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OPTIMA

Optimisation for Sustainable Water Resources Management

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RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

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EXECUTIVE SUMMARY

This report describes the final implementation and operation of the discrete multi-criteria approach designed for direct, interactive stakeholder participation using the results of the baseline scenarios of the individual cases (generated in work packages 7 through 13) and the output from any first level satisficing optimization scenarios for the water resources model and the economic assessment described in Deliverable D3.2.

This report provides a tutorial and guideline on the use of the tools going beyond the basic on-line reference manual. In order to facilitate and better support the decision (post-optimal) analysis work in WP 14, the report is being delivered to the partners and the Commission more than three months ahead of schedule.

The basic optimization approach and paradigm as well as the tools developed and available for the case studies have been described in some detail in

- Deliverable D3.1 Water Resources Modelling Framework
- Deliverable D3.2 Basic Optimization Model
- Deliverable D3.3 Discrete Multi-criteria Optimization

OPTIMA uses a multi-stage procedure with a two-stage optimization approach specifically designed to facilitate a participatory approach and continuing stakeholder involvement:

1. A first phase builds a detailed model representation of the water resources system under study and establishes a baseline scenario for each case study;
2. A second phase based on evolutionary algorithms for complex optimization identifies feasible solutions that meet all or as many as possible of the user expectations expressed in terms of constraints on performance criteria;
3. A subsequent discrete multi-criteria phase is oriented toward conflict resolution: it defines the trade-offs between the conflicting objectives using a reference point methodology and the concept of Pareto-efficiency to arrive at a generally acceptable solution as global optimum.

The overall aim of OPTIMA is to develop, implement, test, critically evaluate, and exploit an innovative, scientifically rigorous yet practical approach to water resources management, in close cooperation with local and regional stakeholders, intended to increase efficiencies and to reconcile conflicting demands. Based on the European Water Framework Directive (2000/60/EC), the approach equally considers economic efficiency, environmental compatibility, and social equity as the pillars of sustainable development. The project realises both the importance of the socio-political and economic aspects, but also the importance of a reliable, consistent, and shared information basis for the policy and decision making process.

The central analytical paradigm in OPTIMA is optimization, based on a dynamic water resources model system describing a river basin in terms of water demand and supply, technical and hydrological efficiency, access and reliability, costs and benefits at various levels of sectoral and spatial or temporal resolution and aggregation. The optimization approach operates on several closely integrated levels with the appropriate feedback cycles and continuous stakeholder involvement.

Project technical objectives

The primary general objectives of the Programme include: Developing comprehensive Decision Support Systems (DSS) through the use of area wide Geographical Information Systems (GIS) combined with remote sensing capabilities in support of policy analysis and enforcement as appropriate.

Within this more generic framework, **OPTIMA** addresses a number of specific scientific objectives:

- To build, and test in a number of parallel comparative case studies, a consistent and well integrated set of advanced but practical DSS tools for efficient, "optimal" water management strategies and policies of use, designed for a participatory public decision making process.
- To extend the classical techno-economic approach by explicit consideration and inclusion in the two-phase optimisation methodology of acceptance and implementation criteria, where the method not only helps to generate optimal solutions, but facilitates the process of agreeing on what exactly optimal means in any particular case, as a shared community vision, including gender sensitive issues where feasible.
- To develop a generic approach to combine engineering analysis and formal optimisation with socio-economic considerations in a unifying and consistent multi-criteria multi-objective framework.
- To integrate expert systems technology and heuristics with complex simulation and optimisation models to improve their usability in data poor and data constrained application situations.
- To develop appropriate tools and methods for the communication of complex technical information to a broad range of participants and stakeholders in the policy making process, based on classical workshops and Internet technology, and in particular the easy and efficient elicitation of preferences and trade-offs in an interactive, reference point approach.
- To adapt and further develop formal methods of optimisation for highly complex, non-linear, dynamic, and spatially distributed systems that are non-differentiable by applying heuristics, genetic programming combined with local stochastic gradient methods and post-optimal analysis for large scale discrete multi-criteria problems.

