MORPHOLOGICAL MANAGEMENT CONCEPT FOR THE WESTERN SCHELDT

PART OF THE LONG-TERM VISION ON THE SCHELDT-ESTUARY

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1. INTRODUCTION

The Scheldt estuary is situated in the Netherlands and Belgium and serves many functions. For centuries nature, shipping and fisheries were in harmony. However, in the 1950's, the economic development put great pressure on the estuary. Industrial activities expanded, big ports developed and the fairway was dredged. Also bank protections and dike reinforcements were constructed. All these activities threatened the natural developments of the estuary. Therefore the Dutch authorities, in 1991, drew up a policy plan for the Dutch part of the Scheldt-estuary, i.e. the Western Scheldt, with the objective to gear all the activities in order to preserve the Western Scheldt as a valuable nature reserve.

The plan established targets for all functions of the estuary (shipping, water management, ecology, water quality, morphological structure and dynamics, fisheries, safety against flooding and recreation) and provided the required measures to reach these targets. Indicators were formulated to monitor the realization of these targets.

In 1998 the Dutch and Flemish government agreed to develop a joint policy plan for the entire Scheldt estuary for a period up to 2030. This plan is referred to as the Long Term Vision of the Scheldt estuary. This Vision was presented to the parliaments of both countries in February 2001. Main aspects of the Vision are the naturalness, the safety of the hinterland against flooding and the accessibility.

One of the aspects of preparing this Vision was translating policymakers' questions into research questions and translating the results back into answers for these policymakers. This paper describes this process with the morphological study for the Western Scheldt as an example. Section 2 gives some background information of the Scheldt estuary. In Section 3 the vision making process is described and Section 4 describes the results of the morphological studies.

2. BACKGROUND

The Scheldt estuary reaches from the North Sea till the sluices of Gent and includes an ebb tidal delta, the Western Scheldt (Dutch territory) and the river Scheldt (Flemish territory). The total length is 160 km. The width of the Western Scheldt varies from 4.5 km at Vlissingen to 500 m at Antwerp and is characterized by a multiple channel system (a pronounced ebb-channel with straight flood-channels). The average tidal range varies from 3 m at Vlissingen to 4.5 m at Antwerp.

Along the Scheldt estuary five ports are situated, of which the Port of Antwerp at the transition between the Western Scheldt and river Scheldt is the largest. Obviously, these ports generate a lot of shipping in the Western Scheldt. Continuous dredging in the ebb-channels guarantees sufficient depth for shipping at low tide. Besides these dredging activities, large stretches of land have been reclaimed along the borders of the estuary. Both dredging and land reclamation affected the morphology and hydraulics of the estuary. Besides the importance as a waterway, the Western Scheldt is also of great international importance as a migrating, feeding and rest area for water birds. In the eastern part of the Western Scheldt a large brackish marsh is situated.

3. VISION MAKING PROCESS

Functions of the estuary

Nature, economy and safety are three very important though sometimes conflicting functions of the estuary. For example, deepening the fairway is beneficial for navigation, but causes erosion of inter-tidal areas, which are the most important areas for nature. Deepening also results in higher water levels, which affects the safety of the hinterland. Conflicting functions can easily be identified, however it is a challenge to look for strengthening functions. An example of a measure from which several functions benefit, is the creation of a spillway: On the one hand this improves safety, while on the other hand the overflow area can be used for the creation of nature. Figure 1 presents the relation between the three most important functions. The morphology is the integrating factor since all measures in favor of one of these functions affects the system's morphology.

