PARTICIPATORY PLANNING IN COASTAL DEFENCE: A PILOT STUDY FROM THE BALTIC SEA COAST OF GERMANY

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INTRODUCTION

Modern society increasingly demands for a more comprehensive and active participation of the (affected) public to planning and decision making procedures (FÜRST et al. 1998). The existing methods and regulations for the establishment of public plans already include procedures to consider private (and other non-governmental) interests. These are, however, all of a more reactive nature. The responsible authority creates a plan on which affected private persons as well as certified NGO´s may comment. No formalised instruments exist for private persons to actively contribute to the development of public plans. As a consequence, reactions are often negative. A time-consuming and costly adaptation of the original plan may become necessary.
In response to this demand, new planning methods are developed by the scientific community that aim at optimising public participation (FÜRST et al. 1998). Participatory planning seeks to consider and integrate all relevant interests in the planning procedure. This active co-operation leads to engagement and shared responsibility of the involved persons, contributes to the recognition of the real problems, and may result in acceptable solutions (EUROPEAN COMMISSION 1999).

The coastal defence administration in Schleswig-Holstein faces the challenge to safeguard the inhabitants of the coastal lowlands against catastrophic flooding during storm surges and land loss by coastal erosion. Partly different from Great Britain, the authorities have the legal obligation to, e.g., build and maintain sea walls that are in the public interest, and protect settled (built-up) coastlines against irreversible land loss. Owners of protected land may be summoned to the costs for building and maintenance according to their benefits. In all, about 345,000 people and economic assets of 46 thousand million euros are concentrated in the flood-prone lowlands along the about 1,200 km long Baltic Sea and North Sea coasts of Schleswig-Holstein (HOFSTEDE AND HAMANN 2000). As in other public sectors, the demand for active participation in the planning of measures is increasingly being forwarded to the coastal defence authorities. In response, they financed a pilot study in which a new method to actively involve private persons in the development of plans was tested.

REGIONAL SETTING

The pilot study area is situated in the inner (sheltered) part of the Lübeck Bight along the Baltic Sea coast of Schleswig-Holstein (Fig. 1). It consists of two spit systems that separate former lagoons from the Baltic Sea. The spits have a mean elevation of about 2.5 and 3.0 meters above mean sea level (MSL), and are intensively built-up areas. One former lagoon is still occupied by a lake, in the other marshes developed that are now drained and extensively cultivated. Littoral currents still transport significant amounts of sand from the adjacent cliffs into the bight. As a result, the coastline is rather stable. As the tidal range is insignificant, hydro- and morphodynamics in the area are governed by storm surges and waves. The highest storm surge ever recorded in the Lübeck Bight reached a water level of about 3.30 m above MSL in the year 1872. As shown in Fig. 2a, however, this storm represents a singular event (i.e., cannot be considered in a statistical probability analysis, see below). Further, it becomes clear that no significant trend in storminess exists. Mean sea level rise in the region amounted to about 0.15 cm per year over the time period 1900 to 2000 (Fig 2b).

Two municipalities, Scharbeutz and Timmendorfer Strand, occupy the area. Local economy is strongly dominated by coastal tourism. For example, the municipalities have a tourist bed capacity of 17,710. About 18% or 12.6 km^2 of the total municipal area is situated less than 3 m above MSL. Hence, in the case of the 1872 storm surge, this area would be flooded. In this flood-prone lowland, 5,667 people live and capital assets amounting to 3,423 million euros (mainly houses and inventory) are concentrated (Table 1).

socio-economic parameter	Scharbeutz	Timmendorfer Strand	Sum
area (ha)	279	985	1,264
inhabitants	1,118	4,549	5,667
persons employed	297	1,599	1,896
tourist bed capacity	1,463	4,464	5,927
economic assets (million euros)	597.613	2,825.135	3,422.748
yearly gross value added (million euros)	23.480	112.195	135,675