WP14: Objectives

Objectives:

The objectives of this work package are the comparative analysis of the individual case study results, across the seven case studies.

- Analyse the combined set of alternatives within and across case studies with reference to local stakeholders and actors expressed preferences;
- Identify patterns between objectives, criteria, and constraints in a post-optimal analysis;
- Identify the contributions of individual classes of measures (technological, institutional, economic) and their contribution to the objectives;
- Identify the relationship of decision variables for cross-correlation among the decision variables, and correlations between decision variables and the objectives (sensitivity analysis).

Tasks:

- Just as the feasible alternatives for each case study are subjected to the discrete optimisation step, the combined set of ALL alternatives from ALL case studies can be analysed in the same way to identify generic patterns and relationships across the entire project.
- The analysis of the individual decision support exercises will yield a rich material for decision analysis, i.e., a sensitivity analysis of the decision making process, that will identify user preferences and trade-offs (with direct involvement of local actors) and show local versus general trends.
- The task is a comprehensive statistical analysis of the combined data material, looking for patterns within and between groups of variables such as the decision variables, criteria, constraints, and objectives. The emerging patterns can be interpreted to shed light on the relative contributions of individual measures or classes of measures on the overall results.

The activities in WP 14 build directly on the individual case study results, as well as on the optimization tools developed in WP 3 and integrated in WP 6.

For each of the seven case studies, one or more baseline scenarios with economic evaluation are available as inputs for the decision analysis phase. This should directly involve the stakeholders and any proxy decision makers identified in each of the case study areas (see also: <http://www.ess.co.at/OPTIMA/stakeholders.html> which describes the involvement of stakeholders in the case studies).

D14.2, Stakeholder Involvement and Preferences, will report on this specifically, from the initial identification of problems and issues for each case study to the preference structures identified in the participatory optimization exercises based on the tools and approaches described in this Report.

Decision Analysis: concepts and terminology

Decision Analysis is a loosely defined set of methods, approaches, ideas, that all relate to rational decision making.

To quote from the Decision Analysis Society: it refers to the “development and use of logical methods for the improvement of decision-making in public and private enterprise. Such methods include models for decision-making under conditions of uncertainty or multiple objectives; techniques of risk analysis and risk assessment; experimental and descriptive studies of decision-making behaviour; economic analysis of competitive and strategic decisions; techniques for facilitating decision-making by groups; and computer modelling software and expert systems for decision support. Our members include practitioners, educators, and researchers with backgrounds in engineering, business, economics, statistics, psychology, and other social and applied sciences”.

In the context of the OPTIMA project, Decision Analysis refers primarily to **the exploration and analysis of preference structures and the relationship between decision variables and performance variables.**

Preferences are defined by the stakeholders or any proxy decision makers within the framework of the participatory multi-criteria optimization approach developed in the project. The objective is to identify commonalities and differences toward more generic best practice solutions.

The basic set of criteria to describe individual alternatives is the same for all case studies. The preference structures of different groups of decision makers can therefore be described in terms of:

1. Any additional criteria beyond the default set;
2. Deleting or switching off any of the criteria;
3. Setting of (secondary) constraints beyond the constraints used for the first round of satisficing optimization runs;
4. Setting of a reference point away from UTOPIA.

For the analysis procedure, the following concepts are relevant:

- **Optimization scenario:** refers to a set of alternatives to be evaluated together; the scenario has a name, an owner, a META data description, creation and modification dates. A scenario or Set of Alternatives should include at least 5-7 cases. The set can be understood as forming an N dimensional (N is the number of criteria) space or decision space, where each alternative is located according to the value of its criteria.
- **Alternatives:** these are results of an individual WRM model run, and may include additional criteria added by the user interactively beyond model generated criteria (see below);
- **Criteria:** these are the attributes that describe the alternatives, For a multi-criteria problem, we do need at least two criteria.
- **Constraints:** these are minimal or maximal values for the criteria the user is willing to consider. An alternative that has attribute values (criteria) outside these constraints is considered infeasible and excluded from further consideration.
- **Objectives:** the objectives define the optimization strategy. For each of the criteria to be considered simultaneously, the user can define a strategy, namely:

- **MAX**, maximize, i.e., bigger is better;
 - **MIN**, minimize, i.e., smaller is better;
 - **DEV**, minimize the linear deviation from a norm or target, where only the absolute value of the deviation without regard to direction is considered.
 - **DEV2**, as above, but consider the squared deviation as the criterion to be minimized, which penalises deviation more the greater they are.
- **NADIR**: a hypothetical point that combines the “worst” of all the criteria values.
 - **UTOPIA**: a hypothetical point that combines the “best” of all the criteria values.
 - **Reference point**: this is again a hypothetical point (or alternative) that closely represents the users aspirations. By default, UTOPIA is used as the reference point, which implies that all criteria have the same importance, weight, or contribution to the solution. The individual criteria which may have very different units and ranges are normalized between NADIR and UTOPIA so that every specific value can be expressed as a % of achievement (moving from NADIR towards UTOPIA). One unit of achievement along one axis (dimension represented by criteria) is considered to be equivalent to the same unit achievement in any other dimension.

The set of alternatives is organised in different ways, the ultimate objective is to find the “best” alternative given the current preference structure:

- **Feasible subset**: this is the set of alternatives that meets all constraints;
- **Pareto or non-dominated subset**: consists of all alternatives that are better in at least one of the criteria than any other alternative;
- **Efficient point**: this constitutes the solution of the multi-criteria optimization problem. It is the feasible, non-dominated (Pareto optimal) alternative that is “closest” to the reference point. Distance is defined in terms of an N dimensional Euclidean distance in the normalized (see above) decision space.

The decision process or exercise consists in the manipulation of criteria (switching them on or off), setting of constraints, and moving the reference point to find an efficient point as the solution. The definition of the preferences thus expressed is done by the stakeholders as a group who has to agree on each of these settings. The interactive and participatory decision analysis consists in making the implications of any one of these settings transparent (in particular, the implied trade-offs) by experimenting with the interactive system and thus learning about its response.

The decision analysis can, however, also be performed as an off-line post mortem analysis given the decision scenarios and the preference structures they represent.

It is important to note however, that the strength of the discrete multi-criteria approach rests on the assumption that the repertoire of alternatives is large enough to contain an optimal solution with high probability. There is no guarantee for convergence towards a global optimum, which is part of the price to be paid for treating a complex, dynamic, distributed and non-linear system in all detail. To generate such a large set of alternatives, OPTIMA uses the basic optimization version of the water resources model (Deliverable D3.2: Implementation Report: Basic Optimisation Model). The alternative for cases where the set of alternatives is heavily constrained is to generate them individually by runs of the WRM model and the export of the results summary file for treatment with the DMC tool.

Using DMC: A tutorial introduction

The first step in using DMC is, after login and proper user authentication, is to select and configure the scenario and its alternatives.

The primary listing of available scenarios shows their name, a short description, the owner, and the last modification date. Alternatively, the number of criteria and alternatives (cases) in each scenario can be shown.

The button menu (upper right corner) offers to

- Log out and change the user name
- Close the application
- Start the corresponding help page from the user manual
- Refresh the current listing after some changes
- ADD a new scenario.

To select one of the existing scenarios, the user simply selects from the listing with a left mouse button click.

Once an existing scenario is selected, the corresponding overview is presented.

This main scenario page includes:

- A header with name and meta data description
- A set of standard and main navigation buttons (upper right corner)
- A menu block for the selection and configuration of the criteria
- A button menu for data import
- A listing of the current alternatives and a button to create a new alternative

To select, display, and edit the criteria for an individual alternative, select the alternative from the list of available alternatives by a left mouse button click.

