

Impact assessment of scale choices

Sonja Karstens¹, Pieter Bots² & Wil Thissen²

^{1, 2}: Delft University of Technology, Faculty of Technology, Policy and Management
Jaffalaan 5, PO Box 5015, 2600 GA Delft,
The Netherlands
Phone: 0031 15 278 7452, Fax: 0031 15 278 2464, E-mail: krs@geodelft.nl

¹: GeoDelft
Stieltjesweg 2
2628 CK Delft
The Netherlands

Key words: impact assessment, decision making, scale choices

Abstract

Although rarely addressed in the literature, selecting the spatial and temporal scale for problem analysis is an important and challenging activity at the start of any Strategic Environmental Assessment (SEA), Environmental Impact Assessment (EIA), or Policy Analysis. The adoption of a particular scale in a study sets bounds on the types of problems addressed, the kind of solutions to be found, and the kind of impacts to be evaluated. Analysts should realize that scale has a strategic value and is not politically neutral: the selection of scale may intentionally or unintentionally privilege certain stakeholders. In this paper, the Long Term Vision Study of the Scheldt Estuary is used to illustrate how scale choices are made in practice, what the impacts of scale choices are, and how the problem of scale selection can be structured to facilitate rational deliberation.

1. Introduction

1.1. Structure of analytic studies

Strategic Environmental Assessments (SEA), Environmental Impact Assessments (EIA) and Policy Analyses (PA) have in common that they are modeled after the general *intelligence-design-choice* structure of (bounded) rational decision making, but end at the point where the actual decision is made. By passing (and often iterating) through a sequence of activities, the analysts generate information that is intended to support decision making by others. In Figure 1, these activities are grouped in a *scoping* phase, a *design* phase and an *impact assessment* phase. In each phase, important scale choices need to be made.

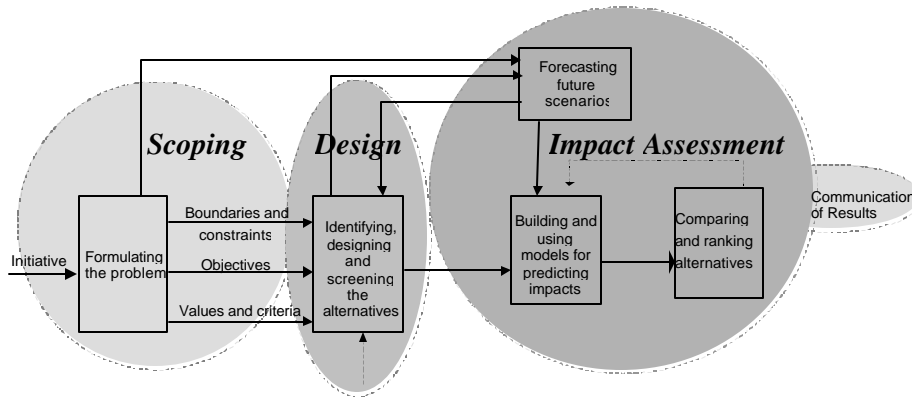


Figure 1: Overview of EIA studies and policy analysis studies

1.2. Scale choices in different phases

Scale choices in the scoping phase

In the scoping phase, the problem to be analyzed is defined. The analyst may opt for a focused problem analysis by choosing narrow system boundaries, or for a comprehensive problem analysis by choosing broad system boundaries. That scope can vary widely and has great consequences for the analysis can be illustrated using the case of water shortage in a large river basin. On the *basin scale*, the problem is how to distribute (as far as physically possible) scarce water resources among nations. On a *national scale*, the question is how water resources can best be allocated to regions within the nation, taking into account that some regional functions, such as electricity production and shipping, may be vital to the national economy. On a *regional scale*, the direct impacts of water shortage is felt by, for example, farmers, and trade-offs have to be made between the interests of local stakeholders. Choices made in the scoping phase will determine whether the problems that become manifest at different scales are addressed in a single, comprehensive analysis, or in a range of studies that focus on a selection of specific issues. These choices will lead to large differences in the design of the studies, the models that are used, the results they generate, and the influence they have on the decision making processes.

Scale choices in the design phase

Once the problem has been defined in the scoping phase, scale choices in the design phase may set additional bounds on the solutions to be considered. This can be illustrated using the case of mitigating the risk of flooding of the river Rhine in The Netherlands. Even if the analysts focus only on the problem of high river tides and on ways to keep the dikes from breaking, they still can make choices regarding spatial and temporal scales.

Flooding problems can be solved at an international or a national scale. Looking at the Rhine flooding problems in the Netherlands and only taking into account solution directions in the Netherlands we ignore possible (maybe more effective) solutions in Germany. This limited scale selection has the advantage that the possibilities to implement measures are within the authority of the Dutch government, but the measures itself might be less effective.

If the problem needs to be resolved on the short term, for example in case of large risks for calamities, solutions will be used with a short term impact such as dike improvement. In that case long term solutions do not provide an answer. If the problem of high river tides is studied on the long term also other alternatives such as calamity polders and giving more space to the

rivers may be promising. Although on the long term more solutions become feasible also more uncertainties play a role. Therefore it is more difficult to take decisions, which may cause limits to the action ability.

