Training of coastal engineers to work in a non-engineering environment

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Introduction

Integrated Coastal Zone Management (ICZM) is an interdisciplinary process by definition. Individual actors in CZM need to cooperate and communicate to come to an optimum management strategy for the coastal zone. Because engineers focus on finding the "best" solution in engineering terms, they often are quite surprised that in the end of the day their best solution is not considered as the best solution by the other participants in the process. At Delft University and UNESCO-IHE we started in 1990 with a course on ICZM, which evolved into a training course for engineers to make them aware of this point and to train them in communication with other professionals [Verhagen, 1995]. This paper will give an overview of the experience with this course gained over the last 20 years.

Present practice

Often engineers consider ICZM as finding the best engineering option to solve coastal problems. "Best" means in this respect that for example that the coastline is maintained at a given place for the lowest costs. However, other considerations are often of equal importance. Although ecological values are usually considered as important (also by engineers), social and political aspects and associated decision making processes are often completely neglected. In the education of engineers not much time is devoted to the interaction with other professions, but especially not in the interaction with non-professional stakeholders. The word "non-professional" means in this respect groups which main profession is not the management of the coastal zone. Examples of non-professional stakeholders are inhabitants of the coastal zone, fishermen, but also local politicians.

It is not the primary task of coastal engineers to manage the political decision making process. However, engineers should be aware of this process and their specific role. They should make reports, etc. in such a way that they can be used effectively in the decision making process. Also engineers should not be surprised when decisions are made opposite to the engineering recommendations, due to the weight to non-technical arguments in the political discussion.

Intermezzo 1

An example of a well prepared, but completely failed decision in coastal zone management is the "de-poldering" of some areas around the Westerscheldt estuary in SW Netherlands. Because of improvement of the access to the port of Antwerp extensive dredging works have to be carried out in the Westerscheldt, being a Natura2000 area. As compensation the creation of more "nature" was needed. Ecological studies indicated that the main problem was the decrease of intertidal area. Morphological studies revealed that inundating a few polders along this estuary (by giving them an open connection to the tide of the estuary) would increase the intertidal area. Also economically this is a feasible project, because the area to be inundated is mainly agricultural land. An engineering proposal was made for this de-poldering project, supported by ecological and economical studies. All experts agreed that this was the best option for the problem.

However, during the compulsory EIA-hearings with the public it became clear that de-poldering in this area was completely unacceptable for the local population. Mainly for emotional reasons. This land had been reclaimed by their ancestors at great costs. It had been defended against extreme storm surges, also at great costs. It was simply not possible for the local population of even thinking about inundating this area. And this in spite of all good quality background research. For engineers this strong reaction of the public came as a complete surprise.

Definitions of "Coastal Zone Management"

There are many definitions of coastal zone management. One of the definitions is "planning of the human activities in the coastal zone in such a way that the best strategy is followed for management of existing activities and the development of future activities". In order to elaborate this, one first has to define what the coastal zone is. In order to clarify the topic of the discussion it is good to distinguish the following "types of ICZM":

- Coastline management
  This is a mainly technical type of management to keep the coastline in a good shape. This can be done by construction of revetments, beach nourishment, but also measures to allow a controlled retreat. This is the realm of the engineer.
- Coastal strip management
  This is the legal and institutional management of the coastal area. Building permits, etc. belong to this domain. This is the realm of the lawyer and the administrator.
- Coastal Zone Management
  The integrated planning of the complete coastal zone, including its effect on the abiotic and biotic systems. This is the realm of the political decision maker.

In some case people also call Coastline Management or Coastal Strip Management "Coastal Zone Management", but this is in fact a misnomer. Especially engineers (and mainly involved in Coastline Management) often refer to Coastline Management as "Coastal Zone Management". This is often the starting point of quite some misunderstanding between engineers and other stakeholders in the coastal zone. The optimum solution for coastline management is often not the optimal solution for coastal zone management. A standard training program for coastal engineers focuses on coastline management; but engineers should realise that this is only one aspect in the decision making regarding coastal zone management.

What is best?

In the above definition, the term “best strategy” is used. However, there is no objective definition of “best”. What is "best" in the eyes of one person is not necessarily also the "best" in the eyes of another person. Therefore the decision on what is "best" will always remain related to a political decision, which can only be taken by what is called in this course, the "decision maker". This decision maker can be an elected official, but it can also be a non-elected influential person (a village elder for example). In any case it is not an expert in some kind of field, and certainly it is not an outside advisor.
Engineers are used to compute the best technical alternative, and for them it is therefore difficult to accept that sometimes a sub-optimal solution (in their eyes) is selected as the best option by the decision makers.

