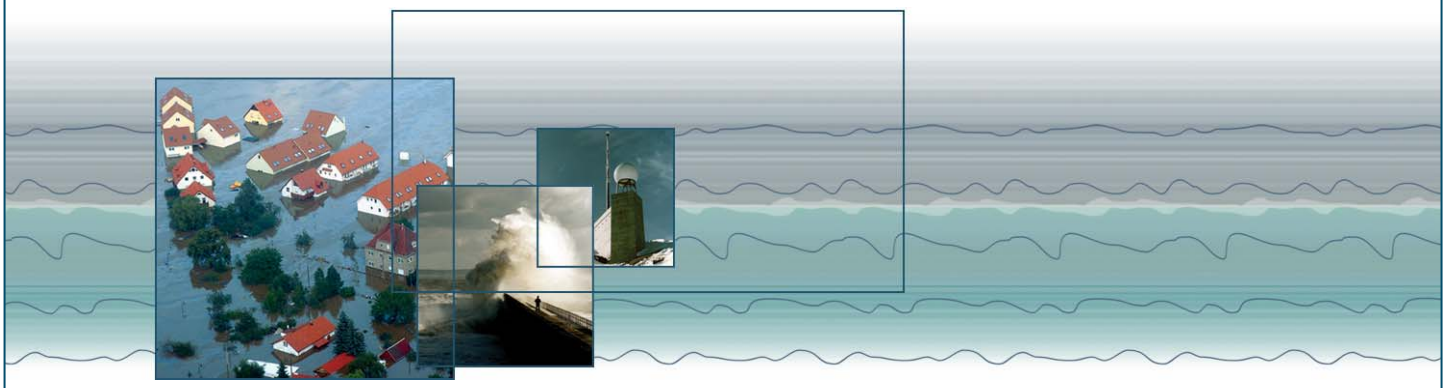
Integrated Flood Risk Analysis
and Management Methodologies

FLOODsite



Final report of the Schelde Pilot Study

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SUMMARY

The FLOODsite Schelde Pilot Study focused on a flood risk analysis and assessment for the flood prone areas along the Schelde estuary. Linked to flood risk analysis, the first objective was *to study the future vulnerability of the society along the Schelde Estuary to flooding, taking into account changing hydraulic conditions and demographic and economic developments*. As part of a flood risk assessment the second objective was *to evaluate sustainable flood management strategies in association with stakeholders*, thereby acknowledging the importance of the process dimension as part of strategies for flood risk management. We chose to engage with scientists, policy makers and the local public (citizens). Instead of assuming that only improved scientific assessment (e.g. via hydrodynamic model simulations and flood hazard mapping communicated directly to policy makers via reports) can accomplish this, we hypothesised that active involvement of citizens can contribute to knowledge development for a flood risk assessment. We used modelling and scenario analysis, semi-structured interviews, workshops and questionnaires in our study.

The aim of this report is to document the output of the three workshops and the questionnaire. The results of the Flood risk analysis has been reported in another Floodsite report: De Bruijn et al., 2008. For a complete description of the Schelde pilot study reference is made to Chapter 8 of the FLOODsite book on pilot sites (Schanze, in prep.).

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1. Introduction

1.1 Study objectives

The rationale for the Schelde pilot study was to apply and test the approach to flood risk management developed in the FLOODsite project. This approach consists of three main elements (Gouldby & Samuels, 2005; FLOOD*site*, 2008):

- *Flood risk analysis*, to determine risk objectively by analysing and combining probabilities and negative consequences of floods;
- *Flood risk assessment*, to understand perception of risk, to assist societal weighing of costs and benefits of risk and to support decisions; and
- *Design and implementation* of physical measures and policy instruments for flood risk management.

Our pilot study focused on the first two elements, i.e. flood risk analysis and flood risk assessment. Design and implementation of measures was not included in the study as such. However, both in the analysis and assessment parts, a wide range of potential measures and instruments was taken into account.

Linked to flood risk analysis, the first objective was *to study the future vulnerability of the society along the Schelde Estuary to flooding, taking into account changing hydraulic conditions and demographic and economic developments*. As part of a flood risk assessment the second objective was *to evaluate sustainable flood management strategies in association with stakeholders*, thereby acknowledging the importance of the process dimension as part of strategies for flood risk management (Hutter, 2006).

1.2 Study approach: linking science with policy and public perspectives

The FLOODsite project adopted a multidisciplinary approach to studying the vulnerability of the region bordering the Schelde estuary. Our approach combined insights deriving from engineering and the natural and social sciences. Research activities were planned so that they complemented other ongoing or recent flood risk studies in the region.

Figure 1 shows the complexity of flood risk management in full. Insight in the sources, pathways, receptors and impacts of a flood is required as well as in the feasibility of a wide range of potential measures. In deciding on a preferred risk management strategy all combinations need to be analysed in principle. The various ongoing projects, studies and research activities lead to a respectable body of knowledge, albeit in a rather fragmented and partially integrated way. But even more problematic for a sound risk assessment is that these activities take place almost exclusively in the (applied) science and policy, largely ignoring the public. This prompted us to focus on the role of local citizens and stakeholders within the flood risk management process.

A major aim of the Schelde Pilot was therefore to evaluate sustainable flood risk management strategies in association with stakeholders. We therefore chose to engage with scientists, policy makers and the local public (citizens). Instead of assuming that only improved scientific assessment (e.g. via hydrodynamic model simulations and flood hazard mapping communicated directly to policy makers via reports) can accomplish this, we hypothesised that active involvement of citizens can contribute to knowledge development for a flood risk assessment. We used modelling and scenario analysis, semi-structured interviews, workshops and questionnaires in our study (see Figure 2).

