sector, our interviewee touched upon this while describing the reason of their involvement in the project:

"There are two production sites [in Zeeland]: Lake Grevelingen and the Eastern Scheldt. In the Eastern Scheldt, the oyster beds are located in the immediate vicinity of the Oyster Dam... Therefore, we are a stakeholder [regarding the Safety Buffer]."

Following Table 1, we identified the **experiences** of the oyster sector by answering the research question 'from which (personal) historical situations does the actor draw to interpret

the topic?'. The oyster sector aimed to strengthen their argument by pointing at the negative side effects on a mussel bed due to an earlier nourishment pilot. As our interviewee stated:

“Look, the first pilot, so that was on a tidal flat at the Schelphoek. [A pilot] regarding that Sand Hunger. Well, [at the Schelphoek], there is some damage at a mussel bed. But that is [just] an incidental damage. However, if it goes wrong here [at the Safety Buffer and the oysters are harmed], then you have a significant [financial] loss... Yes, so therefore we proposed to raise a damage fund.”

Following Table 1, we identified the **actor position** of the oyster sector by answering the research question ‘what is the societal or political position of the actor regarding the topic compared to other relevant actors, in terms of power or influence?’. Similar to the project team, the actor position of the oyster sector is ambivalent. The oyster sector has no formal power to prevent project implementation, as they do not have the authority to take decisions. Nevertheless, because the oyster sector is an economically vital actor, this suggests they have a powerful position (as discussed above regarding the actor position of the project team). For instance, an interviewed project member stated:

“The oyster sector is really very important for Zeeland... There is big money in that [sector]. And there are major interests [attached] to that.”

However, during the interview, the oyster sector representative claimed that his sector does not have a powerful actor position and cannot influence the development of the Safety Buffer:

“We, [the oyster sector], are of course a very important party in this whole business... Well, the people I represent, they are [against] that sand nourishment... [However], it is fighting windmills... Opposing Rijkswaterstaat and the Province, that is too much for me and my 36 [Dutch Oyster Association] members.”