NEEDS ASSESSMENT AND CONCEPTUAL DESIGN OF THE NILE BASIN DECISION SUPPORT SYSTEM CONSULTANCY

NILE BASIN DECISION SUPPORT SYSTEM

FINAL INCEPTION REPORT

ANNEX C: DSS Training Material and Programme

Vienna/Austria, Addis Ababa/Ethiopia, 27 November 2007

NILE BASIN INITIATIVE
Initiative du Bassin du Nil

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NEEDS ASSESSMENT AND CONCEPTUAL DESIGN OF THE NILE BASIN DECISION SUPPORT SYSTEM CONSULTANCY

By

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1 Executive Summary - DSS Training and Awareness Workshops

1.1 Objectives

The objective is to introduce the potential of DSS tools, illustrate the scope and benefits of possible applications, but also their limitations, data requirements, and infrastructure and institutional requirements, but in general get the participants interested in active involvement, including the exploratory application of the on-line tools for any specific problem or project.

1.2 Course Structure and Content Description

The DSS awareness and training workshops are planned for a two days duration and will be offered in two sub-regional workshops, repeated in 9 national workshops according to the TOR. The first day will be dedicated to six introductory lectures of about an hour each, plus 15-20 minutes questions and answers; each lecture can be concluded with an optional multiple-choice test (on site or completed on-line later, at leisure) invited written questions from the participants, answers to be shared on-line (DSS workshop web page).

1. Definitions, theory, DSS structure, DM process, basic approaches
2. Problem structures: IWRM, DPSIR, criteria for assessment, valuation
3. Formal decision making with DSS, objective functions
4. IWRM decisions, design of alternatives, instruments, constraints
5. Uncertainty and risk, game theory
6. DSS tools and methods

On the second day, this will be followed by live demonstrations of selected demo cases including examples drawn from the Nile basin subject to data availability but also active contributions from the workshop participants and hands-on exercises.

Details of the lecture units (course content) and the proposed schedule for the workshop are available on-line at

- http://www.ess.co.at/WATERWARE/NILE/workshop.html
- http://www.ess.co.at/WATERWARE/NILE/schedule.html

The lecture notes are available on-line for interactive use with comments, and will be made available in handout format to the workshop participants.

1.3 Support tools and material

A number of online support tools have been implemented, including a web page dedicated to the workshops (http://www.ess.co.at/WATERWARE/NILE) with on-line registration of participants, stakeholder institutions, and questionnaires, as well as on-line versions of the lectures and associated multiple-choice test for participant self evaluation; and on-line web based model and DSS tools for exploratory self study, anytime, anywhere, on demand.

2 DSS Training Material and Programme

WP 1.1, Activity 1.1.9: Modules for the DSS Awareness/Training Workshops

Objectives: Key technical staff (workshop participants) will be familiar with basic DSS concepts, terminology, and tools, and thus be ready to facilitate the detailed needs assessment in the Central Analysis project phase.

Outputs: DSS awareness/training Workshop Modules ready to be discussed during inception workshop.

WP 2.1, Activity 2.1.1: IWRM/DSS Awareness and Training Workshops

Objectives: Carry out awareness and consultation Workshop and discuss with all identified stakeholders on their needs and requirements towards implementation of the Nile Basin DSS, in a participatory way.

Sub-regional and National Workshops: Awareness and Training Workshops (two days each) consisting of introductory lectures, discussions, and interactive model and DSS applications and exercises. While the workshops at national and sub-regional level will share the majority of the lecture material, the emphasis in the application examples will reflect the different (geographical) and managerial scope; while the national workshops will put more emphasis on the project level and project design and evaluation, the sub-regional workshops will put emphasis on interactions at the basin scale, upstream/downstream issues, competition and cooperation, win-win strategies, multi-layered decisions, hierarchical objectives and constraints, etc.

Examples and case studies from the NBI will be included in the training material subject to the availability of appropriate data (downloaded from the NBI ftp server at: 67.15.172.18; at the point of writing(September 24, one example problem data set for the Karadobi multi-purpose dam and reservoir could be retrieved from that server.