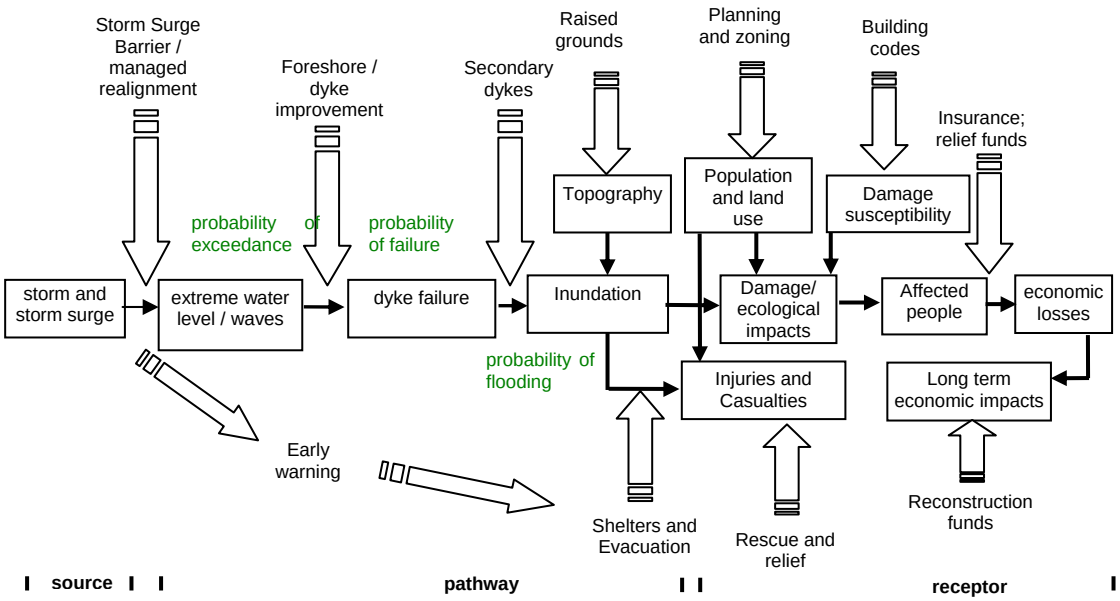

Figure 1 Schematic representation of the flood risk components along the Schelde estuary

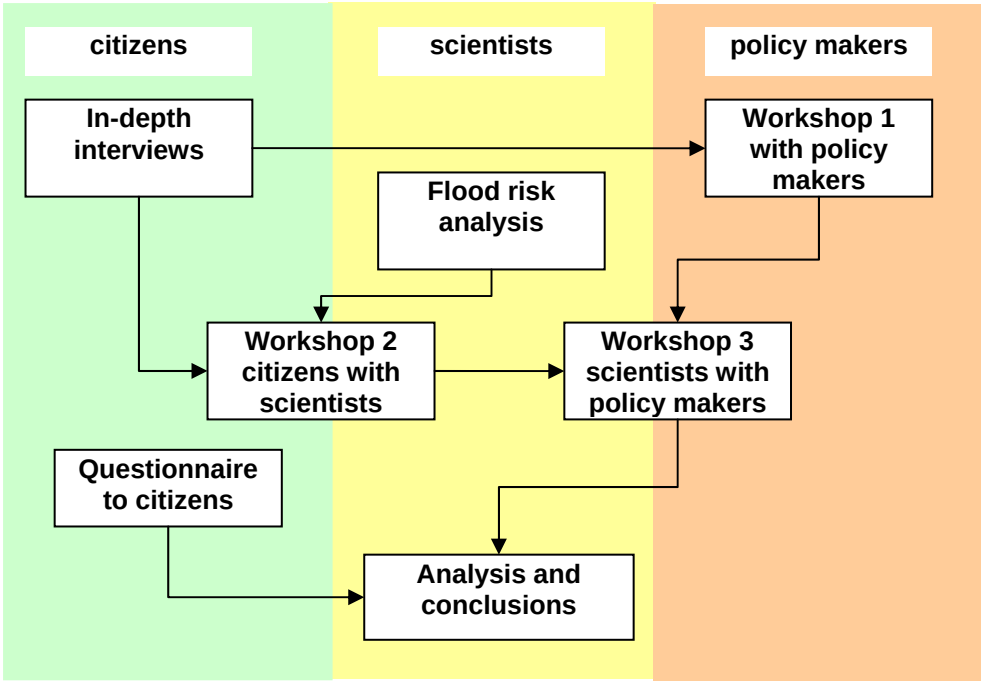

Figure 2 Sequence of workshops and interviews used in the pilot study

1.3 This report

The aim of this report is to document the output of the three workshops and the questionnaire. The results of the Flood risk analysis has been reported in another Floodsite report: De Bruijn et al., 2008. For a complete description of the Schelde pilot study reference is made to Chapter 8 of the FLOODsite book on pilot sites (Schanze, in prep.). See also Marchand et al., 2008 and Slinger et al., 2006, 2007, 2008.