Scale choices in the impact assessment phase

A major challenge for SEA, EIA and PA is to clarify the interdependencies between impacts on different scales, and to produce relevant information on a scale that is appropriate for different stakeholders involved in different sectors. The scales that are appropriate for the impact assessment need not coincide with the scales used during the design phase. This is illustrated using the case of the construction of a medium-sized hydro-dam. Assuming that in the scoping phase, hydropower was seen as an efficient and sustainable solution to meet a city's growing demand for electricity, it is likely that when developing and evaluating different dam designs, the focus will be on the power generated, plant operability, safety, and of course cost. It is unlikely that in this stage engineers will take notice of the growing evidence that the decomposition of forests which are under water in the dam's reservoir produces more greenhouse gas than a coal firing plant that would generate the same amount of electricity as the hydro-power plant. Likewise, impacts of a dam on a larger scale, such as the collateral social damage (displacement of population), health risks (malaria) and ecological damage (loss of habitat), may be ignored since they do not discriminate between different dam designs. But a full-fledged EIA could reveal that the local and regional benefits of a dam (electricity, irrigation) are lost to the system overall.

These examples show two scale choices: time and spatial scale. A third scale choice can be added that is closely related to these scales: level of aggregation. For this research therefore a distinction is made between three scale choices:

- Selection of spatial scale: large (river basin, national) or small (channel, local)
- Selection of temporal scale: long term or short term
- Selection of level of aggregation: amount of detail

1.3. Scale choices: important but neglected

From the above it can be concluded that scale choices are of great consequence. Moreover, they involve difficult trade-offs:

All three examples make clear that scale choices will affect interests of actors in different political arenas. Scale is not politically neutral; scale choices have a strategic value, because the selection of scale may intentionally or unintentionally privilege certain stakeholders at the expense of others. The examples also show that choosing broad boundaries will make the analysis complex from the onset, but initial problem formulations that are too narrowly focused and oriented to one specific solution type may lead to the ignorance of more fundamental but far superior solutions (Thissen, 2000). But even if decision makers would prefer a comprehensive analysis, the available time and budget for the study often will be very limited.

Despite their importance, scale choices in EIA studies and in policy analysis studies appear to get little attention in practice and in literature. It is also unclear how these scale choices are handled in practice. The selection of scale depends on the problem that is formulated, the stakeholders that are involved, and the solution directions that are initially taken into account. Different points of view can be chosen in the selection of scale. For each selection sound arguments from that point of view can be made. As some actors emphasize time and costs of the study, some may consider scientific validity to be important and others want to protect

their own interests. This is consistent with the assumption that different kinds of trade-offs need to be made.

1.4. Aim and outline of this paper

In this paper the importance and impact of scale choices will be illustrated by the case study of the Long Term Vision of the Scheldt Estuary. Next, the question is addressed how to proceed in making scale choices.

First the scale choices made in the case study are reconstructed and verified with documents and interviews. Then alternative scale choices are generated in a thought-experiment. The actual choice and the alternatives are tentatively compared on a number of criteria in a qualitative impact assessment. For each scale choice (selection of spatial scale, selection of time scale and selection of level of aggregation) the analysis of the scale choice made, alternatives, explanation and impact assessment will be presented.

In the next step the criteria are clustered to be able to clarify the trade-offs that played a role in the case study. This way of reflecting on scale choices could be useful in ex-ante design of impact assessments and policy analyses and therefore finally some recommendations how to use it will be given.

2. Introduction to case study: LTV study of the Scheldt Estuary

2.1. Issue context and problem definition

The river basin of the Scheldt is located in Northern Europe and stretches over three countries: the Netherlands, Belgium and France, with a total length of 350 kilometers. The Scheldt basin is exploited intensively by the riparian states, which have assigned several user functions to the river. An important function of the Scheldt is navigation. The Scheldt Estuary is the maritime access to the port of Antwerp, which is one of the biggest ports in the world. In spite of the intensive human exploitation of the Scheldt, the basin still has high ecological values. Especially the estuary is a unique tidal system with high ecological value and potential. The brackish tidal water areas and marshlands, such as the Verdrongen Land van Saefthinge, and the fresh tidal water areas in the upper estuary are unique (Meijerink, 1998).



Figure 2: Map of the Schelde Estuary (Source: www.proses.nl)

Problem situation

The most prominent policy issue playing at the moment is *the possible deepening of the waterway*. This is considered necessary to keep the port of Antwerp accessible in view of the steadily increasing size of container vessels. It is expected that the actual tide dependent depth in the (near) future will hamper the economic development of the region. Belgium, situated upstream from the Netherlands (see figure 2), depends on the Netherlands as regards to the permits for captive and maintenance dredging and improvement of maritime access to the port of Antwerp.