The Delft course in Integrated Coastal Zone Management

In 1990 a number of institutions in the Netherlands started the development of a a Master course in ICZM . As a start-up a short course was given, trying to accommodate students and practitioners with various backgrounds. The course focused on experts, and consisted of participants from various fields of expertise (See figure 1, upper left block). It proved that this did not work at all, because nearly all groups considered the depth of the course as not sufficient in their own field of expertise. Also we concluded that in fact ICZM is not really a science, but merely a matter of good cooperation in planning and decision making, requiring skills to cooperate of scientists and practitioners with different backgrounds. So we shifted the focus to the communication between the experts (represented by the arrows in the upper left block) and not on the interactions between the stakeholders (lower right block).

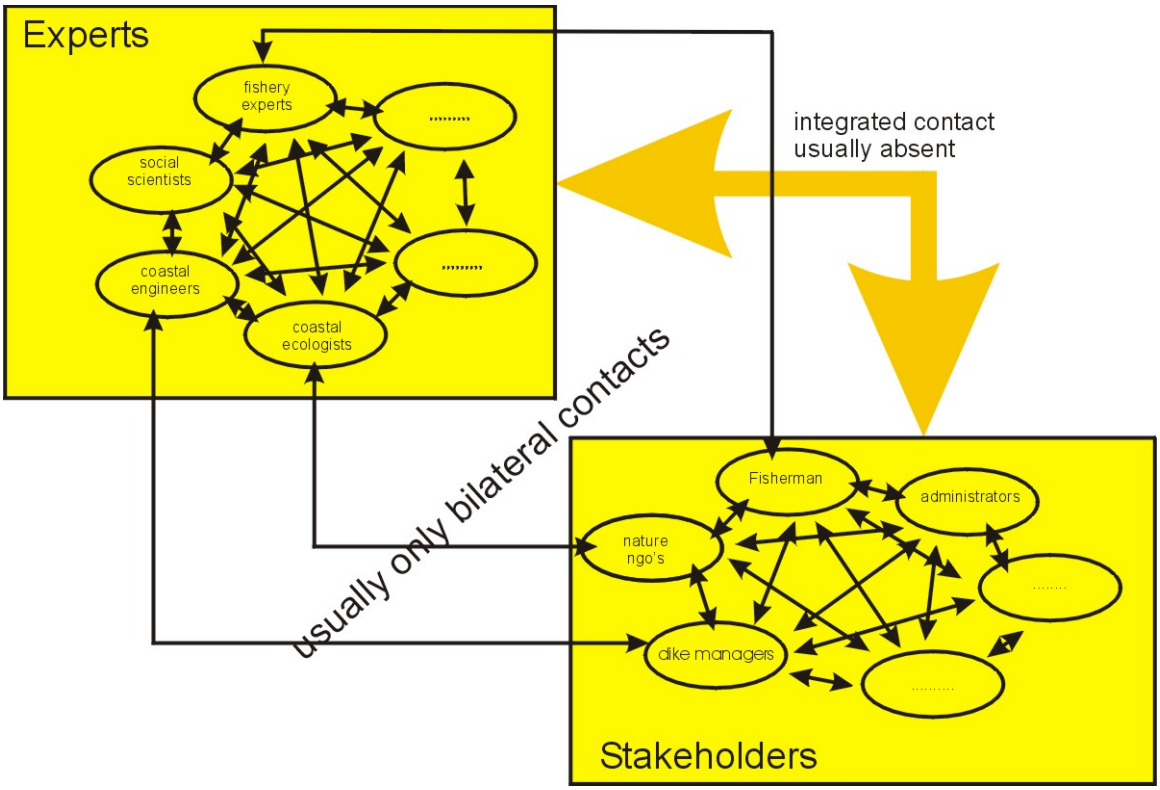

Figure 1. Communication between experts, between stakeholders and between groups

Starting from 1992 onwards we focussed our course on students with a background in the exact sciences (coastal engineers and physical geographers, from Delft University of Technology, from Utrecht University and from UNESCO IHE in Delft). The course is given in the final year of the master programme. This means that all students have a good knowledge of the physical processes in the coastal zone. Therefore there is no need to pay much attention to these processes. The course also includes some short introductions in ecology of the coast and in the sociological problems of the coastal zone.
However, the main line in the course is the process of decision making in the coastal zone. In order to make this practical a case study is made of a fictive coastal region in a developing country, Pesisir Tropicana. The coast of Pesisir Tropicana has all standard problems of a coastal zone. There is an eroding coastline, a rising sea level, an increasing and poor population migrating to the main city. There is some mining activity (cassiterite dredging), artisanal fishery, agriculture and tourism.