2. Workshop 1: Risk analysis for the Schelde estuary system

2.1 Background

Date: 9 December 2005
Location: '***Het Landshuis'*** in the small town of Lillo (B), near Antwerp
Organiser: M. Marchand, WL Delft Hydraulics

This has been the first workshop out of three that will be executed in the framework of the EU Research Project 'Floodsite', Task 25: Scheldt Pilot. This first workshop had risk assessment as subject, the second workshop will deal with alternative flood management strategies while the final workshop will have a focus on transition management.

In recent years much discussion and studies have been going on both in the Netherlands and in Belgium with respect to the perceived risk of flooding, especially in view of the changing external conditions (such as sea level rise) and increasing assets under threat (expansion of urban and industrial areas for instance). The tragic events in New Orleans have made this discussion even more important: people are asking whether or not this could happen here too. Both the Dutch and Belgian governments have been working on an improved understanding of the risk through a number of studies. In Zeeuws Vlaanderen (NL) a pilot study was undertaken under the VNK (Veiligheid Nederland in Kaart) project of Rijkswaterstaat (Ministry of Transport and Water Management). In Belgium the updated *Sigmaplan* has just been ratified by the Parliament. Simultaneously, the bilateral project of Belgium and the Netherlands '*Proses'* is studying the opportunities and consequences of increased navigability of the Scheldt estuary, with due attention for the safety and nature compensation aspects.

Hence, there is much going on at both sides of the border, and it is of high research interest to compare these activities and the flood risk philosophies of both countries, especially in the perspective of the entire physical hydrodynamic Scheldt system.

The objective of the workshop was *to gain a shared understanding regarding the background motivations regarding the Scheldt flood management strategies and policies in the Netherlands and Belgium. It focuses on a 'snapshot' of current policies and perspectives for future policy changes.*

2.2 Purpose and set-up of the workshop

Participants of the workshop included so-called secondary stakeholders (i.e. mainly the experts / civil servants in the various government agencies dealing with safety). Together with the researchers of Floodsite the participants freely discussed the background motivations, ideas and facts that have led to the flood management strategies as they are now evolving. The purpose of the workshop was to start a communication between the researchers and local experts/officials from both the Netherlands and Belgium in two ways. At the one hand the local officials gained information regarding the Floodsite project, which can be regarded as the prime European forum in which flood management is discussed and studied. On the other hand the researchers developed a better understanding of the complex and delicate situation with respect to risk management in both countries.

Workshop programme:
11.00 – 13.00 Presentations and questions
13.00 – 14.30 Lunch
14.30 – 16.30 Group discussion
16.30 – 17.30 Conclusions and closure.

Table 1 Participants

Jos Claessens	PROSES (B/NL)
Rob Termaat	Rijkswaterstaat Directie Zeeland (NL)
Marc Sas	International marine & dredging consultants nv.(IMDC (B)
Stefan van Damme	Instituut voor Natuurbehoud / Univ. Gent (B)
Marcel Marchand	Delft Hydraulics (NL)
Alessandra Crosato	Delft Hydraulics (NL)
Jill Slinger	Delft University of Technology (NL)
Maaike Muller	Delft University of Technology (NL)
Joerg Krykow	University of Twente (NL)

Because the nature of the workshop was rather flexible and informal, no detailed account of the discussions has been made. Instead, these proceedings provide content-wise structured information that emerged from these discussions as well as from the presentations. Opinions expressed and conclusions drawn in these proceedings remain the sole responsibility of the organisers.

2.3 Flood risk and safety policies: a comparison between two countries

Flood risk along the Scheldt in Belgium is considered essentially different from the Dutch part. Although a tidal surge could penetrate deep into the Belgian parts of the Scheldt, the potential impact in terms of damage and casualties is entirely different. In case of a similar flood disaster casualties are of the highest concern in the Netherlands. If a dyke breach occurs, the polder behind the dyke floods almost immediately, leading to high water levels (several metres) within a short time span. Evacuation plans are difficult to realise. Next to the loss of life also the economic damage would be considerable, but mostly limited to farms, villages and small industries.

Belgium would face considerable economic damage because of the presence of the industrial area of Antwerp, whereas there is less chance of a high number of casualties. Higher ground is nearby which makes evacuation plans much easier.

The table below summarises some generalised differences between the two countries:

Table 2 Differences in flood risk between Belgium and the Netherlands

	NL	**B**
Risk characteristics:		
potential economic damage	low – medium (mainly agricultural)	high (industry)
potential number of casualties	high	low
'safety standard'*	1:4,000 per year	1:70 up to 1:2,500 per year
Differences in physical and socio-economic characteristics:		
flooding process	immediately after a breach a polder floods and water depths quickly reach high levels (several metres)	much smaller areas involved, lower water depths
evacuation opportunities	higher grounds are far away; traffic jams can be expected	higher grounds are nearby
land use	predominantly agricultural	highly industrialised around Antwerp
main historic flood event and response	1953 disaster → Delta Plan	1976 flood → Sigma Plan

*: in terms of probability of a high water level occurrence

These differences in risk characteristics have given rise to a fundamentally different flood risk policy in the two countries. The 1953 disaster created such a trauma in the Netherlands that very high safety standards were adopted (Delta Law) and implemented through the Delta Plan. For Zeeland no spatial differentiation was made in safety levels: 1:4,000. The flood strategy of the Delta Plan was exclusively based on traditional measures of flood control: dyke enforcements, closure of estuaries and a storm surge barrier. Flood control measures were based on standards of the exceedence frequency of water levels . More recently the Dutch government embarked on a process analysing the entire safety chain, including the probability of dyke failure, but excluding the behavioural response of the population (VNK). However, this has not resulted in a new safety policy yet. Also new flood control concepts are investigated, such as the 'Brede Waterkering' (Broad flood control measure), that allows more overtopping than traditional dykes.

