

REDUCING COMPLEXITY AND FACILITATING DIALOG Knowledge visualization tools for multi-stakeholder decision processes

SUMMARY

Multi-stakeholder and multi-criteria decision problems involve challenges that hinder negotiations of widely accepted solutions. Adequate visualization such as those developed in the course of the DAFNE project can address some these challenges. The **Screening Tool** and the **Multi-Perspective Visualization Tool** reduce information asymmetries by providing knowledge visualizations for an easy analysis of different alternatives and trade-offs between them. The tools also facilitate understanding between the different stakeholders involved, and in effect support the identification of solutions that consider the interests of all parties.

BACKGROUND

Multi-criteria decision problems involving different actors with conflicting interests face challenges that hamper the identification of widely accepted solutions. Information complexity makes it hard to identify trade-offs between discussed alternatives and to engage stakeholders with different levels of technical expertise. Moreover, the difficulty in seeing beyond one's own area of interest and expertise additionally hinders the negotiation process and identification of compromise alternatives. These issues call for intelligent tools to support multi-stakeholder negotiation processes.

As part of its activities, the DAFNE project has developed a toolkit that facilitates online engagement, knowledge visualization and decision support. This document highlights two of its applications:

- The Screening Tool supports the discussion of multiple alternatives, understanding the tradeoffs between them and reducing their number.
- 2. The Multi-Perspective Visualization Tool allows a more detailed exploration and analysis of the pre-selected alternatives, highlighting similarities and differences.

Both tools help to communicate scientific insights on complex interrelations between alternatives through visualisations. They allow stakeholders to compare their perspectives on the issues analysed and on the possible trade-offs between potential solution pathways. The tools have been developed in but are not limited to the context of sustainable integrated transboundary water resource planning. They can support various decision- and policy-making problems in which conflicting interests need to be resolved under the principles of objectivity, inclusion and participation.



Figure 1. Stakeholders in the DAFNE project using the screening tool to discuss possible alternatives for water resources management the Zambezi river basin.





SCREENING TOOL Moderate negotiations, explore trade-offs, select viable alternatives.

In some decision processes, the number of alternatives and their potential impacts is beyond comprehension. In the DAFNE project, for example, possible options related to water resources planning and management (*Whether, where, and when to expand infrastructure? How to operate it?*) results in dozens or hundreds of alternatives, each affecting several sectors. This begs the question of how to best narrow down this large number of options through negotiations between stakeholders with various interests.

The Screening Tool is a knowledge visualization application that directly addresses information complexity in multi-stakeholder decision and planning processes. It provides an at-a-glance overview of a broad range of available options, of their main impacts, and of the trade-offs between them. It allows stakeholders to easily grasp the complex relationships between the sectors. Moreover, the Screening Tool can support moderated group discussions aimed at narrowing down the list of promising alternatives for further, more detailed analysis. Its functionalities, such as filtering of options above certain criteria, facilitate the selection of options that are most interesting for stakeholders. This in turn addresses the cognitive and technical impossibility of analysing in detail all conceivable options. Used in a dedicated negotiation process, the tool helps to ensure that the interests of all stakeholders are accounted for.

Key features:

Impacts visualization. The tool displays the main impacts of multiple alternatives using a handful of quantitative indicators, one per each sector involved. It marks the baseline values that correspond to the status quo. It allows (also non-expert) users to easily explore the expected impacts and to recognize trade-offs between the alternatives.

Absolute and satisfaction values. The impacts can be displayed in terms of their absolute values in which they have been estimated (e.g. energy units) and "satisfaction values" (absolute values transformed to a 0-1 scale). This allows users to choose between a more informative or a simplified view.

Complexity reduction. The threshold setting functionality allows users to filter out alternatives that don't fulfil the minimum criteria with respect to the expected impacts. This gives the possibility to easily select for more detailed analysis only the most promising options with the potential to be pursued.

Dedicated negotiation procedure. The tool can support a moderated group discussion designed in a way that ensures accounting equally for interests of all stakeholders.

www.dafne-nsl.eu/screening-tool



Figure 2. The Screening Tool displays the main expected effects of considered alternatives and the respective trade-offs between a large number of different development options ("pathways").





MULTI-PERSPECTIVE VISUALIZATION TOOL Understand impacts, select preferred options, facilitate dialog.

Once only a handful of alternatives remains on the table, stakeholders need to understand the more detailed impacts of and the trade-offs between them. In the DAFNE project, for example, multiple indicators expressed diverse impacts that the preselected alternatives would have on the sectors involved. Having access to this detailed information, stakeholders can negotiate potential solution pathways and reach an informed consensus. The challenge lies in presenting them in an easily comprehensible way and supporting understanding between the parties involved.