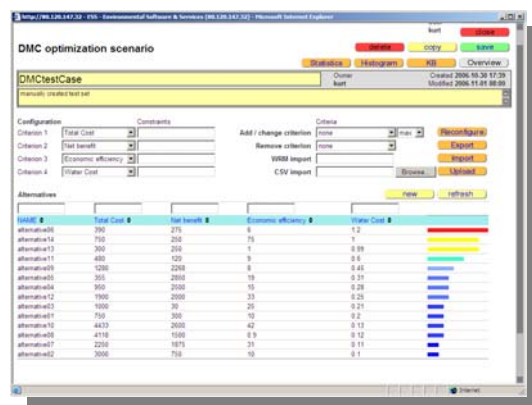
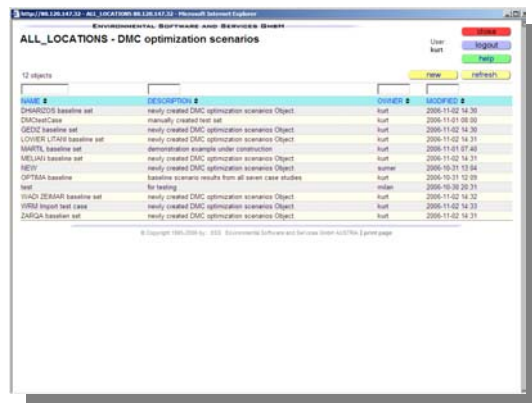
The navigation buttons

The standard generic set includes a

- help button (link to the user manual),
- close the application
- delete the current scenario (requires ownership)
- copy the current scenario
- save any changes to the data base.

The application specific options include:

- Statistics for the analysis of the entire scenario
- Histogram for the analysis of individual criteria
- KB, the Knowledge Base Editor to create and edit new criteria.



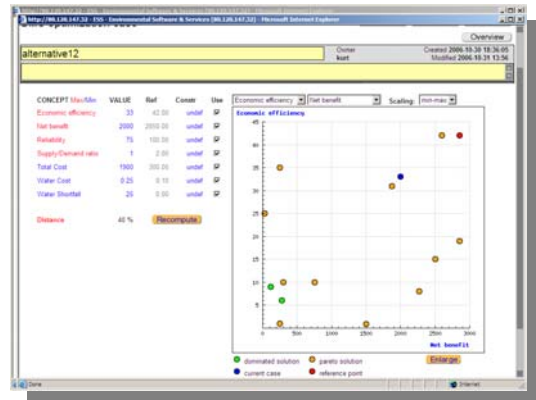
Creating and/or editing an alternative

To edit an alternative, one can either

- Select an existing one, edit or possibly first cope and then edit it
- Create a new, empty instance with the NEW button.

In both cases, a new page will be displayed that combines

- A tabular summary (or empty template) for the criteria of this alternative as well as any applicable constraints;
- A scattergram of all available alternatives with the current alternative highlighted.



In the tabular summary of the current alternative's criteria values, these values can be edited by clicking on them, then using the interactive editing tool that includes

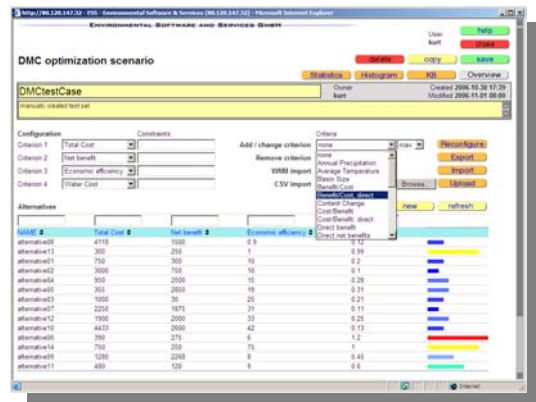
- A description of the variable in question;
- a set of symbolic default values
- an analog slider tool to set the value
- the possibility to type in value
- the possibility to unset (undefined) the value.

Creating and configuring criteria

If an existing alternative is edited or a new one created interactively, the set of criteria offered for editing is fixed. At the level of the scenario (the entire set of alternative), it is possible to ADD a new dimension (criterion to describe alternatives).

The list of currently available alternative is shown in the pull-down menu under Add/Change criterion. This is the list of criteria currently defined in the Knowledgebase.

If a new criterion gets selected, the button: RECONFIGURE will add it as a new dimension to the current set, all value initially UNDEFINED.



When a new criterion is added, the user should also set the correct optimization strategy (MIN.MAX, DEV, DEV2).