For Belgium the Sigmaplan was initially considered to provide a safety level of 1:10,000. Later this was reduced to a much lower level based on an explicit risk approach using risk maps. After full implementation (in the year 2030) the New Sigmaplan will provide differentiated safety levels varying between 1:1,000 to 1: 2,500.

Another difference with the Netherlands is that in Belgium a wide array of potential measures has been evaluated (storm surge barrier, flood by-passing, managed realignment, dyke enforcements etc.)[1]. Furthermore, via the binational project office *Proses* and *Proses2010*, an explicit multi-functional planning approach has been adopted, combining navigation requirements and nature development objectives with safety.

Interviews with primary stakeholders in Belgium and the Netherlands were undertaken[2] and interesting information was obtained. The respondents were selected on the basis of their occupations and/or their activities related to the Scheldt estuary. Preference was given to respondents with no or only limited involvement in local or regional organisations. Equal numbers of Flemish and Dutch people were interviewed. Some of the insights obtained include: Most people feel safe from flooding and think that the government can be trusted to protect them from the danger of flooding. This trust is higher in the Netherlands than Belgium, but the Flemish have more faith that their government would help with restoration should a major flood occur than do the Dutch. Despite feeling safe, many people have made their own plans regarding evacuation, not trusting the government in this and unaware of any official plans in this regard.

Respondents who work with or on the water of the Scheldt had a more realistic appreciation of flooding risk than those with little affinity for water. Existing measures such as the return of the Hedwige-Prosper Polder to the Scheldt estuary is viewed as very threatening and wasteful of good agricultural land by farmers. They also question whether it is of sufficient scale to be effective as a flood amelioration measure. In contrast the Belgian "potpolders" were viewed more positively.

Farmers and (professional)fishermen are most threatened by current policy processes and feel themselves victims of long drawn out or short-sighted planning processes.

People are concerned about the consequences of flooding, particularly the loss of life. There are also concerns regarding the consequences of flooding and the potential environmental and health impacts of flooding on chemical and industrial plants. Additionally, Insightful comments were made about the post-disaster process within their society. For instance, the probability that a production facility destroyed by a flood would be moved to a safer region abroad.

[1] We have to consider of course that the Delta plan in the Netherlands was developed in the nineteen fifties and sixties, while the New Sigmaplan is much more recent.
[2] At the workshop the first observations were presented of the interviews held by J. Slinger and M. Muller from TUD during the second half of 2005.

During the discussion following the presentation of the interview findings, Mr Claessens explained that many of the chemical and industrial plants are situated on higher grounds (TAW + 8m), making the chance of flooding and subsequent chemical spills very low. He agreed with the scepticism regarding the effect of the addition of the Hedwige-Prosper Polder to the Scheldt on flooding levels and explained that this should be understood as primarily a nature development measure with some benefits for safety. The officials present agreed that it would be wise if ir. Leo Meyvis were to be interviewed as he is directly responsible for safety in the ZeeSchelde.

2.4 Factors that influenced the new safety policy for the Scheldt in Belgium

The original Sigma-Plan of 1977 adopted a more or less similar approach to flood management as the Dutch Delta Plan: a uniform high safety level which would be reached mainly by traditional measures of dykes and a storm surge barrier. Also areas were identified that could be used as temporary storage basins during extreme high waters (Gecontroleerde Overstromings Gebieden).

Flooding incidents during 1993-1994 prompted an emergency plan for flood management that initially called for an accelerated execution of the ongoing Sigma-Plan. However, it soon became clear that the original set-up of the Sigma-Plan could not meet the multiple objectives of integrated water management that had become the new paradigm. This prompted the initiation of a long-term study programme (OMES: Onderzoek naar de Milieueffecten van het Sigmaplan). Concern regarding climate change and subsequent accelerated sea level rise added to the idea that the original and partly realised Sigmaplan needed significant adaptation.

In 1999 both the Dutch and Belgium governments decided to formulate a common long term vision and management strategy for the entire Scheldt Estuary, based on three important objectives: safety against flooding, accessibility of ports and naturalness of the estuary (veiligheid, toegankelijkheid en natuurlijkheid). In 2001 a long term vision for the Scheldt estuary was adopted by the authorities. In order to successfully implement the long term vision a special council was initiated with stakeholders and delegates from both countries (OAP: Overleg Adviserende Partijen). Participation in this council includes delegates of port authorities, water boards, municipalities, provinces, environment and nature conservation societies and agricultural stakeholders. Although there was much internal opposition in the OAP, a common Development Outline (Ontwikkelingsschets) has been agreed in 2005.

2.5 What have been decisive factors in the decision making?

Accessibility: The need to maintain an up-to-date shipping channel through the Western Scheldt towards Antwerp is one of the dominant factors that necessitated collaborative decision making between the Netherlands and Belgium. Economic considerations as well as an old statutory obligation were decisive in agreeing to the so-called 3rd deepening of the navigation channel.

EU Directives: Without the existence of the EU Habitat and Bird Directives the objective of naturalness would have been much more difficult to materialise. Also the EU Water Framework Directive provides some pressure on decision makers through their deadlines for the implementation of the Framework policies.