The Multi-Perspective Visualization Tool allows stakeholders to visualize alternative solutions and their expected real-world impacts using a broad range of quantitative indicators. It offers a possibility to explore all indicators at once as well as to narrow the view to only those most important to them ("create a perspective"). It provides both a holistic view, useful for users with non-technical backgrounds, as well as detailed information on specific issues for those with special interests. The tool also facilitates discussion and comparison of perspectives between different actors. This way, it allows stakeholders to identify the interconnections and trade-offs between themselves and other parties and identify alternatives that also satisfy the perspectives of others. In effect, the tool facilitates trust-building necessary for decisionmaking in multi-stakeholder settings.

Key features:

Impact visualization. The tool displays the detailed impacts of few alternatives using a broad number of quantitative indicators. Users can select indicators particularly important to them ("create a perspective"). The tool allows (also non-expert) users to easily explore the expected impacts of the alternatives and to recognize trade-offs between them.

Absolute and satisfaction values. The impacts can be displayed in absolute values (e.g. energy units) and "satisfaction values" (absolute values transformed to a 0-1 scale). This allows users to choose between a more informative or a simplified view.

Comparison with others. The tool allows a comparison of one's own indicator selection ("perspective") with that of others. It builds understanding between stakeholders and supports identification of similarities and differences, and in that way facilitates dialog.

Access to detailed information. While simple, the tool is linked to an online repository with detailed information on considered options and their impacts as well as on the methodological background. Interested users can simply access it by clicking on provided links.



URL www.dafne-nsl.eu/multi-perspective-tool



Figure 3. Comparing perspectives helps to get an understanding of other actors' perspectives, to develop a shared understanding and to identify a compromise solution.





The DAFNE Tools in Practice

Case study I: Omo-Turkana Basins

To satisfy energy and water demands and enhance the national economy, Ethiopia is developing the Gibe Hydroelectric Cascade scheme and the Kuraz Sugar Development Project in the Omo-Gibe basin. These developments will lead to changes in water availability in the Lower Omo Valley and Lake Turkana, the inflow of which largely depends on the Omo River. The specific challenge addressed has been how to operate this new infrastructure to minimize the trade-offs and conflicts in water use.

Case study II: Zambezi River Basin

The Zambezi River Basin is the fourth largest basin in Africa populated by almost 40 million inhabitants. In 2004, the eight riparian states created the Zambezi Watercourse Commission to enhance cooperation over the shared water resource in order to increase agricultural yields, hydropower production and economic opportunities. While operating preferences have been well established in this case, the main question has been when and where to expand the water management infrastructure.

DAFNE Tools successfully co-designed, applied and positively evaluated in real-world challenges

Following a participatory approach, stakeholders from both case studies have been involved in the development of the DAFNE tools right from the start and they successfully applied them to facilitate identification and negotiation of water resources management alternatives ("development pathways").

The **Screening Tool** enabled the selection of the most promising pathways by showing their expected impacts on different sectors and visualizing the trade-offs between them. The tool helped to significantly narrow down the number of potential solutions (e.g. in the Omo-Turkana-Basins from several hundreds to only six).

With the **Multi-Perspective Visualization Tool**, stakeholders analysed in depth the impacts of the considered pathways most important to them by selecting indicators that correspond to their interests ("perspective" e.g. of a specific sector). By exploring their perspective with those of others, they were able to find similarities and differences between then, and ultimately identify solutions that balance different needs and priorities.

Evaluation with stakeholders has confirmed their usefulness and ease of use. The tools were found to be a valuable support for stakeholder dialogues stimulating the discussion with the data and enabling agreements to be found. They were considered useful not only for negotiation, but also for research and teaching.

"Interaction with the tools [is] very interesting, very friendly; congratulation on the tools [...], they show real data and allow interaction, they are very useful tools not only for Omo-Turkana but also for other transboundary basins in the world." – Stakeholder from the Omo-Turkana



Figure 4. Stakeholders comparing different solution pathways for the Omo-Turkana Basins using the Multi-Perspective Visualization Tool











ABOUT THE DAFNE PROJECT

The DAFNE project advocates an integrated and adaptive water resources planning and management approach that explicitly addresses the water-energy-food (WEF) nexus from a novel participatory and multidisciplinary perspective that includes social, economic, and ecologic dimensions. In two cross-boundary case studies, the Zambezi River Basin and the Omo-Turkana Basins, the WEF nexus has been quantified and analysed as the trade-offs between conflicting objectives such as hydropower production vs. irrigation or land exploitation vs. conservation. DAFNE generates and explores alternative planning and management solutions based on the cooperation of public and private stakeholders, which fosters the profitable but equitable use of resources without transgressing environmental limits or creating societal conflicts.

The DAFNE project has been funded by the Horizon 2020 programme of the European Union and coordinated by ETH Zurich. The European Institute for Participatory Media e. V. (EIPCM), apart from its major role in project dissemination and outreach, led the participatory design and development of the DAFNE knowledge visualization tools in collaboration with the Institute for Applied Computer Science (IACS) of the University of Applied Sciences Stralsund. For a full list of all partners involved, please visit <u>http://dafne-project.eu/consortium/</u>.



For more information on DAFNE visit www.dafne-project.eu



Project funded by the Horizon 2020 programme WATER 2015 of the European Union, GA no. 690268