When Belgium segregated from the Netherlands in 1839, different agreements were signed for the large joint infrastructures. The far-sighted Belgians insisted on a clause that would include the guarantee of free access of the ships to the port of Antwerp. In 1925 the agreement was added that if necessary the Scheldt would be deepened. The Belgians are now referring to this clause to proceed with the deepening. A treaty for deepening the waterway to 11.6 meters was signed in 1995. The actual deepening was carried out in 1997-1998, and part of the works (nature compensation) is still in progress. At the moment, it is not clear what the impacts of the recent deepening on the ecosystem of the estuary are, and more time is needed to assess these long term effects. Therefore some stakeholders doubt whether a further deepening of the waterway should be allowed.

2.2. Different perceptions on the Scheldt Estuary

The Netherlands and Belgium both recognize the importance of access to the Scheldt harbours, the value of a dynamic ecological functioning of the estuary and the need to guard against flooding. In the policy discourse, the Netherlands seem to emphasize the ecological value of the Scheldt and the risks of transportation of dangerous substances, while Belgium seem to emphasize its economic function. For Belgium the Scheldt is the most important economic transport medium, because it connects the port of Antwerp to the sea. For The Netherlands the Scheldt is one of many transport channels. In the Netherlands the most important ports are Rotterdam and Amsterdam. Some small ports are located along the Western Scheldt, such as Flushing and Terneuzen, but these are of less importance for the national economy. The Western Scheldt contains important habitats. These habitats are lacking in the access channels to Rotterdam and Amsterdam. This may be another reason why the Netherlands emphasizes the ecology in the Western Scheldt more than the economy (Santbergen et al., 1998).

2.3. Policy support study

The Dutch politicians had noticed that previous deepening led to long troublesome and costly procedures. The Dutch government opted for a study that would resolve this issue once and for all. Because the deepening program has to be carried out on Dutch territory for a Belgian port, it was decided to work on a joint bilateral vision for the long-term future of the Scheldt estuary.

A comprehensive study, called the Long Term Vision for the Scheldt Estuary was organized which was undertaken from June 1998 until January 2001. The policy support study was initiated by the Dutch Ministry of Transport and Water Management. The Dutch Ministry of Transport and Water Management and the Ministry of the Flemish Community decided to delegate the study to the Technical Scheldt Commission (TSC). In this way the TSC became the client for the study. The TSC was founded as a commission that prepares decision making on joint issues related to the Scheldt between Flanders and the Netherlands. The study was

executed by a Dutch and Belgium consortium of policy analysts (Resource Analysis and Technum).

The objectives of the policy support study were stated as follows:

- Create an integrated joint Long Term Vision for the Scheldt Estuary. The leading objective for the development of the joint vision is “the development of a healthy and multi-functional estuarine system that is used for human needs in a sustainable way”. The objective for 2030 was formulated as follows: “The Scheldt Estuary is in 2030 a healthy and multi-functional estuarine water system. The system is used for human needs in a sustainable way.”
 - Stimulate joint co-operation between the Netherlands and Flanders by conducting this study together.
 - Work out different policy options to implement this vision
- (Ministerie van Verkeer en Waterstaat et al., 2001a)

The following aspects were considered in the study:

- Economic aspects; the accessibility and economic future of the ports along the Scheldt
 - Environmental aspects in the unique ecosystem
 - Safety aspects; flooding and dangerous goods transports
 - Morphological aspects; consequences of deepening on the morphology of the river
- (Ministerie van Verkeer en Waterstaat et al., 2001a)

Working groups were installed that operated on these aspects. Several scientific advisors provided support in these working groups that consisted primarily of governmental officials.

Despite the fact that the study was executed in a complex policy environment in which despite surface agreement on the objectives underlying tensions exist, it can be considered to be a great accomplishment that this study was finished in time and to the satisfaction of all stakeholders involved in the project.

In the following sections the selection of spatial scale, the selection of time scale and the selection of level of aggregation is discussed. In the Long Term Vision study the selection of spatial scale played the most prominent role and generated much discussion. The selection of time scale was also rather controversial with two conflicting opinions. The level of aggregation however generated little discussion.

3. Analysis and impact assessment of the selection of spatial scale

In this section the spatial scale choices made are analyzed: what scale choices are made, how are they made and what factors seemed to play a role? After having gained insight in these matters the impacts of the spatial scale choices are assessed.

3.1. Selected spatial scale

The selected spatial scale of study is the Scheldt estuary from Gent to the North Sea, including the banks, excluding the tributary rivers and channels. In the additional explanation report of the LTV-study a lot of attention has been paid to the argumentation that led to this selection of spatial scale (Ministerie van Verkeer en Waterstaat et al., 2001b). An important

criterion to limit the spatial scale of the study was the ability to formulate a coherent integrated vision for the Scheldt Estuary (Ministerie van Verkeer en Waterstaat et al., 2001a). The choice not to include the tributary rivers and channels was to limit the number of governments involved in the process. Reason to include Gent (and not to set the boundary at Antwerp, which is located downstream) is that in this way the entire tidal area is taken into account; the project team considered these boundaries to be accurate from the point of view of the physical system. From a *morphological perspective* it makes perfect sense to set the spatial boundaries around the estuary system, although the choice not to include the tributary channels is not completely in line with that perspective. However morphology is only one of the aspects under study; other aspects that were identified were economy and ecology. From these perspectives other selections of scale could have been made as is shown underneath.

