

Decision Support Systems for Integrated Coastal Zone Management: experiences from the Netherlands

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Contents

- ⇒ Introduction
- ⇒ Decision Support Systems (DSSs)
- ⇒ A characterisation for DSSs
- ⇒ Some example DSSs
- ⇒ Results
- ⇒ Conclusions
- ⇒ Discussion



Introduction

- ➔ *Integrated* coastal zone management (ICZM) requires at least two types of integration:
 - i. Knowledge integration, knowledge from social and natural disciplinary fields needs to be combined
 - ii. The management has to deal with stakeholders from different sectors, who have different perceptions of the problems at stake.



Introduction (2)

- ⇒ The two required types of integration make the *decision-making process* for ICZM very complex
- ⇒ How to facilitate this?
 - Many Decision Support Systems (DSSs) have been developed
 - What is the supportive role of the current systems?



Decision Support Systems

⇒ Broad definition of a “DSS”:

“a computer-based information system that is designed to support unstructured problem solving, decision-making and decision implementation” (Le Blanc, 1991)

Le Blanc, L.A., 1991. An assessment of DSS performance. *Information & Management*, 20: 137-148.



Decision Support Systems (2)

- ⇒ Requirements for tools that have been taken into account in this research
 - the system is a computer-based interactive tool
 - that has been developed or used for an ICZM issue in The Netherlands
 - the system is an integrative tool which is aimed at taking physical processes, human activities and the interrelationships into account



Decision Support Systems (3)

- ⇒ Several tools –which meet our requirements- have been developed in the past 12 years
- ⇒ Analysing the existing DSSs requires a methodological framework for investigating and comparing them



A characterisation for DSSs

⇒ For this purpose a characterisation has been developed. It is aimed at:

- Presenting a structured overview of existing tools
- Answering the questions: “what are the current tools capable of?” and even more important “what are the current tools not capable of?”.



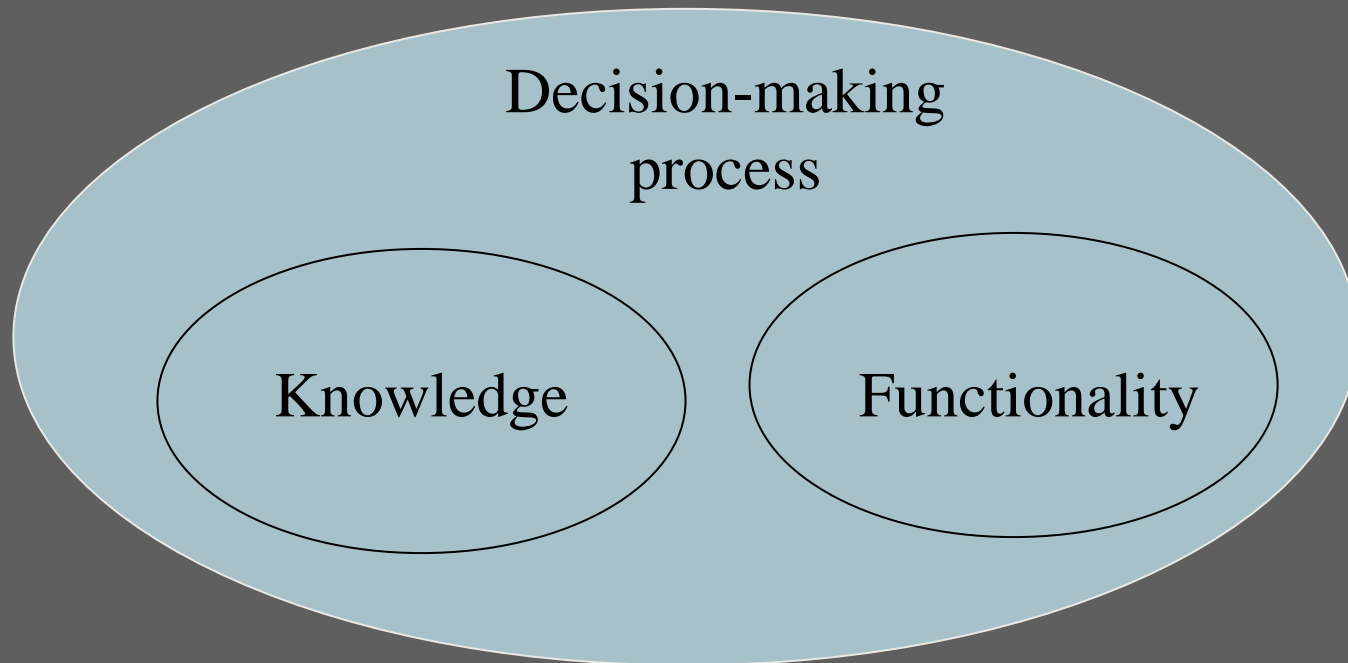
A characterisation for DSSs (2)