The question to the students is simple: make the best strategy for the development of the coastal zone given the amount of money available.

In the first phase of the exercise the students are divided in small groups, playing the role of a Policy Consultant Company. Each group gets basically the same assignment (as defined above), but has a different client. All clients are stakeholders from society (e.g. local government, fishermen association, Cassiterite Dredging Company). A short list of the primary and secondary objectives of the clients is given to the groups. They are requested to prepare a report for use by their client in a decision making meeting.

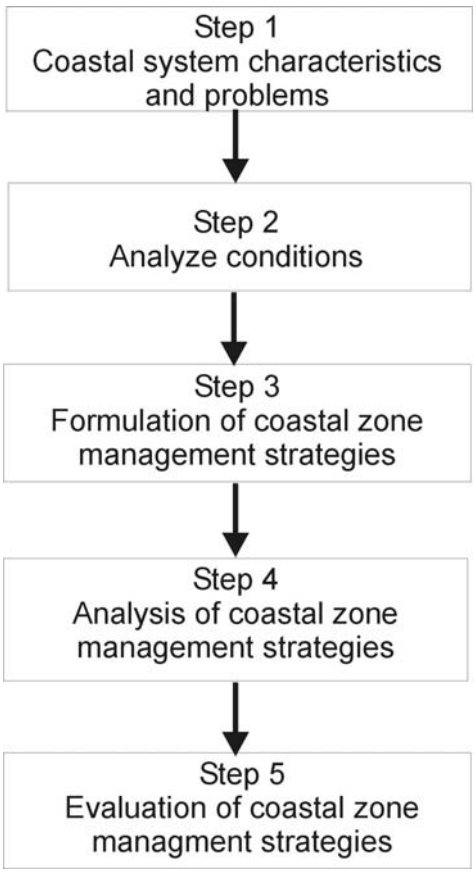

Figure 2. Used steps for setting up a CZM strategy (following WCC'93)

For this exercise we follow the steps of WCC'93 (see Figure 2). For step 4, the calculation of the effect of the various strategies a resource allocation model is used. This is a spreadsheet where controlled parameters like investments can be entered, but also scenario values (like the expected sea level rise). The spreadsheet then calculates the effect of the strategy on employment, income, pollution, ecological quality, etc. Finally the strategies are evaluated using a simple comparison programme with weight factors. For this purpose we use Jesew, a computer program for '**J**oint **E**cological and **S**ocio-economic **E**valuation of **W**ater resources development. The program is originally written in Basic (Torno, 1988), but for the purpose of this course rewritten as a spreadsheet application (Zitman, 2003).
At the end of this phase the students have made a nice report and are convinced that they have found the most optimal solution for their client. Usually they do not realise at this stage that the weight factors included in Jesew are not objective at all, but reflect their own preferences.

In the second phase of the exercise each student gets a different role. They will act in the second phase as stakeholders (like the mayor of the town, the owner of the mining company, etc) and will participate in a decision making meeting on the way to plan the future of the region. They receive also an "expert report", which is in fact a report written by another group during phase 1. During the discussion in this meeting they are confronted with the strengths and weaknesses of their own reports and the experience how background material for such a decision making meeting has to be prepared.

Lessons learned from the Delft course in Integrated Coastal Zone Management

One of the first things we experienced is that it is not very useful to make a course in ICZM with the aim to train people to become Coastal Zone Manager. Coastal Zone Management is more a skill than knowledge; it is also more a process than a discipline. In this process information is needed from several disciplines and the information has to be presented in such a way that it helps the decision maker to make a good decision. Decision makers can only make good decisions when they are aware of the alternatives and of the effects of their choices. This means that in the preparation phase before final decisions can be made alternatives (management options) have to be generated. Also the effect of the alternatives has to be predicted (preferably for different scenarios). In fact these are steps 2 and 3 of the scheme of Figure 2.
One could call the person in charge of facilitating this process the Coastal Zone Manager, but in fact that is not the case. There is no Coastal Zone Manager. The process of ICZM develops by stakeholder interaction. There may be facilitators for this process but they will never have a directive, leading role. Therefore it was not useful to make a course to train people as Coastal Zone Managers. It means also that the focus of the course is more on communication and less on analysis.
The conclusion is that for good ICZM one needs experts educated well in their own field of expertise, augmented with some skills in managing decision making processes. The ICZM course trains experts in these siklls, so that they are aware of what kind of input they should provide to the ICZM process.

For good Coastal Zone Management one needs three groups: the decision makers, the process facilitators and experts in various disciplines. In the next paragraphs these three groups are described in relation to the course.