Local stakeholders

The role of local stakeholders in the process is still not very clear. In the OAP representatives of main stakeholders were present, but it can be expected that in the actual implementation of the new policy local interest groups will still have an important role[3]. The interviews revealed differences in the effects of obligatory and voluntary expropriation and made clear that slow governmental decision making can impact citizens adversely. Information from local stakeholders will help in defining the

[3] Recent press releases already show malcontent with some decisions (cf.: 'Terneuzens raadslid C. Freeke (LCF) vindt het onderwerp ontpoldering of getijdennatuur een typisch geval van achterkamertjespolitiek' Provinciale Zeeuwse Courant, 6 December 2005)

scope and extent of appropriate planning processes to come to decisions regarding flooding defence measures (not only dykes).

Supporting Research
Many studies and research activities have been executed in support of the decision making process of the Sigmaplan. The example of ecological research is illustrative with respect to the importance of knowledge provision in the whole policy making process. A key problem was the quantification of nature reconstruction in order to restore/maintain the naturalness of the estuary. The research used more than one approach, i.e.:
- a functional approach focusing on ecological processes;
- a habitat approach
- a species approach
- spatial relations and connectivity;
- local characteristics and desirability.

Through this combined approach it was made plausible that an additional 500 hectares of intertidal area is needed to maintain the carrying capacity and ecological integrity of the Zeeschelde estuary. This could be very well combined with flood protection measures, such as the temporary storage basins, provided that they would be permanently connected to the estuary.

For the Sigmaplan several Cost Benefit and Multi-criteria Analyses have been made. Based on these studies, it was for instance concluded that a storm surge barrier at Oosterweel and the Overschelde (a connection between the Westerschelde and Oosterschelde, NL) are much too expensive in relation to the avoided damage in Belgium.

Cost Benefit Analyses in the Netherlands and Belgium cannot reliably be compared, since variables and parameters are different. This makes a combined CBA for the entire Scheldt estuary – that takes into account trans-boundary costs and benefits – very difficult. For the SigmaPlan this was not necessary, as both costs and benefits are entirely on Belgium territory. But for the Accessibility, the benefits are roughly divided as follows: 1/3 NL and 2/3 B. Of the costs (€250 million), Belgium pays 92%. The fact that severe flooding in the Netherlands would lead to significant loss of life whereas the major effect in Belgium is that of economic damage means that cost benefit analysis is more useful when applied to the Belgium situation than to the Dutch.

2.6 Conclusions and suggestions

- There is a significant difference in the approaches to flood protection between NL and B. This is largely attributable to the difference in flood risk (polders versus floodplains).
- The local people interviewed had knowledge and useful insights regarding flooding of the Scheldt Estuary. Most feel themselves safe from flooding and have a relatively high degree of trust in the government. The occupations most threatened by current policy developments are farming and fishing.
- The Belgium SigmaPlan is a good example of a combination of safety and nature restoration.
- Economic considerations *combined* with EU legislation created the climate for a binational management of the Scheldt Estuary in which aspects of Safety, Accessibility and Naturalness are integrated.
- During the formulation of the Plans public participation was mainly limited to secondary stakeholders. In the implementation phase of both the SigmaPlan and the 'Ontwikkelingsschets 2010' (Proses/Proses2010), intensive deliberations / resistance with local stakeholders can still be expected.
- Invite people to next workshop that are directly involved in flood management, such as the Storm Warning Service (Eric Taverniers, WL Borgerhout), and Afd. Zeeschelde (, Leo Meyvis, Wim Dauwe).
- Invite people from regional governments (province of Zeeland, Province of Antwerp).

3. Workshop 2: Risk assessment for the Schelde estuary

Date: 26 January 2007
Location: Bezoekercentrum Saeftinghe (Zuid-Beveland, the Netherlands)
Organiser: J. H. Slinger & M. Cuppen (TUD)

3.1 Workshop objectives

Following an initial round of interviews with 16 citizens living and working in the vicinity of the Scheldt Estuary, a follow-up workshop was convened primarily to provide feedback to study participants on the use to which the information garnered from them during the interviews had been put. Besides this, the workshop provided a forum for:

- Gathering further information on the priorities that citizens and scientists place on the management measures for flood risk management
- Providing information to participants on the latest scientific findings
- Facilitating the exchange of ideas and opinions on these issues
- Measuring whether the new information and interaction between workshop participants had a measurable effect on their opinions.

In this document we describe the proceedings and outcomes of the workshop on 26 January 2007 at Bezoekerscentrum Saeftinghe alongside the Scheldt Estuary. This information is used further to support interactions with policy makers regarding flood risk management in the Scheldt Estuary within the framework of Task 26: Pilot Study Scheldt Estuary of the FLOODsite project.

3.2 Participants

An invitation to attend the workshop was extended to all of the original interviewees and their partners. Seven of the original interviewees were present as well as 4 of their partners, relatives or friends. Only one of the scientist previously interviewed was present. Additionally, three other scientists involved in tasks within FLOODsite participated in the workshop. The categorization of the workshop participants is presented in Table 1.