- ⇒ Three possible ways of constructing such a characterisation:
 - Studying the systems and clustering them
 - Studying existing typologies for computer tools
 - Studying theory on decision-making
- ⇒ Combining these approaches resulted in three groups of characteristics



A characterisation for DSSs (3)

⇒ Schematic view of characteristics:



Characteristics regarding *knowledge*

- ⇒ Three types of knowledge: embedded, input and output
- ⇒ What aspects are being modelled?
- ⇒ Knowledge integration from diverse disciplines
- ⇒ Universality of the tool
- ⇒ “Quality” of the knowledge



Characteristics regarding *functionality*

- ⇒ policy evaluation vs policy-optimisation
- ⇒ How does the system deal with knowledge gaps
- ⇒ Interactive usage
- ⇒ Simultaneous usage by multiple users
- ⇒ Gaming?
- ⇒ (Multi-) agent-based?



Characteristics regarding the *process*

⇒ The ICZM decision-making process as a rational process, which can roughly be divided into four stages:

- Problem structuring
- Generating options
- Option assessment
- Agreement on actions



Characteristics regarding the *process*

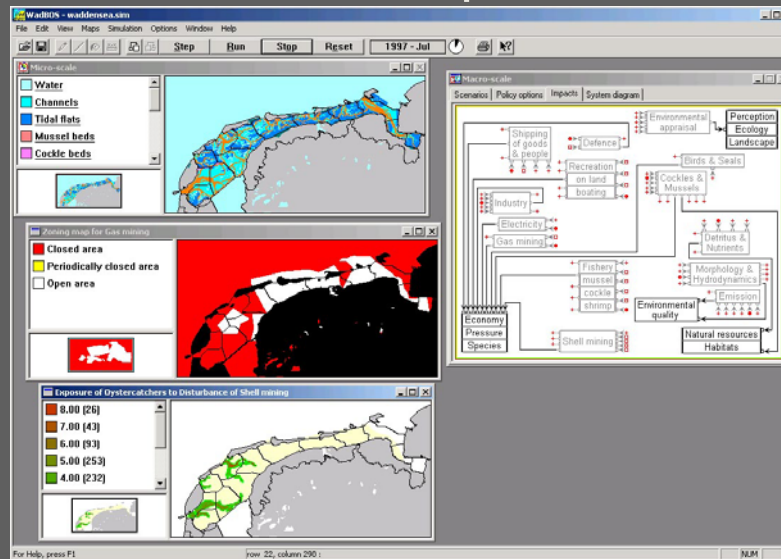
- ⇒ in which stage of the decision-making process is the system *supposed* to be used?
 - During the *problem structuring*
 - If yes, is it designed to involve non-expert stakeholders?
 - Does it support interactive model construction?
 - For *generating options*?
 - For *option assessment*?
 - To achieve *agreement on actions*?