The proposed program of the Workshops will be discussed during the Inception Workshop. The regional workshops are to be held in Addis Ababa, Ethiopia for the Eastern Nile Countries and in Kigali, Rwanda for the Equatorial Lakes Countries. Furthermore these workshops will be repeated with a national scope in each of the nine NBI countries.

3 Training Course Content Description

The training course material comprises six main lectures of about an hour each, plus 15-20 minutes questions and answers; each lecture concluded with an optional multiple-choice test, invited written questions from the participants, answers to be shared on-line (DSS workshop web page), as well as the demo examples data sets.

3.1 Day 1 - The introductory lectures

The six main introductory lectures for day one address:

1. Definitions, theory, DSS structure, DM process, basic approaches
2. Problem structures: IWRM, DPSIR, criteria for assessment, valuation
3. Formal decision making with DSS, objective functions
4. IWRM decisions, design of alternatives, instruments, constraints
5. Uncertainty and risk, trade off, game theory
6. DSS tools and methods, comparison (SWOT), satisficing and reference point methods.

The lecture notes are prepared as PowerPoint presentation currently amounting to about 300 slides, that are also available on-line.

Lecture 1: and introduction to DSS and structured decision making, basic concepts and terminology: Definitions, Decision theory, DSS-Structure, DM Processes and Concepts, basic approaches: information systems, scenario analysis, EIA/SIA, rational maximization, multi-attribute theory (multi-criteria, multi-objectives)

Lecture 2: application conext in IWRM, criteria and indicator frameworks, economic valuation methods: Structuring the problem: IWRM, criteria and indicators, the DPSIR concept, WFD and Dublin principles, economic valuation methods, multi-criteria representation;

Lecture 3: Structured, formal and rational decision making, methodological framework: Formal DM examples (MiniMax and Bayesian), rational maximization, multi-attribute extensions. Basic concepts: (uncontrollable) input versus (controllable) decision variables, system performance measures: criteria; objective constraints, feasible vs non-feasible, dominated vs non-dominated, Pareto optimality, compromise, trade-off;

Lecture 4: Application domain: model representation ans cenario analysis in water resources management: IWR management; problems, model representation, data requirements, scoping, design of alternatives, policy, strategy, instruments; hydrological cycle, cascading reservoirs, EVT, routing, GW, water quality.

Lecture 5: Logical limitations, sources and impacts of uncertainty,multi-party games: Uncertainty and risk (including climate change impacts), decisions under uncertainty, institutional framework, gaming concepts (zero sum vs win-win), group decision making, participation, consensus building;

Lecture 6: Overview of the most common methods, short comparison of strength and weaknesses (introduction to SWOT analysis): DSS software tools, overview and typical model applications, classical decision problems, scenario development.

3.2 Day 2 - Application examples and demo cases

Introductory lecture 1:

1. Demo cases overview
2. Short review of the Nile DST
3. Data bases, data analysis, hypothesis testing

Introductory lecture 2:

- Scenario analysis, modelling, comparison, export to the DSS
- Optimization scenarios, design of alternatives (selection and allocation of instruments)
- Discrete multi-criteria DSS, interpretation and user interaction.

Demo cases:

Joint interactive model/DSS use with hands on subject to the availability of the necessary technical infrastructure (broadband Internet access and individual PCs for participants), or taking turns on the local workstation.

1. Generic multi-criteria example with every day adapt (comparing cars): application of decision matrix versus reference point method
2. Generic (irrigation) demand with alternative supplies (surface and groundwater), role and effects of a reservoir, demand reduction, efficiency, versus increased supply, inter-annual variability: reservoir strategies vs alternative supply options. Extension to competing (regional, upstream/downstream) demands, zero sum versus win-win strategies.
3. Water quality issues: treatment investments vs. constraints of use
4. Complex integrated (basin wide) systems, upstream/downstream, lakes and reservoirs, large scale irrigation, efficiencies and loss reduction

Final discussion:

- Debriefing of participants,
- Final multiple-choice test
- General DSS implementation considerations
- Short presentation of the on-line support tools for continuing exploratory study and experimentation, models and DSS tools, student self evaluation with interactive on-line multiple choice tests.

4 Auxiliary material and on-line tools

In support of the two-day workshops, a range of on-line support tools linked from the workshop support web pages at http://www.ess.co.at/WATERWARE/NILE (in part also available in hardcopy to be distributed to the participants at the workshops) have been prepared.