3.2. Alternative options

Estuary including Zeebrugge

The scale of the economic system does not coincide with the scale of the water system but extends into international systems for industrial production and trade (Verhallen et al., 2000). In these international systems a lot of other ports are involved like Hamburg, Rotterdam, London and LeHavre. Deepening the navigation channel will have economic effects on a larger scale than the Scheldt itself (for example on the port of Rotterdam and the port of Zeebrugge). In different background studies it is stressed that from an economic perspective it is important to consider a larger scale. In a second opinion study it was concluded that from a transport- economic point of view it would be good to include the ports of Zeebrugge and Oostende in the design of policy options (Roos et al., 2000) because of the future advantages of sea ports. In this way more policy options besides only deepening or not would come into the picture. A second plea for sea ports was made in the consultation study in which interviewed stakeholders emphasized that from a safety point of view the trans-shipment of dangerous substances preferably takes place near the sea. (Leemhuis-Stout, 2001). This also pleads for scaling up and involving the sea ports in the solution, even when the selection for the tidal area is kept constant.

River Basin of the Scheldt

Ecology is one of the aspects that were studied in the long-term vision project. Water quality issues, however, do not fit the selected scale, but play out over the entire river basin. Many pollution sources are located in upstream parts of the Scheldt. In the LTV-study water quality was taken into account as an exogenous factor, because otherwise many more stakeholders from the entire basin would have been involved in the process. Another reason that was stated was that water quality issues are already addressed in other arenas like the International Commission for the Protection of the Scheldt.

3.3. Explanation

Clearly a lot of reasonable options exist for the selection of spatial scale. These options are related to different disciplinary perspectives but can also differ within a discipline. The question arises why scale choices are made in this way. Pragmatic considerations appear to play an important role in making scale choices. The selection of spatial scale in a study is always related to the level of authority of the client of the study. This can also be recognized in the LTV-study. The Ministries made an explicit choice to delegate the study to the Technical Scheldt Commission, which also led to a limitation of the spatial scale. By delegating the study to the Technical Scheldt Commission (TSC) the estuary became almost

automatically the object of study because the authority of the TSC was limited to the estuary. In this way the deepening would be the key issue on the agenda. The authority of the TSC does not involve water quality. This selection of scale was thought to be essential to be able to involve all relevant stakeholders in the study: the willingness to co-operate was dependent on the selection of scale. The only way to get the Port of Antwerp to co-operate was to exclude the other ports like Zeebrugge, Oostende and Rotterdam from the process. So it appears that not only rational arguments played a role in the selection of scale but also political reasons were present.

The amount of time available for the execution of the project also played an important role in the selection of the limited spatial scale. In Flanders the feeling exists that the Dutch were trying to delay the deepening process by starting the LTV study. “Many people feel that the LTV study is being started and abused to postpone the next deepening phase” (Blomme, 2001). Reason for this according to the Flemish is that the Netherlands are afraid for the competition position of Rotterdam (Blomme, 2001). The Flemish had an urgent interest at stake here: it was in their interest that this study would be finished as soon as possible to be able to take a fast decision on the deepening. This was one of the reasons to limit the time frame of the study. Before the project started it was decided that the project had to be finished within two years time. For such an extensive project this was an extremely difficult task. Finally the wish not to involve too many stakeholders led to a limited spatial scale.

3.4. Impact assessment for spatial scale

From the arguments given above, a number of associated criteria can be identified that apparently play a role in choosing for one or another alternative, for example completeness of policy options, costs and time needed for the study, economic validity, ecological validity, morphological validity and the willingness to cooperate.

In further analysis and based on common sense the complexity of the study, possibilities for consensus building (which was an important objective) and possibilities for issue trade-off appeared to play an important role.

Table 1 shows an impact table of the spatial scale.

Table 1: Impacts of spatial scale

Impact criteria	Selected alternative (I): Scheldt Estuary excluding tributary rivers/ channels	Alternative II: Include Zeebrugge	Alternative III: Scheldt River Basin
Complexity of the study	0	>	>>
Completeness of policy options	-	++	+
Costs and time needed for the study	0	>	>>
Economic validity	-	++	+
Ecological validity	--	-	++
Morphological validity	+	-	+

Possibilities for consensus building	0	-	0
Possibilities for issue trade-off	-	+	++
Willingness to cooperate	++	--	-

(- = small (negative), + = large (positive), < = decrease (positive), > = increases (negative), 0 = moderate)

Complexity of the study

By increasing the spatial scale of the study the complexity of the study increases as well because more issues (like water quality) and relations play a role. A consequence of a limited spatial scale is that some issues that play outside the scope become less important or can not be taken into account at all (for example water quality). The Dutch however did succeed to make ecology a joint issue on the agenda beside the deepening issue.