Table 1: socio-economic parameters of the flood-prone area (< MSL +3 m) in the municipalities of Scharbeutz and Timmendorfer Strand

The existing flood defence for the coastal lowland is the spit system with a mean elevation among 2.5 and 3.0 m above MSL. Hence, from a coastal defence point of view, the situation is rather critical. Fig. 3 displays the frequency distribution of the yearly highest water levels for the time period 1921 - 1996 at the gauge station Neustadt, situated about 10 km to the North. Through the yearly values, arranged according to WEIBULL, the frequency distributions „GUMBEL“ and „JENKINSON A“ were fitted. It is estimated that a breaching of the spits will occur with a water level of about 2.1 m above MSL. Statistically, this extreme water level has, in the present situation, a return interval of about 80 years. If MSL rises by 0.5 m, which is a realistic scenario for this century (IPCC 2001), the statistical return period would diminish to about 15 years, as indicated in Fig. 3.

With the last catastrophic storm surge about 130 years ago, an economic dominance of tourism which depends on broad (idle) beaches, it becomes clear that local population was rather sceptical towards coastal defence. As no sea walls exists in the area, the municipalities are responsible for flood defence, i.e., the municipal councils have to decide whether and what kind of sea defence they actually want. The coastal defence administration acts advisory and contributes to the costs. Hence, an appropriate coastal defence solution for the area can only be achieved **with** active participation and acceptance of the local population. For this, a new method, introduced to the coastal defence division in the responsible Ministry by a consulting company, was tested.

METHOD

The applied method is called „Sensitivity Model of Prof. Vester©“, developed to cybernetically evaluate complex systems (VESTER 2001). The basic idea is that each system (country, region, company, etc.) is composed of a number of interacting elements and should be viewed upon in a holistic way. Further, it is recognised that the affected persons (citizens of a region, employees, etc.) have a profound knowledge of their system, and should be actively involved in the analysis. Following this line of argumentation, a conceptual model may be established by the affected persons that describes the complex system in a simplified way. With this (computer-aided) model, possible future developments under different scenarios may be simulated. The development of the model and the simulation involves several steps that are described below.

As a starting point, a public meeting is organised by a consultant to which all affected persons as well as local boards, councils, etc. are invited. At this meeting the initiator (the person who thinks something should be done) gives a description of the present situation and the need for action (**not** the solution). The consultant than broadly explains the sensitivity model and invites the participants to collaborate. The people who respond will then, in a number of meetings together with the initiator, and moderated by the consultant, conduct the sensitivity analysis:
- characterisation of the system with appropriate variables,
- definition of the effects (direction and strength) of the system variables upon each other,
- definition and (semi-)quantification of a subsystem that zooms in on the problem/action,
- definition of, and simulation for different scenarios that focus on the problem/action,
- discussion of the results and establishment of recommendations by the working group.

To avoid prejudice under the local participants, the consultant (who normally is financed by the initiator) should moderate the analysis neutrally and independently. Further, the working group should not consist of more than about 25 persons to be effective.

EXECUTION OF THE ANALYSIS

The sensitivity analysis for the pilot area Scharbeutz and Timmendorfer Strand consisted of nine meetings of the working group and two public meetings. The consultant company Kaul & Reins GbR moderated the meetings, established the model with the data delivered by the working group, performed the simulations, and wrote the reports (KAUL & REINS 2000).

Before the project started, a public meeting was organised as described above The invitation to the meeting came from the mayors of the municipalities, who made up a distribution list and publicly announced the meeting in the local news magazine. About 65 persons, mostly representatives from affected local interest groups, e.g., the society of beach-chair hirer, and municipal representatives attended the meeting. After being informed about the problematic situation by the coastal defence administration, the consultant explained the model and invited the participants to conduct the analysis. Each of the following project group meetings was attended by about 20 to 25 persons (in all, about 50 persons participated).