Example DSSs

→ WadBOS:

- DSS developed for the Waddensea specifically
- Integrated, analytical model of physical, ecological but also socio-economical processes



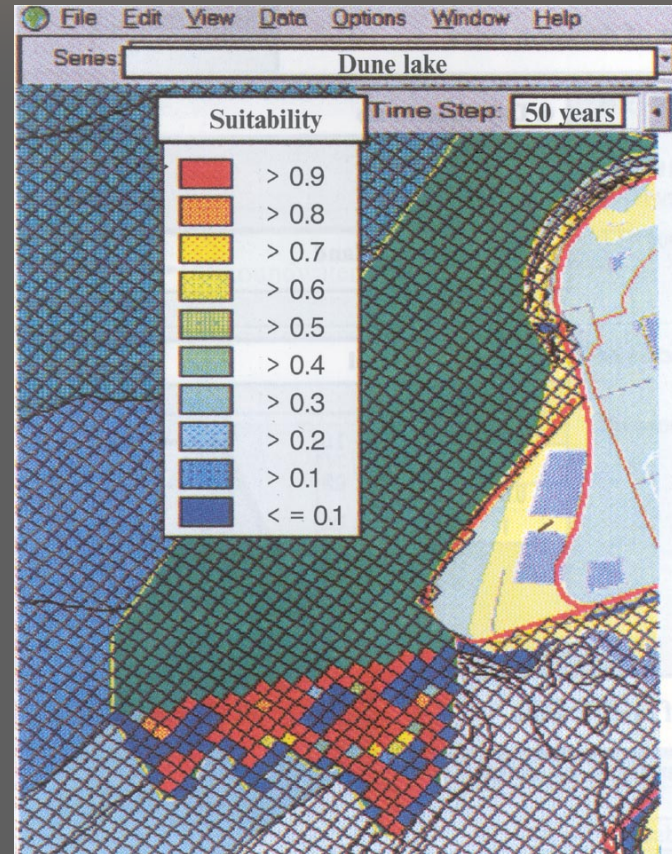
Example DSSs (2)

- ⇒ Nature Development and Valuation (NDV) module
- ⇒ Tool to support decisions on changes in land use in coastal zones
- ⇒ Two main objectives:
 - to predict nature development, the occurrence of species and the formation of landscapes;
 - to support the trade-off between ecological and economic interests by valuing nature



Example DSSs (3)

→ The NDV module has been developed for and applied to the Rotterdam harbour land reclamation plan (Tweede Maasvlakte)



Results: knowledge

System:	NDV-module	Topic
Universality:		
Is it designed specifically for the area it is applied to?	yes	no
Can the system also be used for some other ICZM cases?	yes	yes
Can the system also be used for all other ICZM cases?	no	yes
Quality of the knowledge:		
Does it contain quantitative information ?	yes	yes
Can the system handle uncertainty margins?	no	no
Can the system make calculations with spatial information?	yes	no
Is the system dynamic (is time an adjustable parameter) ?	yes	no



Results: functionality

System:	NDV-module	Topic
Policy-optimization/policy-evaluation:		
Can the system generate scenarios, based on measures provided by user?	yes	yes
Can the system suggest measures, based on targets submitted by user?	no	no
Uncertainty		
Can the system handle incomplete knowledge?	no	no
Is it possible that the output is like "don't know, based on current knowledge"?	no	no
Is it aimed to help in understanding what knowledge is needed for better results?	no	no
Interactive usage:		
Is the user interface designed for interactive usage specifically?	no	yes
Does it take less than a few minutes seconds for all possible calculations?	yes	yes
Does the system support simultaneous usage by multiple users?	no	no
If yes, does the system support gaming?	no	no
Visualisation:		
Can the system visualise relations conceptually?	yes	yes
Can the system visualise scenarios graphically?	yes	no



Results: process

System:	NDV-module	Topic
In which stage of the management process is the system <i>supposed</i> to be used?		
During the phase of problem exploration and problem structuring?	no	yes
If yes, is it designed to involve non-expert stakeholders?	no	yes
If yes, does the system support interactive model construction:	no	yes
Involving experts?	no	yes
Involving non-expert stakeholders?	no	yes
During the phase of generation of options?	yes	yes
During the phase of options assessment?	yes	no



Conclusions

- ⇒ The results showed that the tools are usually exclusively aimed at either:
 - Problem structuring
 - or
 - Generating options/option assessment
- ⇒ No tool supports multiple users
- ⇒ No tool uses gaming techniques
- ⇒ None of the tools address knowledge gaps explicitly
- ⇒ Only policy-evaluation tools