Table 3 Characteristics of the workshop participants

Occupation	Relation to project	Nationality	Age	Sex	Native
Farmer A	Interviewee	Dutch	20 - 30	Male	Yes
Farmer B	Interviewee	Dutch	40 - 50	Female	Yes
Farmer C	Farmer B's Partner	Dutch	40 - 50	Male	Yes
Farmer D	Farmer B's Friend	Dutch	30 - 40	Male	Yes
Camping Manager	Interviewee	Dutch	50 - 60	Male	No
Camping Employee	Camping Manager's Relative	Dutch		Male	No
Pastor	Interviewee	Dutch	60+	Male	No
Housewife	Pastor's Partner	Dutch	60+	Female	No
Wheelman	Interviewee	Dutch	60+	Male	No
Environmentalist	Interviewee	Flemish	40 - 50	Female	Yes
Civil Engineer	Interviewee	Dutch	30 - 40	Female	No
Scientist	Participant in Task 14 of FLOODsite	Dutch	20 - 30	Female	No
Scientist	Participant in Task 14 of FLOODsite	Dutch	40 - 50	Female	No
Scientist	Participant in Task 26 of FLOODsite	Dutch	50 - 60	Male	No

3.3 Programme and Method

The programme of the workshop was as follows:
11:30 – 12:30 Coffee/tea are ready
12:30 – 14:00 Lunch and introductory round (Jill Slinger, TU Delft)
14:00 – 14:30 Results of the research up till now (Maaike Muller, TU Delft)

14:30 – 15:30 Preliminary results of flood modelling study (Karin de Bruijn & Marjolein Mens, WL|DELFT HYDRAULICS)
15:30 – 16:00 Coffee break
16:00 – 17:00 Advantages and disadvantages of measures (All)
17:00 – 17:30 Impressions and changes in perceptions(All)
17:30 – 18:00 Revised judgments of measures and evaluation of the workshop
18:00– 19:00 Drinks

Upon arrival at the workshop and prior to its official opening, participants were required to fill in a questionnaire regarding the priorities that they would like policy makers to have in flood risk management of the Scheldt Estuary. The questionnaire is attached in Appendix B. This a-priori measurement of their opinions was necessary to be able to establish the effect of the exchange of information and ideas between participants and between scientists and participants in the workshop itself.

The management measures are divided up according to the phases of Flood Prevention, During the Event and Post Event as well as a category of Overarching measures. The list of management measures was initially generated by the scientists directly involved in the interviews and later checked for completeness by the scientists involved in the flood modeling. The final list then reflected the measures mentioned by the respondents as well as those considered in the modeling studies.

The feedback on the results of the initial round of interviews and the reactions of policy makers (meeting of 6 December 2005) to the findings was presented to the workshop participants (Appendix C) and discussed. The discussions were primarily aimed at gaining understanding and requests for clarification rather than any dispute about the findings of the studies.

Thereafter, the preliminary results from the flood modeling study were presented and discussed (Appendix D). Participants were interested in the location of the dyke breaches (randomly chosen) and the effects of secondary dikes on the containment of the flood. In addition, participants expressed interest in the implications of the flood modeling studies for evacuation options. Clarification of the choices made in selecting the scenarios for determining the damages associated with the floods was required.

Next, posters for each of the flood risk management measures listed in the initial questionnaire were placed around the room. The workshop participants then came up with the advantages and disadvantages for each of these measures in a brainstorm session. These were then discussed so that differences in opinion could be made apparent rather than hidden.

Finally, the participants were requested to once again allocate priorities to the management measures. This was undertaken by placing stickers on the posters of each management measure.

3.4 Results and Analysis

The advantages and disadvantages attached to the various management measures by the workshop participants are listed in full in Appendix E. The prioritization allocated by the workshop participants to the different management measures are summarized in Tables 3 to 6.

Prior to the workshop, the single most favoured of the management measures aimed at flood prevention was an Early Warning System (Table 4). However, the total number of positive votes allocated to broadening, heightening and strengthening the primary dikes (sea dikes) far outstripped all other measures, representing 26 % of the total positive vote. After the workshop, the sea dikes received the highest priority of any measure and the early warning system was still favoured.

The least favoured of all other measures prior to the workshop were Large and small scale de-poldering, which received 21 % and 31 % of the negative votes, respectively (Table 4). Small scale de-poldering for nature development was particularly unpopular. A more nuanced picture was present following the workshop. The least favoured measure was large scale de-poldering in the Western Scheldt. This was discussed in detail during the workshop because modeling studies had clarified that this measure was ineffective in ensuring safety from flooding but was still beneficial for the environment. Small scale de-poldering was then divided into two management measures Small scale de-poldering in Belgium and Small scale de-poldering in the Western Scheldt with the idea that a combination of functions such as nature development, recreation could be possible in these areas. The voting on these new measures then became marginally positive for Belgium, somewhat negative for the Western Scheldt or principally against. The latter opinion was held solely by farmers.

Table 4 Prioritization allocated to the management measures aimed at flood prevention.

The a-priori measurement is indicated by Pre and the measurement taken at the workshop after interchanges of information and opinions occurred is indicated by Post. Positive votes are indicated by + and negative votes by -

Flood prevention measures	Pre		Post	
	+	-	+	-
Early Warning System	16	0	15	0
Flood defence barrier, e.g. Maaslandkering	2	3	8	3
Overschelde canal: channeling Western Scheldt water to the Eastern Scheldt	5	6	0	12
Primary dikes (sea dikes)	0	0	3	0
Widening	13	1	24	0
Raising	17	0	1	0
Strengthening / armouring	16	0	5	0
Large scale de-poldering (several large areas e.g. Braakman Polder)	2	18	1	28
Small scale depoldering (many small areas along the Schelde Estuary)	0	0	0	14
Nature development	4	12	0	0
Extending the floodplain storage capacity	6	6	0	0
Other functions e.g. recreation	4	8	1	2
Western Scheldt	--	--	0	4
Belgium	--	--	5	0
Total	**85**	**54**	**63**	**63**

The management options of the Overschelde canal initially received mixed approval and disapproval. In the final voting, the scientists voted heavily against this measure. A large flood defence work such as the Maaslandkering initially received mixed, relatively neutral reactions and received slightly more positive reactions following the discussions.