With the left hand side of the configuration interface, four of the criteria can be selected as descriptive columns in the listing of alternatives. The last, rightmost one will also be shown with a color coded value scaled horizontal bar in addition to the corresponding numerical value.

Default set of Criteria

DMC primarily is designed to post-process sets of alternatives generated by the WRM optimization version or by individual WRM model scenarios.

The alternatives are generated by the model with a basic set of default criteria or indicators computed by the model as a summary of the scenario results. For the comparison of basins, these summary values are normalized by basin size (e.g., precipitation in mm) or population (e.g., economics per capita).

The set of model results used for the second phase discrete optimization consists of a combination of the first page WRM results summary and the economic results summary parameters (button: ECONOMIC SUMMARY).

The set of criteria are summarized at the scenario level, so that there are equivalent values at the sectoral and the individual node level.

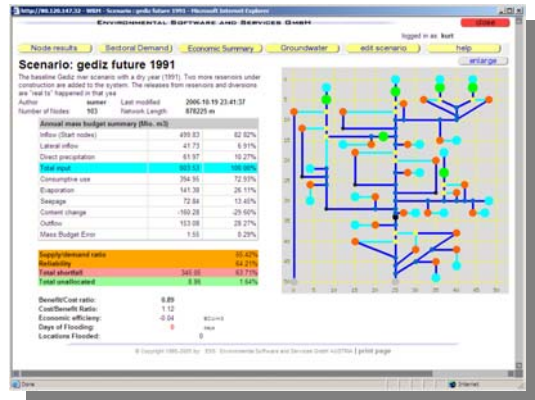
The summary includes basic supply/demand and reliability, flooding, and a set of economic criteria, always based on direct costs and benefits only, as well as from a combined evaluation including non-monetary valuation.

In addition to the scenario results, the default set of criteria also includes a few basin characteristics such as

- basin size or area,
- total population,
- population density,
- total annual precipitation,
- annual average temperature, and
- a synthetic runoff coefficient.

These can not be used for optimization, of course, but are used to

- normalize results for inter-basin comparison (WP 14 and WP 15)
- provide potentially explanatory variables for the decision analysis.



	Direct benefits	Compliance	Leakoff	Penalties	Positive	Flood damage
Generic demand	0.000		0.000	0.000	0.000	0.000
Municipal Demand	150176.000		7668.620	1050.620	444.000	0.000
Touristic Demand	0.000		0.000	0.000	0.000	0.000
Agricultural Demand	0.000		0.000	0.000	0.000	0.000
Residential Demand	36642.000		8402.120	6790.300	7020.300	0.000
Industrial Demand	0.000		0.000	0.000	0.000	0.000
Light industry Demand	16108.200		1108.610	758.474	0.000	0.000
Services Demand	0.000		0.000	0.000	0.000	0.000
Commercial Demand	0.000		0.000	0.000	0.000	0.000
Compliance control nodes		0.000				0.000
Supply - Diversion			0.000	0.000		
Supply - Start nodes			0.000	1683.510		
Reservoirs	0.000		8994.800	1678.420		
Total	218027.000	0.000	107196.350	62294.514	76647.300	0.000

	direct monetary	including indirect	direct monetary	including indirect
Benefit/Cost Ratio:	1.29	0.81	Total Cost:	168401 Mio
Benefit/Cost Ratio:	0.78	1.12	Total Benefits:	218029 Mio
			Net Benefits:	49107 Mio
			Economic efficiency:	0.18 (Mio/m3)
			Water costs:	0.36 (Mio/m3)

Criteria name and description	Unit and norm	Strategy
Overall Supply / Demand	ratio	maximize
Reliability of supply	% average over all nodes/days	maximize
Total shortfall	% of total input	minimize
Unallocated water	% of total input	meet target
Water content change	% of initial content	maximize increase, meet target
Total cost, combined	€/capita	minimize
Total cost, direct	€/capita	minimize
Total benefit, combined	€/capita	maximize
Total benefit, direct	€/capita	maximize
Net benefit, combined	€/capita	maximize
Net benefit, direct	€/capita	maximize
Benefit/Cost ratio, combined	€/capita	maximize
Benefit/Cost ratio, direct	€/capita	maximize
Cost/Benefit ratio, combined	€/capita	minimize
Cost/Benefit ratio, direct	€/capita	minimize
Economic efficiency, combined	€/m ³	maximize
Economic efficiency, direct	€/m ³	maximize
Water cost, combined	€/m ³	minimize, meet target
Water cost, direct	€/m ³	minimize, meet target
Days of flooding	days	minimize
Area flooded	% of node/days	minimize