The decision makers

One cannot set-up a course to become decision maker (one could train decision makers in making better decisions). Making a training program to illustrate decision makers how the process works is therefore a useful process, but it is not typically a Master course. It has to be a short course and may include simple simulation games. In fact the computer program Cosmo, developed for the WCC 1993 functioned as a training tool for CZM decision makers.

The strong point of Cosmo was that it focussed quite well on the decision making process and illustrated on what basis one could make a decision. We did apply Cosmo and similar programs at the WCC and other short courses for decision makers all over the world. In some cases it was successful in showing decision makers how the process works. In some cases decision makers got the idea that it was possible to put the decision making process into a computer and the computer calculates the best solution. We found that it is very difficult to tell to decision makers that this cannot be done, because it depends on what aspects they consider as most relevant.

Intermezzo 2:
Computer tools exist where decision makers are asked to give weight factors for various aspects of the problem. Then the computer calculates what the best alternative is according to the viewpoint of this decision maker. Some other type of programs ask decision makers to choose between two options, and after a list of questions the best option for this decision maker is presented.
However, we found that decision makers usually answer these questions on the basis of their preferred choice. The thinking pattern of the decision maker is: "I want alternative 3, so I should answer the questions in such a way that alternative 3 appears in the end as the best option".
Because of this behaviour it is not very useful to apply these tools in this way. It is better to give a list of alternatives with their quantified effects to the decision makers (a score-card format works quite well).

The process facilitators

Process facilitation is a typical process to be done by people with a good feeling for inter-human relations. In fact no knowledge of the coast is needed; knowledge is needed on how people interact and how one can come to well supported decisions. Also the facilitator should act as the interpreter between the experts and the decision makers. The process facilitator has to guard that only relevant information is presented to the decision makers in such a way that it is also understandable for non-experts. We concluded during our courses that, although process facilitators are essential, it is not our task (i.e the task of a University of Technology) to train such facilitators. It seems more a task for Universities with humanities departments.

The experts

In the ICZM-process many disciplines are needed, and consequently many experts with different backgrounds. Communication between the experts is important, and communication between them and the decision makers is even more important. Because all groups have their own jargon, such communication is not easy. Therefore one could think of a course for experts with various backgrounds with introductions in adjacent fields in order to help them to understand the other disciplines.

We found that it is impossible to make one course for experts with various backgrounds in order to give them more background knowledge on adjacent disciplines. In the initial stages

of the course we did try so, but that was a failure. The biologists were bored during the introductory lectures on ecology, while the engineers did not like the introductions in how to manage the coastline. The general opinion of all participants at the end of these courses was that the content was to general and lacked sufficient depth. Therefore we decided to focus the course on how coastal engineers and physical geographers should act within the ICZM-process. This focus became quite successful.

From the course we learned that engineering students take it for granted that they can compute what is the best solution. They do not automatically acknowledge that many parameters are in fact unknown and that some scenario parameters are in fact highly uncertain (such as sea level rise and its effects). Furthermore, engineers and other experts are usually able to explain their findings to their "own" stakeholders (coastal engineers communicate with the ministry of public works and environmental scientist with the ministry of the environment) However, they insufficiently realize that there are many different stakeholders, each with their own agenda. Students are only little aware that decisions regarding large investments in the coastal zone often have a dominant political dimension.
We found that it is of no use to explain these aspects by pure lecturing. However, when students experience this in a simulation game, and they are confronted with the limited value of their own engineering reports, they start to understand their role in the coastal zone management process. This kind of course made that engineering students and engineering professionals were more able to put their findings in such a way on paper that this become a valuable contribution to the decision making process.

Figure 3. Participants from various countries active in the Simulation Game

Cultural aspects

The past 20 years about 30 students per year enrolled in the ICZM course ending up in about 400 trained people. About 25% of these students were from non-Western nationality (see Figure 3). Apart from the courses in Delft we have given the same course in many overseas countries. We experienced several discussions on the government style in different (non-

Western) countries in relation to the decision making processes and stakeholder participation advocated in our course. We believe that there are no fundamental cultural differences in the decision making process. Most governments have an interest of serving the needs of people in an optimal way, although management style, stakeholder participation and procedures may differ considerably over different countries (even already within the group of 'Western' countries).

Conclusions and recommendations

It is important to train students (working in a given discipline) in communication with other disciplines. For example, for engineering students focus has to be on political decision making. Also they have to be trained in communication with stakeholders. Also they should realize that “communication” differs from “providing information”. We found that a mixture of lectures and simulation games works quite well to create awareness with students that it is not always obvious what is the “best” solution to solve a coastal zone management problem.
Coastal engineers should be educated in coastal engineering and trained in the interaction with decision makers.

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