The workshop participants were favourably disposed towards measures designed to reduce the impact of flooding should it occur. The most favoured measure prior to the workshop is compartmentalization (secondary dikes) with a sound information network and communication running a close second followed by safe havens and evacuation (Table 5). Following the workshop in which the role of secondary dikes in containing a flood, but possibly causing deeper inundation locally, the preferences had shifted slightly away from compartmentalization. The creation of safe havens and inspection of the dikes became the most favoured measures. This reflects a growing understanding on the part of the participants that evacuation out of the area would not be possible for all citizens and that a safe haven located relatively near by was likely to offer more safety in the short term and make rescue at a later date possible. Dike inspection was viewed as necessary because the people most threatened could then be evacuated first and others warned to go to the safe havens. Participants expressed a need to know which buildings or dikes were highest in their area. Farmers indicated that they knew, but the other participants were more doubtful.

Table 5 Prioritization allocated to the management measures aimed at ameliorating the consequences during the event.

The a-priori measurement is indicated by Pre and the measurement taken at the workshop after interchanges of information and opinions occurred is indicated by Post. Positive votes are indicated by + and negative votes by –

Flood defence measures designed to ameliorate the consequences during an event	Pre		Post	
	+	-	+	-
Secondary dikes or compartmentalisation	14	0	10	2
Limiting housing and industrial development in low-lying areas	7	4	6	7
Prevention of an environmental disaster from factories and ships by regulating the storage of hazardous and chemical substances, evacuation exercises and protecting factories with dikes	8	1	8	1
Dike inspection	6	1	13	0
Evacuation (incl. detailed plans and large scale exercises)	10	1	7	1
Safe havens (and route to them)	11	0	18	0
Extensive, sound information network (TV/Radio/Internet) and communication to citizens	12	0	4	0
Limiting the reduction of the discharge capacity in the upper reaches of the Schelde estuary	--	--	1	0
Total	**68**	**7**	**67**	**11**

Doubts were expressed about prohibiting or limiting the development of low-lying land and this received both more negative votes in the post test than the pre-test.

Although the management measures orientated at the recovery period only received about 10 % of the overall positive votes, the view that there should be a state fund for compensation following a flood was supported both in the pre- and post tests (Table 6). The idea that plans for the recovery of the region following a major flood should be made even now received support. This was discussed during the workshop with participants expressing concern regarding the possible cost to companies and yet supporting the idea that employment opportunities and commitments to re-invest by existing companies would help in establishing an image of stability for the region. In contrast, the notion that individuals could be responsible for taking out insurance against flooding and flooding damage received more negative than positive votes initially. This changed slightly following the workshop with more people in favour than against.

Table 6 Prioritization allocated to the management measures for the recovery period.

The a-priori measurement is indicated by Pre and the measurement taken at the workshop after interchanges of information and opinions occurred is indicated by Post. Positive votes are indicated by + and negative votes by -.

Management measures for the recovery period	Pre		Post	
	+	-	+	-
Private insurance for flood damage	2	6	4	2
National disaster fund	9	0	11	0
Socioeconomic plan for recovery following a flood, e.g. agreements with large companies regarding employment provision and their return to the area	7	3	8	1
Total	**18**	**9**	**23**	**3**

This concurs with the voting on the overarching management measure regarding the revision of the role of citizen-state, which was predominantly and strongly negative prior to the workshop and remained largely negative thereafter (Table 7). The harmonization of management measures across the border was allocated relatively little priority by the workshop participants.

Table 7 Prioritization allocated to overarching measures.

The a-priori measurement is indicated by Pre and the measurement taken at the workshop after interchanges of information and opinions occurred is indicated by Post. Positive votes are indicated by + and negative votes by -.

Overarching measures	Pre		Post	
	+	-	+	-
Harmonization of flood risk management between the Dutch and the Flemish, e.g. dikes of the same height at the border	6	4	4	2
Revision of the roles and responsibilities of the citizen in relation to the state e.g. self reliance of the English citizen	1	11	2	8
Total	**7**	**15**	**6**	**10**

In summary, prior to the workshop, the participants indicated that in regard to flood risk management measures they wished policy makers to focus 47 % of their attention positively on flood prevention measures, 38 % on flood amelioration during an event, 10% on recovery following a flood and 4 % on overarching measures. In contrast, they indicated with 63 % of the negative vote that they wished policy makers not to focus attention on certain of the flood prevention measures. In total, flood prevention received 57 % of all votes prior to the workshop.

Following the discussions and information exchange, participants indicated that they wished the policy makers to spread their positive attention more evenly over the flood risk management phases, namely: 40 % to flood prevention measures, 42 % to flood amelioration during the event, 14 % to the recovery period and 4 % to overarching measures. They were even more directive regarding their wish that attention be diverted from certain flood prevention activities (now 72 % of the negative vote) and only moderately to slightly negative about the other phases of flood risk management.