These include:

- On-line participant registration; in parallel a registration form was prepared. The objective is to gain early information on workshop participant background and interests. At the same time, the on-line registration generates user accounts for the use of the on-line tools.
- Simple introductory questionnaire (15 questions with a Likkert scale response scheme) to determine general attitudes and opinions in the domain of IWRM.
- On-line registration of stakeholder institutions, together with individual participant registration.
- On-line questionnaire for water resources issues. These can be used to describe individual cases (basin) and their problems with the possibility of multiple entries b institutions and individual. Designed to provide background information of problem issues of particular importance that can be used to adjust and better customize the workshops to the different audiences' specific interests.
- On-line interactive model tools, designed to generate scenarios for comparison, optimization scenarios, and input to the DSS tool demo proper. Models include:
  - Dynamic rainfall-runoff to estimate runoff from ungaged catchments;
  - Irrigation water requirements estimation;
  - Water resources model: dynamic, distributed (network topology model with embedded economic valuation and scenario comparison. Forms the basis of the optimization and DSS scenarios.
  - Water quality model; uses the hydrology results from the water resources model to describe DO/BOD and/or conservative or first order pollutant, including economic valuation and scenario comparison.
  - Multi-criteria optimization: a satisficing framework to generate feasible alternatives for water resources management problems based on a data base of instruments (water technologies, policies);
  - Discrete multi-criteria DSS (reference point method) that can be used with annual inputs of alternative and their criteria, or as an automatically coupled post-processor to the multi-criteria optimization framework.
  - Screening level rule-based EIA framework for project assessment.

4.1 Nile DSS Training & Awareness Workshop – Registration Form

Last name	
First/middle name	
Acad. title	
Year of graduation	
Study topics	
Gender	
Functional title	
Institution	
Street address	
City	
Country	
User name	
Phone	
Fax	
Mobile	
Email	
Languages	
Computer literacy	
Special interests	
Case studies	

Online registration: http://www.ess.co.at/WATERWARE/NILE

4.2 Questionnaire

Instructions:

Please circle the field best corresponding with your agreement or disagreement with the statement above it; the colours and numbers in the fields are interpreted as follows:

1	I completely agree:	YES !
2	I largely agree:	Well, yes
3	I somewhat agree:	Yes, BUT.....
4	Indifferent, no opinion:	Don't know, not applicable
5	I somewhat disagree:	No, but …..
6	I largely disagree:	NO, however …..
7	I completely disagree:	Absolutely NO !

1. The main water resources problem (in my domain of responsibility) is scarcity

1	2	3	4	5	6	7

2. Water quality is just as important as quantity for water resources management.

1	2	3	4	5	6	7

3. Agricultural water use is dominant, but also very inefficient.

1	2	3	4	5	6	7

4. Access to safe and sufficient water is a human right and should be free or easily affordable, everywhere.

1	2	3	4	5	6	7

5. In arid countries, fresh water released to the sea is a waste and to be minimized.

1	2	3	4	5	6	7

6. Consistent water pricing (and metering) would increase the efficiency of use.

1	2	3	4	5	6	7

7. There is often the possibility for a win-win situation if water could be better allocated between different users, including upstream,/downstream demands.

1	2	3	4	5	6	7

8. The core of any water resources issues is always institutional and eventually, political.

1	2	3	4	5	6	7

9. The “polluter must pay” principle is correct, what is lacking is serious enforcement and effective penalties.

1	2	3	4	5	6	7

10. If water services are priced for full cost recovery, the cost of water will become a social issue.

1	2	3	4	5	6	7

11. Water allocation for environmental purposes (in stream water quality, wetlands) should have absolute priority.

1	2	3	4	5	6	7

12. Water used in industry or tourism including recreational uses generates much higher benefits than irrigated agriculture.

1	2	3	4	5	6	7

13. I fully support the Dublin principles. They should be integrated in all national legislation.

1	2	3	4	5	6	7

14. Lack of data and poor quality are the main constraints for using quantitative analysis and computer based models, DSS.