The first project meeting consisted of a more detailed introduction into the sensitivity model and a general brainstorming on possible system variables. In all, 47 variables were listed and roughly related to each other.
During the second meeting, the number of variables was reduced to 17 in a systematic way to achieve a „workable“ systems representation. Before the third meeting, these 17 variables were investigated by the consultants on their potential to characterise the system.
During the third meeting, the participants evaluated the results and slightly corrected the list of variables. The following 17 variables were defined by the participants: economic power, (quality of) tourist services, (degree of) employment, (Nr. of) inhabitants, (Nr. of) tourists, (quality of) beach, (quality of) coastal protection, (quality of) living, (security of) people, (quality of) recreational activities, (ecological quality of) landscape, (ecological quality of) Baltic Sea, (effectiveness of) infrastructure, (height of) municipal budget, (quality of) future oriented politics, (quality of) image, and (development of) traffic.
The fourth meeting focused on defining interrelations between the variables, and quantifying these relations. The results are presented in a matrix (Fig. 4a). If a strong direct effect was ex-

pected between two variables (e.g. number of tourists on economic power), a „3" was listed in the matrix, if no direct effect exists (e.g. number of inhabitants on number of tourists), a „0" was filled in. Based on the matrix, four parameters to characterise each of the variables were calculated by the consultants (Fig. 4a):

1) the active sum **AS** shows the sum of the effects of variable x on the other variables. A high/low value indicates a strong/weak influence in the system.
2) the passive sum **PS** determines the sum of the effects of all variables upon variable x. A high/low value indicates that variable x is strongly/weakly affected by the system.
3) the **Q-value** is the quotient of AS and PS. The higher the value, the stronger variable x works on the others and the weaker the influence of other variables on x is, and vice versa.
4) the **P-value** is the product of AS and PS. The higher the value, the stronger variable x effects other variables and the stronger it is affected by other variables, and vice versa.

The calculations resulted in four active variables: beach, recreational activities, infrastructure, and politics. These variables represent levers within the system that might be used to initiate controlled changes in the system. Three variables (employment, living quality, and image) were thought to be reactive, i.e., they react sensitive to changes in the system. Further, the four variables economic power, tourist services, tourists, and municipal budget were found to be critical (a high Q- and P-value). They have a strong influence on other variables, but are affected strongly by other variables as well. Hence, they may function as a lever, but there is a risk of uncontrolled developments as they strongly react to changes. Finally, two buffering (low Q- and P-value) variables were recognised: coastal protection, and security of people. They stabilise the system, as they cause few effects and respond to few influences in the system.

During the fifth meeting, the direction and sign (positive or negative) of the influences of the variables upon each other were established and elaborated (Fig. 4b). A positive influence (solid line) indicates that an increase in variable x will induce an increase in variable y. A negative influence (dotted line) means that an increase in variable x will induce a decrease in variable y. Apart from direct influences, indirect influences or, rather, control loops may become visible as well. In Fig. 4b, an example of a negative control loop is shown. An increase in economic power will induce an increase in tourist services, which will have a negative impact on the landscape. The diminishing quality of the landscape will result in a decrease in the number of tourists which will, finally, reduce the economic power, etc. This is an example of a negative feedback or self regulation of the system. The result is a stabilisation of the system in a steady state or dynamic equilibrium. A positive control loop, on the other hand, may cause a development towards a new (undesired?) steady state. In all, 141 negative and 57 positive control loops were defined, which indicates that the system is robust.

The second phase of the sensitivity analysis concentrated on the possible effects of different coastal defence strategies on the system. Five possible strategies had been defined in the fifth meeting: (1) zero option where no coastal defence is executed, (2) maximal option where a primary state dike is built on the beach, (3) coastal protection option where measures to protect the coastline against erosion are implemented, (4) flood defence option where measures to reduce the risk of flooding are implemented, and (5) mixed option where coastal protection and flood defence measures are combined.