Completeness of policy options

A consequence of this selection of spatial scale is that the deepening of the navigation channel was placed prominently on the agenda. That was exactly the intention because the deepening was one of the most important reasons to start this study. The selection for this spatial scale can be seen as rather solution oriented because it makes the space for other solutions than deepening extremely limited. If only the port Zeebrugge was incorporated in the study many more options would have been present. Additional policy options for accessibility by enlarging the boundaries would be possible. Examples of these options mentioned in the study “Analysis of exogenous factors” (Resource Analysis, 2000) are the improvement of the existing channel connection between Zeebrugge and Antwerp (Pas van ’t Zand) and the construction of a new channel between Zeebrugge and the Channel Gent-Terneuzen. These solutions would lead to less shipment in the Mouth of the Scheldt. These options did not appear in the report of the Long-Term Vision study. The choice not to include the port of Zeebrugge clarifies that one of the constraints set beforehand is the development of the Port of Antwerp. It is however clear from the analysis of exogenous factors that the analysts wanted to clarify the context of the study and the limitations.

Costs and time needed for the study

A larger spatial scale would lead to a more complicated project because more policy options would be present and other issues like for example water quality should be taken into account. This would have been more time and cost consuming. A larger scale might also have led to a delay of the process, because a large number of stakeholders (that would have to be involved in case of a larger scale) would hinder the desired relatively fast process. The selected scale contributed to the progress of the study. The Port of Antwerp would have obstructed the process if a larger scale was selected in which the port of Zeebrugge was incorporated.

Economic validity

When the spatial scale of the study increases the economic validity of the study will also increase. The scale of the economic system extends into international systems for industrial production and trade (Verhallen et al., 2000). Deepening the navigation channel will have economic effects on a larger scale than the Scheldt itself (for example on the port of Rotterdam and the port of Zeebrugge).

Ecological validity

Upstream water quality has an important impact on the ecological system downstream. Therefore ecological issues play out over the entire river basin.

Morphological validity

From a morphological point of view the estuary is a logical selection of spatial scale. However the choice not to include the tributary channels is not completely in line with that perspective. The river basin would also be a good option, because all the sediment transport taking place in the basin could be included on that scale. Including Zeebrugge is a less obvious option because Zeebrugge is not situated in the Scheldt river basin.

Possibilities for consensus building

From the point of view of consensus building there is not an ideal spatial scale. The alternative that includes Zeebrugge does definitely not contribute to the possibilities for consensus building because the Port of Antwerp would then be unwilling to cooperate. In the other options the preferred spatial scale depends on the actor that wants to build consensus. For the Netherlands the Scheldt Estuary would be a good alternative to be able to build a good understanding with Belgium because they consider the Scheldt Estuary to be the best option. For Belgium it would be good to include the river basin, because in that way there are possibilities for issue trade-offs with the Netherlands within the project (see also possibilities for issue trade-offs).

Possibilities for issue trade-offs

This selection of spatial scale led to a limitation of possibilities for issue trade-offs. At a larger scale more possibilities for issue trade-offs within the project would have been present (for example water quality and deepening). Nevertheless issue trade-offs took place, but this time outside the project. In interviews it became clear that Flanders wishes a further deepening of the Scheldt to take place, but needs to take into account the desires of the Dutch in this matter. The Flemish people state clearly that Flanders accepted the track of the High Speed Train (HST) to please the Dutch wishes. They feel that the current track was not needed at all in Belgium. The Flemish conclude that there should be a balance in giving and taking between the different dossiers (HST and deepening the Scheldt) (Leemhuis-Stout, 2001). If the Dutch would have had a larger interest at stake in this study they would have had more interest in the progress of the project. Although these "package deals" exist outside the project this is not stimulating the Dutch to take action inside this project. The Dutch national government does not have an interest in the deepening issue that is on the agenda, they only have an interest in the flooding issue and in maintaining a good relationship with the Flemish government. The flooding risks might become larger in case of deepening so that is another reason for the Dutch not to be in favor of the deepening. By limiting the study to the deepening issue the Dutch do not have a high priority in the progress of the project. If package deals would have been available within this project then the Dutch might have had more interest in the progress of this project.

Willingness to cooperate

The Port of Antwerp is strongly opposed to any plan that would stimulate the development of Zeebrugge at the cost of Antwerp. Therefore it is not desirable to include the port of Zeebrugge. The interests of the key stakeholders (especially Port of Antwerp, and the Belgian government as well) are protected best by selecting the Scheldt Estuary.

4. Analysis and impact assessment for selection of time scale

In this section the temporal scale choices made are analyzed: what scale choices are made, how are they made and what factors seemed to play a role? After having gained insight in these matters the impacts of the temporal scale choices are assessed.

4.1. Selected time scale: 2030

At the start of the LTV-study a discussion took place on the time scale to be considered in the vision. Long term is of course quite a vague and broad notion. Finally it was decided to work on a Long Term Vision for 2030 based on a short term situation sketch of 2005 (see figure 3). Back casting could be used to develop policy options for the middle to long term. Four development sketches are created which containing policy options to reach the long term vision.