1	2	3	4	5	6	7

15. Computer hardware and fast and reliable Internet access are only temporary constraints for the use of advanced numerical methods.

1	2	3	4	5	6	7

4.3 Training sessions proposed schedule

The workshop will be conducted by Kurt Fedra, Austria, who will be available for registered participants on-line for questions and support for the on-line resources and demo examples at: kurt@ess.co.at

The workshop will consist of a series of introductory lectures on day 1, followed by a set of practical model/DSS demo examples on the second day.

Six main lectures of about an hour each, plus 15-20 minutes questions and answers; each lecture concluded with an optional multiple-choice test, invited written questions from the participants, answers to be shared on-line (DSS workshop web page).

The main topics of the six lectures include:

- Lecture 1: Definitions, theory, DSS structure, DM processes,
- Lecture 2: Problem structures: IWRM, DPSIR, criteria, valuation
- Lecture 3: Formal decision making with DSS, objective functions
- Lecture 4: IWRM decisions, alternatives, instruments, constraints
- Lecture 5: Uncertainty and risk, trade off, game theory
- Lecture 6: DSS methods and tools, comparative analysis.

4.3.1 Day 1 - Workshop Schedule

1. 09:00 - 09:15 **Introduction** (tutor and participants), short student questionnaire;
2. 09:15 - 09:30 **Introductory baseline multiple-choice test**, explanation and hand out (should be filled in during the first coffee break): test will be used as a benchmark for the assessment of learning results and to introduce basic concepts;
3. 09:30 - 10:15 **Lecture 1**: Definitions, Decision theory, DSS-Structure, DM Processes and Concepts, basic approaches: information systems, scenario analysis, EIA/SIA, rational maximization, multi-attribute theory (multi-criteria, multi-objectives)
4. 10:15 - 10:45 Coffee break
5. 10:45 - 11:30 **Lecture 2**: Structuring the problem: IWRM, criteria and indicators, the DPSIR concept, WFD and Dublin principles, economic valuation methods, multi-criteria representation;
6. 11:30 - 12:15 **Lecture 3**: Formal DM examples (MiniMax and Bayesian), rational maximization, multi-attribute extensions. Basic concepts: (uncontrollable) input versus (controllable) decision variables, system performance measures: criteria; objective constraints, feasible vs non-feasible, dominated vs non-dominated, Pareto optimality, compromise, trade-off;
7. 12:15 - 13:45 Lunch break
8. 13:45 - 14:30 **Lecture 4**: IWR management; problems, model representation, data requirements and META data, scoping, design of alternatives, policy, strategy, instruments; hydrological cycle, cascading reservoirs, EVT, routing, GW, water quality.
9. 14:30 - 15:15 **Lecture 5**: Uncertainty and risk (including climate change impacts), decisions under uncertainty, institutional framework, gaming concepts (zero sum vs win-win), group decision making, participation, consensus building;
10. 15:15-15:45 Coffee break
11. 15:45 - 16:30 **Lecture 6**:´DSS software includeing the Nile DST, basic methods (decision matrix, MCA apporaches) tools, reference point apporach
12. 16:30 - 17:00 **Final discussions and Assignment**: Issues questionnaire for one or more selected cases/basin per participant. This will be the basis for discussion of the demo cases for the interactive training, and can be set up also as Internet based scenarios for further self-study by interested participants. The questionnaire should be returned in the morning of the second day of the workshop (after the first coffee break) if possible.

4.3.2 Day 2 - Workshop schedule

Day 2 starts with two introductory lectures again:

1. Introductory lecture 1:
   - Demo cases overview
   - Data bases, data analysis, hypothesis testing
2. Introductory lecture 2:
   - Scenario analysis, modelling, comparison, export to the DSS
   - Optimization scenarios, design of alternatives (selection and allocation of instruments)
   - Discrete multi-criteria DSS tool (reference point method).

The Demos cases: joint interactive model/DSS use with hands on subject to the availability of the necessary technical infrastructure (broadband Internet access and individual PCs for participants), or taking turns on the local workstation: (for the demo cases, see section 3.1.1 above).