A sixth meeting was organised with a smaller „expert team". In order to reduce the complexity, the 17 original variables were summarised into 7 „key variables" (significant to coastal defence) in a coastal defence model. Further, one external variable (risk of flooding) was defined. This variable is not influenced by the systems variables but has direct impacts on the system.

This coastal defence model was, during the seventh meeting, presented and discussed with the working group. In result, small adaptations were included in the model.

The eighth meeting, again of the expert team, concentrated on making the model operational. For each variable, a scale (ranging from 0 to 30) was defined, and starting values were given to each variable. Further, functions for the external variable risk of flooding and for the relations between the variables were established. Fig. 5 displays the scale, starting value and the internal function of the variable risk of flooding. A value of zero indicates that there is no risk of flooding in the area, a value of 30 means one flooding per year. The starting value of 10 (one flooding per 80 years) was elaborated from the frequency distribution of yearly highest water levels at gauge station Neustadt (Fig. 3). The risk of flooding will increase as a result of sea level rise. As quantified by the internal function, after one time step of five years the present value will increase by two to 12, after 10 years (two time steps) by another two to 14, after 15 years by another two to 16, after 20 years by one to 17, etc. After 35 years, the (statistical) risk of flooding will have increased to 20, i.e., to once in every 40 years.
Based upon the operational model, the consultants simulated the effects of the increasing risk of flooding on the system in 15 rounds of five years for each of the coastal defence scenarios. The results for the maximal option and for the mixed option are shown exemplary in Fig. 6. The curves for each variable should not be analysed in a quantitative way, as they fail a profound scientific basis. Only possible trends for future development become obvious. With the maximal option (Fig. 6a), it is clear that the quality of the beach will reduce significantly as a result of coastal erosion and „occupancy“ by the primary state dike. This will, in the long-term, lead to a significant reduction in the number of tourists which is (clearly) not acceptable to the working group. All variables (apart from the quality of nature) react positively to a combination of coastal protection and flood defence measures (Fig. 6b). The significant interference with nature should, concordant with legal regulations, be compensated for (financial or by environmental measures).
During the last meeting, the results of the simulations were presented and discussed with the working group. The discussion resulted in the following common recommendations of the working group:

- the working group unanimously supports the results of the sensitivity analysis, especially those of the simulations with the coastal defence model,
- the working group recommends a combination of coastal protection and flood defence measures to be implemented, and
- the working group demands further active participation in the process as a technically qualified interest group.

The early active involvement of the affected was valued very positive by the coastal defence administration:

- the participants recognised the long-term risk for their coastal lowland,
- they accepted their responsibility to anticipate this risk, and
- they evolved from sceptics to advocates of an integrated coastal defence concept!

SWOT ANALYSIS

Finally, the coastal defence authorities conducted a SWOT analysis, by which the **S**trengths, **W**eaknesses, **O**pportunities and **T**hreats of the sensitivity analysis may be evaluated (LENZ 2001). With this method, a new or existing product, procedure, service, etc. may be diagnosed on its prospects or effectiveness. It should, however, be stressed that the analysis represents a subjective evaluation of the person(s) conducting it.

The results of the SWOT analysis are listed in Table 2. One major weakness is the relatively low number of participants (max. 25) that conduct the analysis. In consequence, the results of the working group may be questioned afterwards by the gross of the affected. However, as these participants represent interest groups and are, normally, the more active persons in a community, they may function as „multipliers". As stated above, the strengths of the methods are that the affected became aware of the problem, accepted their responsibility, and are engaged in the search for a common integrated solution.

Strengths	Weaknesses
- active involvement of the affected - systematic approach - transparency of the results	- low number of participants (compared to those affected) - tiresome and time-consuming procedure - depending upon volunteers
Opportunities	**Threats**
- recognition of the problems - awareness of the responsibilities - acceptance of possible solutions	- results may not be conform to contractors expectations - loss of interest during humdrum meetings - not enough participants

Table 2: SWOT analysis for the conducted sensitivity analysis

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