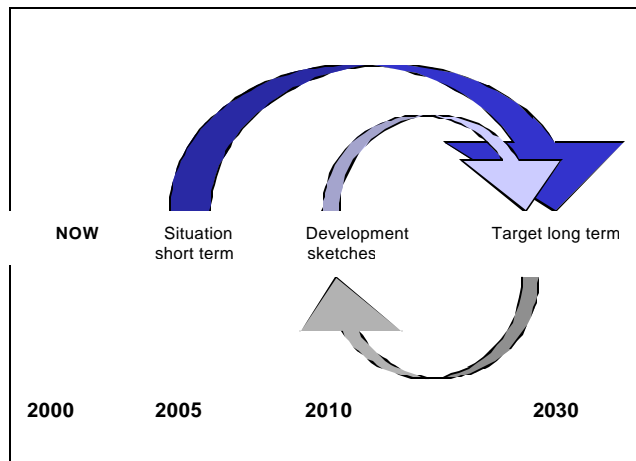


Figure 3: Short term and long term (Source: Ministerie van Verkeer en Waterstaat, 2001a)

4.2. Alternative options

2015

The client of the study suggested a Long Term Vision for 2015 or even 2010. In their perspective this was already long term.

2050

The advisors suggested 2050 as the end of the Long Term Vision. In this way it would be possible to take climate change into account.

In these options the difference in attitude between politicians and analysts can be recognized: for politicians ten to fifteen years is already long term, because they usually think less far ahead. They keep the time scale of political processes in mind in the selection of time scale of a study. Scientists generally have a longer time perspective in mind, because they consider the scale of other processes playing a role. This is however also depending on the discipline. Especially physical processes, such as morphological and ecological processes, tend to play on a larger time scale. For economists smaller time scale tend to be sufficient. This difference

of opinion led to extensive discussions but finally consensus was reached to make a Long Term Vision for 2030.

4.3. Explanation

Also in the selection of temporal scale pragmatic considerations played a role. The selection of this particular time scale had several causes:

- The time scale of 2030 matched better with the time scale of the ecological and morphological processes than 2015.
- On the other side the long term was somewhat limited by climate change. If a longer time scale had been selected the effects of climate changes were expected to be considerably larger. Climate change would be a complicating issue in this situation and should not necessarily be the focus issue. Also the time needed for the study would increase if climate change were incorporated.

4.4. Impact assessment for time scale

From the arguments given above, a number of associated criteria can be identified that apparently play a role in choosing for one or another alternative, for example costs and time needed for the study, economic relevance, ecological relevance, morphological relevance and complexity of the study.

In further analysis and based on common sense action ability, concreteness of recommendations, consensus among stakeholders appeared to play an important role

Table 2 shows an impact table of the time scale.

Table 2: Impacts of temporal scale

Impact criteria	Alternative I: Vision for 2015	Selected alternative (II): Vision for 2030	Alternative III: Vision for 2050
Action ability	++	0	-
Complexity of the study	0	>	>>
Concreteness of recommendations	++	+	-
Possibilities for consensus building	--	0	+
Costs and time needed for the study	0	>	>>
Economic relevance	+	0	-
Ecological relevance	-	+	++
Morphological relevance	-	+	++

(- = small (negative), + = large (positive), < = decrease (positive), > = increases (negative), 0 = moderate)

Action ability

The action ability decreases if the time scale increases. Due to the increasing amount of uncertainties that play a role on a longer time scale it becomes more difficult to determine what the best actions are. Also it is easier to postpone a decision in that case.

Complexity of the study

The complexity of the study increases when the time scale increases because on a longer time scale more uncertainties related to climate change become important.

Concreteness of recommendations

The recommendations tend to get less concrete at longer time scale. This is also related to the uncertainties that play a large role on a longer time scale.

Possibilities for consensus building

In general it might be easier to reach consensus on the long term than consensus on the short term. This has to do with the fact that when creating a long term vision it is easier to express in vague terms of what is considered to be important without having to translate that into direct actions.

Costs and time needed for the study

If the time scale increases the costs and time needed for the study increases because more uncertainties have to be taken into account.

Ecological relevance

Ecologists tend to think on large time scales. Preservation of ecosystems and biodiversity are key issues for them. Human impacts on the ecological systems may not become visible right away, but tend to have a larger dynamics. Therefore ecologists use to think on a large time scale that coincides with the time scale of the ecological processes involved.

Economic relevance

Economists tend to think on smaller time scales than ecologists because economic processes play on a shorter term than ecological processes.

Morphological relevance

Morphological time scales can vary from a few days for changes of small sediment layers to a large number of decades for channel movements. Sediment suppletion and movement of channels are interesting topics according to a morphologist. In the Scheldt Estuary it is fascinating for them to try to predict what the consequences on the morphology of the deepening are: how will the channels move or maybe new channels develop? These processes play on a long time scale.