1. 09:00 - 10:00 **Introductory lecture 1** and presentation of a set of prototypical generic problems using synthetic examples derived from several Mediterranean cases or Nile basin sub-catchments;
2. 10:00 - 11:00 **Introductory lecture 2** and discussion of specific regional projects at SAP and SVP levels, discussion of their decision problems and decision making process structures, role of DSS;
3. 11:00 - 11:30 Coffee break
4. 11:30 - 12:30 **Hands-on session**, details depending on the number of participants, available hardware (individual access), specific cases of interest introduced by the participants (see also the Assignment from 1 !)
5. 12:30 - 14:00 Lunch break
6. 14:00 - 15:00 **Hands on session** and individual QA sessions continued;
7. 15:00 - 15:30 Coffee break
8. 15:30 - 16:30 **Hands on session** and individual QA sessions continued;
9. 16:30 - open ended **Final discussion and debriefing presentation** of on-line support tools and resources for continuing self-study, hand-out of the second multiple choice test to measure learning progress; Can be sent in by eMail, or done on-line by the participants on their own schedule. General DSS implementation considerations (open discussions related to the needs assessment)

Please note: all lectures will be made available on-line as commented interactive presentations.

The analysis of questionnaires and tests (anonymous) will be posted on the Internet, on the workshop support pages. The test are also available for on-line use.

The demo cases discussed will be made available on-line to all registered workshop participants with Email based tutor support kurt@ess.co.at for the participants to keep working with.

5 Didactic concept and implementation strategy

The basic didactic concept of the workshops is an interactive, immersive exposure that applies concepts of cognitive exploration.

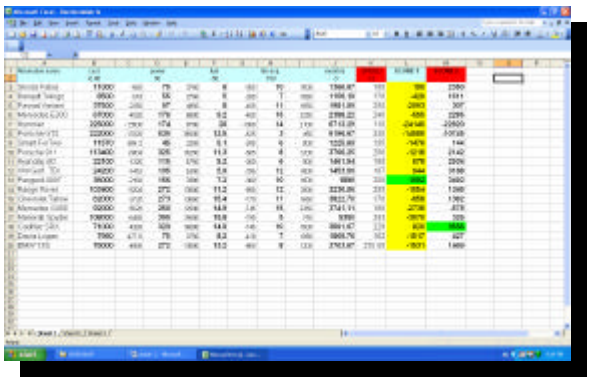
This aims at involving the participants actively as much as possible. The course content will be presented in classical lecture style. However, for every one of the concepts, paradigm, models, applications the audience will be asked to contribute application cases and examples from their own domain of experience that are directly meaningful and of practical interest.

The DSS concepts and tools and methodology as well as the simulation models used to generate feasible alternatives are inherently generic. However, their potential usefulness derived from practical applications to problems of immediate interest to the participants, that are sufficiently familiar to provide basic (scaling level order of magnitude) information to structure the decision problem and select the most appropriate methodology, identify key data and information requirements, etc.

Therefore, all application and demo examples (in particular for the second day of application examples and model/DSS application demos) will be sufficiently generic to adapt ad hoc and interactively to particular problem cases selected and described by the participants. As a fail-safe fall back, the generic cases are sufficiently well structured and scaled to provide illustrative didactic material even in their generic form, that is, however, easy to adjust to specific cases given the necessary information. It is important to note here that the main objective is to present sufficiently well structured didactic examples rather than concrete cases in all their detail that would exceed the time and resources available, e.g., in the time required to run a complete scenario for a “realistic” case with hundreds of nodes in the model representation.

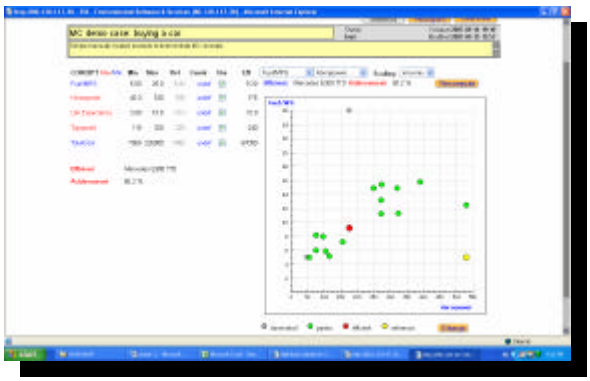
A key objective is to convince the participants of the necessary flexibility of the tools prepared to address any and all decision problem.