Economic evaluation

Most of the criteria used for the optimization are based on economic evaluation of the water resources system, supply and demand:

The use of water generates **benefits**, the supplying of that water incurs **costs**.

For both costs and benefits, the assessment is performed, in parallel for:

1. direct monetary costs and benefits: these include capital and operating costs, and direct use benefits.
2. combined direct and indirect costs and benefits: these also include penalties and estimated flood damages as well as the optional compliance benefits.

Benefits

- **Direct Monetary Benefits:** Benefits are generated by every cubic meter of water demand met. For each **demand node**, there is one parameter to estimate the added value generated by the input of one unit (cubic meter) of water. For any economic sector or activity, the estimate could be based on the value of goods or services produced, divided by the amount of water used, and possibly corrected by the relative important, role, or percentage that water contributes to the value added.

A complex example is the value of urban water supply. A minimum estimate would be the cost of water (corrected for any public subsidies); a maximum estimate would be the gross economic product of the city: obviously, only some fraction can be attributed as the value of water supplied. The marginal benefit of water would be the economic product generated for one additional unit of water supplied. This standard economic model already clearly shows the limits of its applicability to some natural resources. However, it is important to realize:

1. there is **no** single correct method of estimation;
2. what is important is that the **same method** and logic is consistently used for the estimation of all sectoral benefits, and that the estimation strategy used is well documented.

See, for example:

Young, R.A (2005) Determining the Economic Value of Water: Concepts and Methods.

RFF Press, Resources for the Future, February 2005/340 pages ISBN 1-891853-97-X

Heinz, I. (2005) The economic value of water and the EU Water Framework Directive: how managed in practice?

IWA International Conference on Water Economics, Statistics, and Finance Rethymno, Greece, 8-10 July 2005.

- **Compliance Benefits:** A second source of potential benefits are **control nodes**: at every node, we can specify an (optional) monetary benefit for every day the expressed target is met. This can represent direct monetary benefits (sufficient flow to operate a ferry), or environmental benefits (sufficient water for wetlands).

This **Compliance Benefit** is, however, expressed in monetary units **per day**.

Costs: direct and indirect costs

Cost are more complex, as the include both a

- fixed annual costs (annualised) representing investment or capital costs for structures,
- regular (monthly, independent of flow) operatin costs like personnel for a treatment plant or reservoir;
- variable, i.e., volume dependent(linear) operating costs for services related to supply.

Costs can be specified for a number of node types:

- START NODES includes investment, regular and variable operating costs. If a category does not apply, the corresponding number is simply set to 0.0;
 - subtype: pumped wells: for pumped well, the flow dependent costs could also be made a function of the aquifer level, the lower the more expensive;
 - subtype: interbasin transfer
 - subtype: desalination.
- DIVERSION NODES, representing the costs of the structure or pumping, with capital and operating costs;
- RESERVOIR NODES (annualised capital costs and flow independent, regular operating costs only) Reservoir nodes can, if they produce hydropower, have a flow dependent benefit from hydropower generation; Will only be implemented once we have changed to reservoirs with multiple outlast including hydropower.
- DEMAND NODES are assumed to have (optional) water related technologies applied, from irrigation technologies to urban waterworks, so all three direct cost categories apply.

Indirect Costs: penalties

A second costs component (summed separately) are **penalties**: For both demand nodes and control nodes penalties for not meeting targets can be specified:

- Demand Nodes: unit cost **for every cubic meter of shortfall** (demand - supply);
- Control nodes: unit costs **for every day the target is not met**, which also can be used to represent environmental damages.