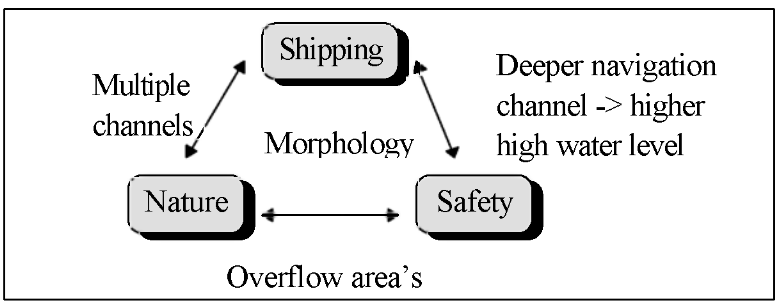

Figure 1: Relation between nature, shipping, safety and morphology

Organization

The integrated Vision for the Scheldt estuary in 2030 is based on three partial visions for the three main functions, shipping, nature and safety. These visions were formulated by three Flemish-Dutch workgroups. To achieve the desired situation in 2030 various strategies can be followed, ranging from very mild to very big interventions in the system. Preparing a vision requires knowledge of the processes in the system. This is visualized in Figure 2. In the process of policy making to research, several steps can be distinguished: Translation of the Vision into requirements for the aspects safety, shipping and naturalness is part of the policy making process. Translation of these requirements into knowledge of hydraulics, morphology and biology is part of the research process. This means that in the end, the research must yield to results useful for the vision making process. Therefore it is very important that policy makers and researchers keep in contact and try to understand each other. Often the gap between both is too large, however.

During the vision making process the available time was very short which required the use of existing knowledge, based on previous research and monitoring. However, it became clear that not all processes of the system are fully understood yet. This made it difficult to draw up a complete Vision of the systems processes. Based on the demands of each function, however, the possibilities and impossibilities of the system could be made transparent. A conclusion of the available information was that the multiple channel system should be preserved to maintain the most important functions: The shipping needs the ebb channels for the larger and the flood channels for smaller ships and from a nature point of view the multiple channels are necessary to keep the system dynamic. This illustrates that the starting question, which was to know the system reaction to interventions, developed in assessing the interventions that can be done without damaging the multiple channel system.

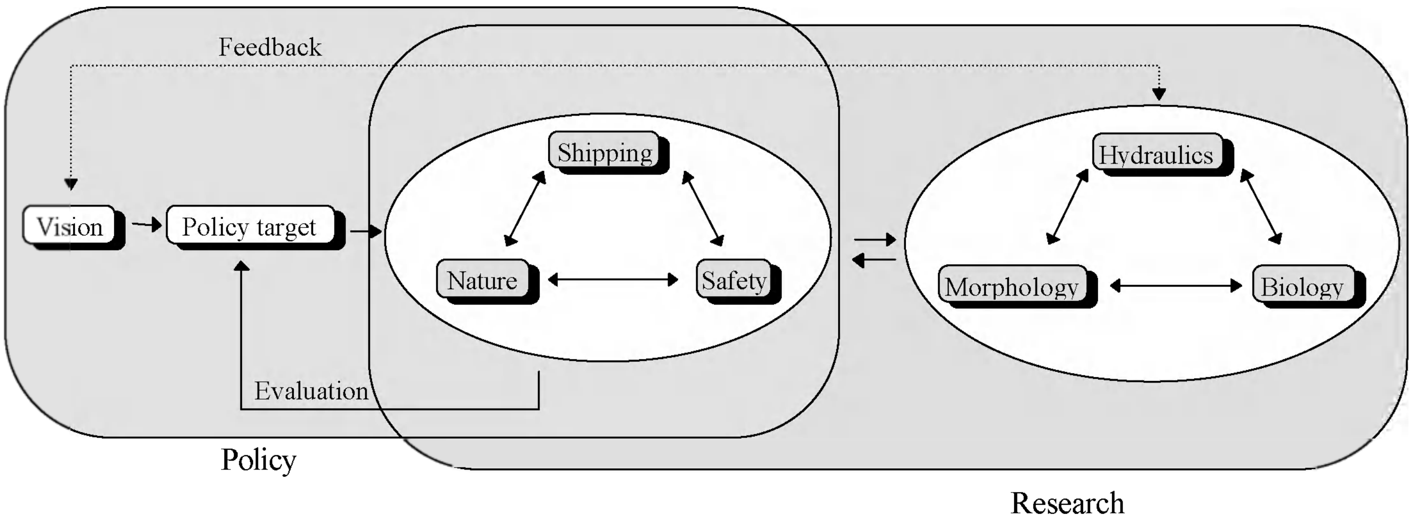

Figure 2: Process from vision making to research.