5.1 Prototypical generic problems

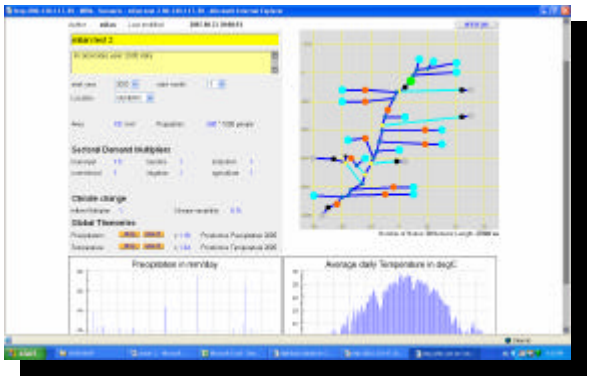


The prototypical generic problems are structured with increasing complexity to ensure both fast interactive use (model performance) but also the possibility to modify, structure and parametrize the test cases interactively as required. The possibility to interact, provide own information and see their effects immediately creates a felling of control and an attitude of ownership that is essential for the adoption and use of any complex tools that does require considerable effort and involvement by the user. This can only be achiever when positive feedback can be generated by a series of successful experiments of increasing complexity.

The generic problems start out with a very simple case of a discrete multi-criteria selection that contrasts the use of a simple decision matrix versus a more complex reference point methodology. The case (selecting a new car) is sufficiently simple and familiar to allow users to introduce their favourite alternative (model) into the selection, and at the same time to define a preference structure as a group decision making exercise.



The second set of problem is a series of classical allocation and investment problems around one to several types and locations of demand, starting with a single irrigation district. The elements of the problem include conjunctive use (alternative supply of surface and groundwater, introduction of a reservoir, flood control benefits, improved efficiency (alternative irrigation technologies or crops, canal lining). Increasing the number of elements and thus complexity leads to a series of scenario that can be



- Directly compared including the results of the economic assessment;
- Processed with a decision matrix for a selected (more manageable) subset of criteria
- Used as the basis of a multi-criteria optimization run with subsequent post-processing with a discrete multi-criteria (reference point methodology) tool.

In any case, the generic examples are designed for:

- Maximum interactive involvement of the participants
- Easy adaptation to any specific local or regional decision problem or case study brought forward in the discussion or identified through the water issues questionnaires.

5.2 Specific regional projects at SAP and SVP levels

To ensure a demonstration case with detailed and realistic local (regional) content, the Karadobi multi-purpose reservoir project (Ethiopia, Sudan) will be used as an example either in support of any other participant defined cases or as an alternative, prepared case that can be used to illustrate a range of DSS concepts.

The example provide material both for

- The local (national) scale with the optimization of the reservoir project and local benefits, illustrating economies of scale, but also the trade offs between different consumptive and allocative uses of the water;
- The sub-regional international scale by illustrating down stream effects (benefits) of a major reservoir and its regulating properties. The trade off between upstream consumptive use for irrigation versus improved (regulated) flow characteristics as well as the energy production and export from Ethiopia to Sudan can be illustrated with that case.

5.3 Hands-on training sessions

The hands on training session planned for the second day will be structured depending on the availability of appropriate hardware, local networking and Internet access, as well as the number and computer literacy of participants. Depending on the logistics and the interests of the participants that format can range from

- live interactive demos with the participants providing suggestions and data for the models to generate alternatives, and preference structures for the decision making processes illustrated;
- participants taking turns in hands-on experience with the portable workstation provided as demo machine for the workshops;
- all participants working (in teams of two or three depending on the number of PCs available) in parallel with the tutor off the local server (portable workstation) or from the main model and DSS servers in Vienna through Internet access.

5.4 Continuing support - distance learning on demand

With two days for a domain and content that usually requires one or more semesters in a normal university course, the workshops can only hope to create a basic awareness and raise interest among the participants. However, for any participants that are interested in deepening the workshop experience, all the models, data sets and tools as well as the lecture material are made available on-line with tutor support for the duration of the project as distance learning environment for learning on demand. The second day of the workshop will include a short presentation of these web-based learning resources.