For damages caused by exceeding maximum flow constraints (flooding conditions) the penalty can (optionally) be made proportional (exponential) to the amount of exceedance, by specifying a multiplier and an exponent that is applied to the flow ABOVE the constraint:

$$\text{FLOOD DAMAGE} = A * (\text{FLOW-THRESHOLD}) ** B$$

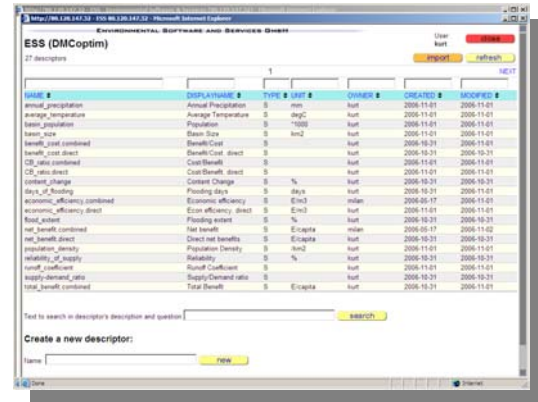
Knowledge Base Editor

To define a new Descriptor that can be used as criterion for the set of alternatives, the button: KB leads to the Knowledge Base Editor.

The entry level shows a listing of all currently defined Descriptors or variables that can be sorted by several criteria.

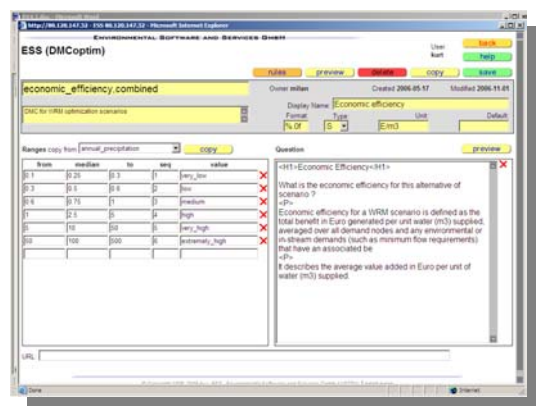
The user can either

- select an existing one for editing (including the option to copy an existing one as template and then edit to create a new one;
- define a new one by specifying its name, and creating a new, empty template for editing with the button: NEW.



A Descriptor (defining the criteria) has

- a name, author and modification date,
- a short explanation of its interpretation, context and purpose,
- a (usually short) display name,
- a unit and
- a display format (C standard notation)
- an associated question to be shown in the editor,
- a range of legal values, defined by a list of symbolic labels and associated contiguous numerical ranges (min, median, max).

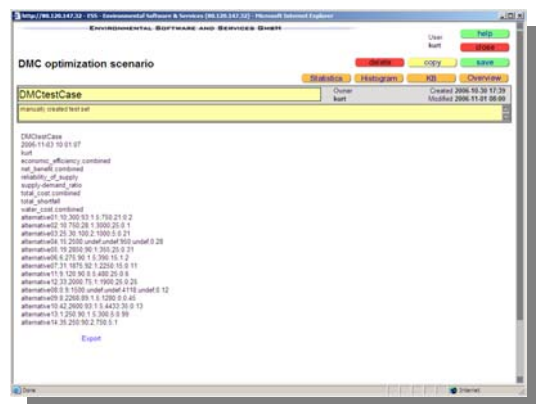


Once a new variable is defined, it becomes immediately available for the configuration of the set of alternatives.

Data import and export functions

As an alternative to the interactive creation and editing of alternatives, DMC can import alternatives or sets of alternatives from

- WRM scenario runs (individual solutions through named CVS files exported from the WRM run into a named file;
- external files (spreadsheets in CVS format, one or more alternatives)
- WRM optimization scenarios (sets of solutions from one optimization scenario around a single model baseline scenario.



The same data format for a set of alternatives is used for an export function. This generates a pop-up window that shows the data for a scenario or set of alternatives; these can be exported

into a local (client side) CSV file for direct use by a spreadsheet, including the column headings (criteria names).