5. Analysis and impact assessment of selection of level of aggregation

In this section the selection of level of aggregation is analyzed: what level of aggregation is selected, why and what factors seemed to play a role? After having gained insight in these matters the impacts of the selected level of aggregation are assessed.

5.1. Selected level of aggregation

A high level of aggregation was selected in this study.

5.2. Alternative options

Low level of aggregation

It would have been possible to conduct the study in such a way that more details would be involved.

5.3. Explanation

The main reason for the selection of a high level of aggregation was that this study was performed in an early stage of the decision making process. It had to stimulate joint collaboration between the governments of Belgium and the Netherlands. A high level of aggregation was thought to contribute to that objective, because conflicts might be prevented. Also it was thought that the details could be worked out in a later stage in the Strategic Environmental Assessment study. Also the limited time scale of the study made it impossible to study all the aspects into great detail. Of course the scientists involved preferred to work and make models on a lower level of aggregation, to be able to give more accurate answers. In general though, there was not much discussion about the selected level of aggregation.

5.4. Impact assessment for level of aggregation

From the arguments given above, a number of associated criteria can be identified that apparently play a role in choosing for one or another alternative, for example complexity of the study, costs and time needed for the study, number of conflicts, possibilities for consensus building, possibilities for model development

In further analysis regional support for the study appeared to play an important role.

Table 3 shows an impact table of the selection of level of aggregation.

Table 3: Impacts of level of aggregation

Impact criteria	Selected alternative (I): High level of aggregation	Alternative II: Low level of aggregation
Complexity of the study	0	>
Costs and time needed for the study	<	>
Number of conflicts	<	>
Possibilities for consensus building	+	-
Possibilities for model development	-	+
Regional support for the study	-	+

(- = small (negative), + = large (positive), < = decrease (positive), > = increases (negative), 0 = moderate)

Complexity of the study

A lower level of aggregation would increase the complexity of the study because more detail would mean that more issues and variables have to be included. Also more detailed models are needed.

Costs and time needed for the study

The costs and time needed for the study would increase enormously when a lower level of aggregation would be selected. Because the available time for the study was rather limited as explained before a lower level of aggregation was no desirable option.

Number of conflicts

A lower level of aggregation was thought to result in more conflicts on the details and therefore not beneficial to the progress of the study.

Possibilities for consensus building

The choice for a high level of aggregation can be considered beneficial to the consensus building in the short term but can also be regarded as shelving in the long term because the difficult details will have to be worked out later. After the project there have been some accusations from the Flemish government that the Dutch are trying to delay the study but in general the feeling exists the study has brought the different parties closer together.

Possibilities for model development

A lower level of aggregation offers more possibilities for model development for the scientists involved.

Regional support for the study

If a lower level of aggregation would have been selected more regional actors should have been involved in the study which would have increased the regional support for the study. This was also thought to delay the desired fast process. The regional support is vital for the implementation of policy options.

6. Perspectives on scale choices

6.1. Scale choices are a trade-off

In this study different objectives can be recognized which complicated the making of scale choices. The limited time available to execute the project was an important constraint that influenced a lot of other choices in the design of the study. For example the choice to limit the spatial boundaries to the estuary was beneficial to quite a number of objectives (consensus building, agendizing of the deepening issue, managerial) but in some way harmful, because according to the analysts good alternative solutions fell outside the scope of the study. Apparently the importance of the other objectives outweighed the importance of creating a large number of policy options in this study. The question can be raised whether this pragmatic approach will bring us to a sustainable solution that is one of the aims of the Long Term Vision.

The case study clearly shows that many different trade-offs are present on scale choices.

- Long term versus short term interests: Long term and short term interests may be conflicting. For example, economic considerations are primarily based on short term objectives whereas ecological concerns have a long term scope (Grijns et al., 1992).
- Perspectives of different disciplines can be recognized when looking at the morphological versus ecological versus economical perspectives on spatial scale
- Political versus scientific perspectives can be recognized in the discussion about the time scale
- Multi-stakeholder perspectives can be recognized in the port of Antwerp who is in favor of a small scale to put the issue of the deepening prominently on the agenda versus the

It is important to realize that the selection of scale always involves a trade-off. There is no perfect scale, each selection of scale has its advantages and disadvantages.

6.2. Perspectives

As shown in the previous section a lot of trade-offs need to be made. A trade-off between interests has to be made: political, but also scientific. This is not new: Goeller (1988) uses a similar distinction, by creating a spectrum of a policy analysis study. He makes a distinction between two dimensions of actor involvement in a policy analysis study: actors may be more or less involved in the problem situation, and actors may be more or less involved in the analysis. Different actors in the policy analysis study have different perspectives: the actors involved in the decision making process have a (dominating) political perspective and act to protect their own interests. The scientists have a (dominating) scientific interest, they want to conduct valid research that is interesting to them. Using this distinction, the criteria in tables xyz can be categorized into these two groups. However this leaves a large number of criteria that do not fit in either extreme.

For this research therefore two other actor roles identified by Goeller are used: the client and the analyst which are in between the extremes of the spectrum. The client tends to be closer to the decision making process and the policy analyst tends to be closer to the analysis.