4. EXAMPLE: RESULTS OF THE MORPHOLOGICAL STUDIES

As stated in Section 3, preserving the multiple channel system in the Western Scheldt was the starting point for the morphological studies. The multiple channel of the Western Scheldt is a stage in between a one channel system with bordering flats and a drowned estuary with no inter-tidal flats. Estuaries of this type will eventually drown or become land, depending on the sediment budget and the sea level rise. But on a time scale of decades, this estuary is in dynamic equilibrium. This multiple channel system can be schematized as a series of linked morphological cells, see Figure 3.

A stability analysis shows that such cells can degenerate, depending on the amount of deposited material, not on the amount dredged in the cell (Wang, Winterwerp, 2001). The capacity of a cell to accommodate and redistribute dredged sediments depends on the gross sediment transports of that cell. Cells with high sediment transport have a higher capacity than cells where almost no sediment transport occurs. It is computed that an amount of 5-10 % of the gross transport can be dumped in a cell, without the risk that the cell will silt up. Exceeding this amount for a few years is allowed, however the long term average annual amount dumped should not exceed this 5-10% limit (Winterwerp et al., 2001). One should realize that changing the geometry of the estuary will change the sediment transports and therefore the dumping capacity of the cells.

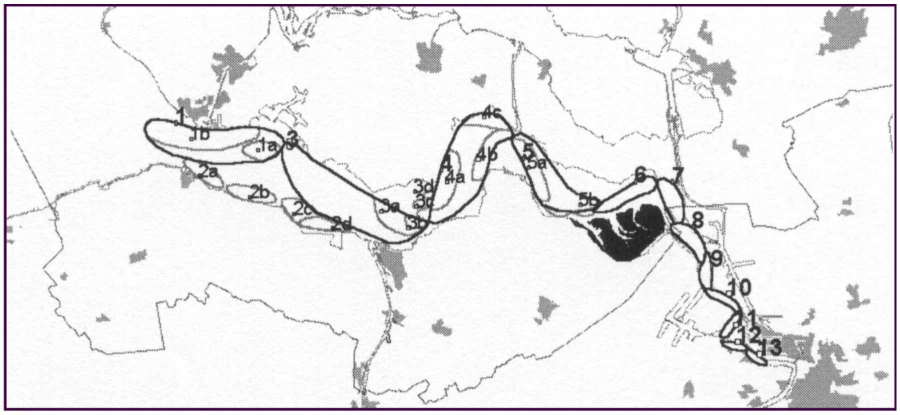

Figure 3: Morphological cells of the Western Scheldt

From practical experiences this concept appears to be correct. This is illustrated by the main dredging activities which take part in the eastern part of the estuary. Because of the short distance, till 1996 the dredged material was dumped in the flood channels in the eastern part as well. As a result that part of the estuary lost its dynamics: All small tidal flats grew together and formed one large tidal flat without small channels. Since 1996, when the main channel was deepened, the dumping strategy was changed. Dredged material from the eastern part is transported to the western part of the estuary. It seems that since that time the dynamics are slightly recovering in the eastern part of the estuary. The cell concept made clear that available space for dredged material is also limited in the western part of the estuary, this is also seen in practice.

Conclusion

Without knowing the exact functioning of the system, a managing concept was developed to evaluate the interventions in the system. With a balanced combination of dredging, dumping and sand-mining, the Western Scheldt can be managed without triggering a development in an undesirabled direction.

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