4. Workshop 3: Signs of transition (?)

Date: 24 January 2008
Location: '***Het Landshuis'*** in the small town of Lillo (B), near Antwerp
Organiser: M. Mens (Deltares)

Table 8 Participants

Hugo Hinderink	Prov. Zeeland, juridische zaken
Ingrid Coninx	KULeuven, sociale studies
Sjaak Portegies	Prov. Zeeland, openbare orde en veiligheid
Hanneke Blok	Prov. Zeeland, afdeling communicatie
Michael den Hamer	Prov. Zeeland, openbare orde en veiligheid
Pieter Jan Mersie	Prov. Zeeland, openbare orde en veiligheid
Leo Adriaanse	RWS Zeeland waterbeheer/kustbeheer
Aloys Sponselee	Waterschap Zeeuws-Vlaanderen, erosiezorg/dijkbewaking
Durk Jan Lagendijk	Prov. Zeeland, afdeling water en natuur
Wouter Vanneuville	WL Borgerhout
Dirk Bulckaen	IMDC Antwerpen
Jill Slinger	TU Delft, beleidsanalyse
Miriam Cuppen	TU Delft, bestuurskunde
Bertien Broekhans	TU Delft, beleidsanalyse
Herman van de Most	Deltares, beleidsanalyse
Marcel Marchand	Deltares, beleidsanalyse
Marjolein Mens	Deltares, waterveiligheid

4.1 Background

In this workshop policymakers focused on the advantages and disadvantages of a new flood risk policy enabling a differentiation of safety standards based on costs and benefits. The workshop was organized by two research projects: FLOODsite and PROMO, and consisted of two parts: in the first part results of the FLOODsite Schelde Pilot and of the PROMO study were presented. During the second part after the break a discussion was held on the pros and cons of a risk approach for flood risk management.

The following questions were addressed:

- What is the present and future flood risk in the areas bordering the Schelde estuary, also in view of climate change?
- Which types of measures can be taken and what is their effect on the risk?
- How do citizens in Flanders and Zeeland think about these measures for flood safety?
- How do citizens in Walcheren think about their individual flood risk and their personal action perspective in this respect?

4.2 Presentations

Ms. Marjolein Mens presented the results of the FLOODsite research into present and future flood risk in the Dutch part of the Schelde area. The impact of autonomous development has been analysed and alternative strategies were compared. The presentation provoked a question from one of the participants whether or not this study leads to the conclusion that a new risk approach is desired. Ms. Mens answered that this could be the case, although other strategies have a better score on the criterion of 'people'. Which provoked the remark from another participant that one always wants to reduce the potential number of victims as much as possible.

Mrs. Jill Slinger presented the results of the FLOODsite research focusing on the policy preferences of citizens, scientists and policy makers with regard to flood risk management. Through interviews and workshops the similarities and differences were studied and the impact of new information was measured. The presentation initiated a remark that in general young people have more faith in the government than older people.

Mr. Herman van der Most presented the PROmO project. PROmO stands for '*Perceptie en Risicocommunicatie bij het Omgaan met Overstromingsrisico's*' (in English: Perception and risk communication in dealing with flood risks). The presentation was focused on the study of risk perception, which is going to take place coming spring in Walcheren. The type of results that could be expected was presented from an earlier study in Friesland.

4.3 Discussion and results

During the discussion each participant was asked to mention two arguments in favour of the risk approach and two disadvantages of this approach. The answers were clustered in four types of advantages and four types of disadvantages:

Advantages:
1. It can have a better cost benefit ratio (economic)
2. It can be embedded in spatial planning
3. Opportunities for multifunctional land use
4. Increasing risk awareness

Disadvantages:
1. Lack of knowledge;
2. Implementation hurdles;
3. Communication difficulties;
4. Resistance of citizens;
5. Institutional complexity.

There was no agreement reached if the advantages outweigh the disadvantages. The new risk approach has been studied and discussed for a long period of time. However, there seems to be little progress in terms of decision-making. Guidance and vision seem to be lacking, which leads to more studies and postponement of decision making. Some workshop participants voiced the concern that the subject is too difficult for public debate and others regarded the discussion to be a hype in the wake of recent media coverage of disasters (such as hurricane Katrina in 2005) and climate change related issues.



5. Questionnaire

5.1 Background and approach

In addition to the interviews and workshops a questionnaire was sent out to 3000 inhabitants living along the embankments of the Schelde estuary in the Dutch province of Zeeland, with the objective of obtaining insight in the level of risk perception and the representative nature of the workshops and interview results. Also an online version of the questionnaire was provided for respondents. After disseminating the letters on the 22nd of February 2008 a press release was sent to a regional daily newspaper in order to generate a positive attitude towards the questionnaire among the public in Zeeland, and to increase the response. The regional TV station reacted to the press release immediately and requested an interview, which was broadcast the next day.

The questionnaire encompassed six different groups of questions: (1) individual data including education, age, profession, experience with inundation and related damage, (2) risk perception (worry), (3) damage on assets and willingness to pay, (4) measures for flood protection, (5) evacuation and early warning systems, and (6) The role of the responsible authorities. The questionnaire included multiple-choice questions, Likert-Scale questions (from strongly agree to strongly disagree) as well as open-ended questions to give the respondents the possibility of expressing their opinions in their own words.

5.2 Results

By the end of April 2008 535 valid replies were sent back to us. This response from 3000 disseminated letters implies a 17.8% response rate. The age structure of the respondents is skewed towards a higher age: the average age of the respondents is 55.3 years, with a standard deviation of 15, and 60% of the respondents are 50 years old or older. The average age of the population of Zeeland is 51 years. The majority of the respondents (81%) have higher education, of which one quarter have an academic degree.

An account of the results and their implications is given in the paper of Krywkow et al., 2008.

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