Following Goeller, we identify two more actor roles: client and analyst, and we elaborate their perspective: the client not only has political interests, but is also pressed for time and limited in budget: we address this to be a managerial perspective. The analyst has to meet the client wishes (objectives of study) within the constraints of time and budget, but also has to meet scientific criteria. He has to design the study in such a way that he navigates between these perspectives, we call this an analysis design perspective. This will call for compromises.

Summarizing the criteria can be grouped into four perspectives:

- Political
- Scientific
- Managerial
- Analysis design

6.3. Clustering the results

Table 4 shows the clustering of the criteria in the three impact tables according to the four perspectives. In table 4 the perspectives are marked with a cross that consider that particular criterion to be important. The clustering of the criteria is thought to be necessary because the initial results show a lot of variety and it is difficult to draw overall conclusions from these results.

Table 4: Clustering of criteria

Impact criteria	Political perspective	Scientific perspective	Managerial perspective	Analysis design perspective
Spatial scale				
Complexity of the study				X
Completeness of policy options				X
Costs and time needed for the study			X	
Economic validity		X		
Ecological validity		X		
Morphological validity		X		
Possibilities for consensus building	X		X	X
Possibilities for issue trade-off	X			
Willingness to cooperate	X			
Time scale				
Action ability	X			
Complexity of the study				X
Concreteness of recommendations				X
Possibilities for consensus building	X		X	X
Costs and time needed for the study			X	
Economic relevance		X		
Ecological relevance		X		
Morphological relevance		X		
Level of aggregation				
Complexity of the study				X
Costs and time needed for the study			X	
Number of conflicts	X			
Possibilities for consensus building	X		X	X
Possibilities for model development		X		
Regional support for the study	X		X	

6.4. Conclusions clustered assessment

Looking back at tables 1,2 and 3 with these perspectives in mind the following conclusions can be drawn:

Selection of spatial scale

From a scientific perspective the river basin scale is preferred, from a managerial perspective the Scheldt Estuary scale seems to be in favor. Political and managerial perspectives appear to be dominating in the selection for spatial scale.

Selection of time scale

A large gap existed between scientists and politicians considering the time scale. This led to extensive discussions. Finally a compromise was made, that was not considered to be an option at first.

Selection of level of aggregation

Although the scientists by nature would prefer to work on a more detailed level, this did not result in much discussion about the selection of level of aggregation. From most perspectives the selected high level of aggregation would be the preferred alternative.

Heterogeneity in perspectives

It is emphasized that in both the political and scientific perspective contradictory scores for the alternatives appear. This can be explained by the multi-stakeholder interests and disciplinary differences that cause multi-disciplinary perspectives on scale. These multi-stakeholder interests and multi-disciplinary views will be explained underneath.

Multi-stakeholder interests

As mentioned in the beginning of this paper consideration of scale is important to the analysis of many problems, because scale can also be used in a strategic way. In policy analysis studies a lot of actors with different (or even conflicting) interests on different scales may be involved. Different points of view can be chosen in the selection of scale. For each selection sound arguments from that point of view can be made. As stated before the adoption of a particular scale in a policy analysis study set bounds on the types of problems that can be addressed. In this way an actor can be privileged if the problem he perceives is central on the selected scale. This may lead to a conflict: which actor is going to be privileged?

Multi disciplinary views

Depending on the disciplinary background of the experts and scientists involved they will look at scale choices with different "glasses". As shown a morphologist and an ecologist tend to be interested in much longer time scales than an economist. Reason for this is that the processes that are of interest to the ecologists and economists have a longer time scale.

7. Discussion and recommendations

What can we learn from this? The case study illustrated that scale choices (spatial scale, time scale and level of aggregation) exist, do matter, have large consequences. It is also noticed that from different perspectives different scale choices can be made. This generates a lot of discussion because a trade-off has to be made between different interests. Scale choices will often be made in a pragmatic way.

The obvious lesson to draw is that scale choices are an important framing instrument in the hand of the analyst. Analysts should carefully consider the consequences of scale choices in view of the interests of the stakeholders at different scales and in the multi-stakeholder perspectives on that scale. Further it is important to keep the objectives of study in mind and be sure to make scale choices in a way that they contribute to the achievement of the objectives. It is important to notice that scale choices are not always made by the analysts involved in the study. Sometimes the client of the study or a group of actors involved in the study make the scale choices. Then the analysts need to handle this in a pragmatic way. The analyst should make the consequences of scale choices transparent to the client and to the people involved.

Scale choices can be rationalized to some extent by generating alternatives for the scale choices and evaluate these choices from different perspectives. By doing this, insight is generated in the different perspectives and trade-offs between different interests. Although the ex-post case study is very qualitative and in some places very subjective and sketchy it shows nevertheless a picture that seems to correspond with the practice.

Scale choices may also be evaluated ex ante using the same approach. Some practical steps to be taken are: generate alternatives, evaluate these alternatives from different perspectives, communicate the impacts with the client and maybe with other people involved to be able to make deliberate scale choices.

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