Analysis functions

The DMC tool has two main functions:

- Discrete optimization, i.e., to find an efficient solution from a set of feasible and non-dominated alternatives;
- Decision Analysis for the individual optimization scenarios.

Interactive Optimization

The primary function of the DMC tool is to facilitate interactive optimization.

This requires one or more *decision makers* (our stakeholders) to work with one or more scenarios, with or without the help of a facilitator from the project team.

The basic preparations include the loading of any and all relevant alternatives to be considered into the data base and verify their criteria values and optimization strategy.

1. Start with the full set of alternatives, but **select only two criteria**: this makes it possible to directly interpret the 2D scattergrams as they directly reflect the structure of the decision space and the concept of multi-criteria trade-off. At the same time, to agree on the two most important criteria is already a first warm-up exercise for the group decision process involving the stakeholders and/or any real or proxy decision makers;



If it is difficult to reach agreement, try methods like a Delphi process to converge on a common selection; if all else fails, try to convince the participants to use Net Benefits, or a Benefit/Cost ratio and Reliability for a start! Since both of these concepts have **maximize** as their default strategy, UTOPIA is located in the upper right corner of the scattergram which makes it more easy and intuitive to read and interpret.

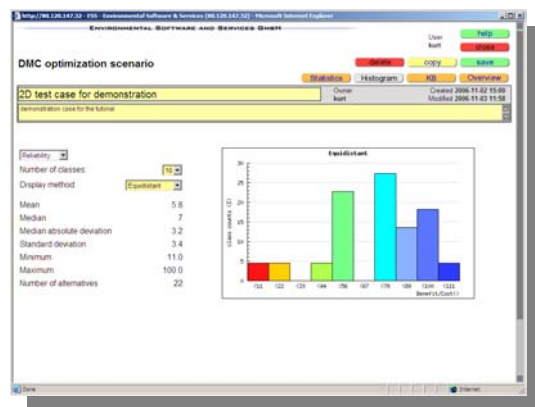
2. For these two criteria, depending on the size (number of alternatives) of the set of alternatives, repeat the same group decision making process to define **constraints** to eliminate a few extreme cases (and to practice compromise solutions ...). With only two dimensions, the concepts of dominated and Pareto sets are easily illustrated, and the effects of moving the reference point from UTOPIA should be evident.
3. In the next step, **add more criteria** (maybe each stakeholder can chose one to add that represents their interests best ?), one by one, and toggle these additional criteria on and off to illustrate the effect! The more criteria are being used, the less intuitive the solution will be, but at the same time the usefulness of the tool can better be demonstrated with non-intuitive solutions to a complex case!

- After these warm-up exercises, the discussion in the stakeholder group should now be both “educated” in terms of the optimization paradigm and its criteria, as well as involved, as the participants will have learned how to represent their preferences. A skilled facilitator will be able to use the tool to make preferences become obvious and explicit, so they can be discussed in the group, eventually leading to a compromise solution and a “shared vision”.

Decision Analysis

Once a optimization scenario has been defined that leads to a generally acceptable compromise solution, we can now try to analyze. Below are some example questions that could be addressed:

- How do the criteria statistics compare between the dominated and the non-dominated sub-sets?
- Are there any patterns (strong coincidence, covariance, correlation including non-parametric measures like rank correlation) between the criteria?
- By toggling individual criteria on and off, which do affect the solution a lot, which only marginally or not at all?
- How does the quality of the solution (level of achievement, normalized distance from the reference point) change with adding or deleting criteria?



Comparing different optimization scenario from different basins and stakeholder groups,

- are there any obvious similarities:
 - in the choice of criteria ?
 - in the choice of constraints ?
 - in the selection of a reference point ?
- for the main differences, can they be related to some of the basin characteristics ?
 - do any of the criteria relate to basin characteristics ?

A major objective of using the interactive tool is not so much finding an optimal solution, but to generate structured and informed dialog based on a common language and the principle of rational discourse and argument in the stakeholder group.

Making individual and group preference structures explicit so they can be subject to the political process is the main objective! To find a solution once values are defined is trivial. To agree on this set of values in the first place and reach a common understanding towards a generally accepted compromise or shared vision is the real challenge.

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