

Developing practices for supporting EIA with Multi-Criteria Decision Analysis

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Introduction

Multi-Criteria Decision Analysis (MCDA) is a general term for systematic and transparent approaches to analyze complex problems involving multiple criteria (Keeney, 1992; Belton and Stewart, 2002; Gregory et al., 2012). MCDA provides great potential for supporting environmental planning processes including a structured framework for evaluating the impacts of alternatives and for combining stakeholders' subjective views about the criteria with objective measurement data about the alternatives. However, earlier experiences (Marttunen and Hämäläinen, 2008; Anderson and Clemen, 2013) suggest that the design and realization of the MCDA process affects greatly how well the results of MCDA reflect participants' opinions, and how satisfied the participants are to the MCDA process.

In this paper, we present and discuss our ideas and plans regarding the use of the principles and tools of MCDA to support three major tasks in the Environmental Impact Assessment (EIA) process: identification of the impacts, assessment of their significance and comprehensive evaluation of alternatives. This study is a part of the IMPERIA project (2012–2015) funded partly by EU's Life+ programme (LIFE11 ENV/FI/905). The project aims to develop and demonstrate methods and tools to integrate MCDA into EIA. The motivation is that the recent studies have shown that there still are weak and inconsistent practices in determining significant impacts and in the comprehensive evaluation of alternatives as well as in the meaningful public participation (e.g. Pope et al., 2013).

MCDA provides an interactive and integrated assessment framework for impact significance assessment and for identification of the key trade-offs among the alternatives. A typical outcome of an MCDA process is the overall evaluation of the alternatives obtained with some mathematical model (Belton and Stewart, 2002). In addition, the systematic structuring of the problem and improved understanding of the problem are essential outcomes of MCDA processes. To emphasize these aspects, we consider the term MCDA to also cover simple structuring methods and tools such as objective hierarchies, strategy tables, consequence tables and (conceptual) influence diagrams. With this broader definition, MCDA has much potential in supporting the different phases of EIA, including the scoping phase and the identification of the most important issues.

The influence of EIA on decisions is limited, and therefore there is a growing need for developing EIA practices (Pope et al., 2013). The assessments are most likely to influence decision making when they are perceived credible (expertise), relevant (address key problems) and legitimate (assessment perceived as fair) (Cash et al., 2003). The systematic MCDA framework can contribute the assessments by integrating diverse information from scientists, experts and local people, and by incorporating the subjective preferences of stakeholders into the analysis.

Our project includes developing systematic, transparent and participatory practices and procedures by integrating principles and practices of MCDA into the EIA processes. In order to better meet the objectives of the EIA directive, we develop approaches to enhance public participation in the EIA procedures and the role of environmental assessment as an integrative tool in environmental planning (Figure 1). The findings

from our literature review and discussions with Finnish EIA and MCDA experts in workshops and interviews indicate that MCDA can be used to bring forward the differences among the alternatives, improve communication and common understanding about the impacts among stakeholders. Our next step is to apply the proposed MCDA approach and its practices and tools in five pilot EIA and SEA projects. We will evaluate the success of applications in detail with interviews, surveys and the method of participatory observation. The first pilot project, the largest planned inland wind farm in Finland, was started in August 2012, and we have applied MCDA principles, practices and tools from the beginning of this project. The developer of this project has been very open to our ideas and plans and thus far, the feedback from the Finnish EIA society to our approaches and tools has also been encouraging.

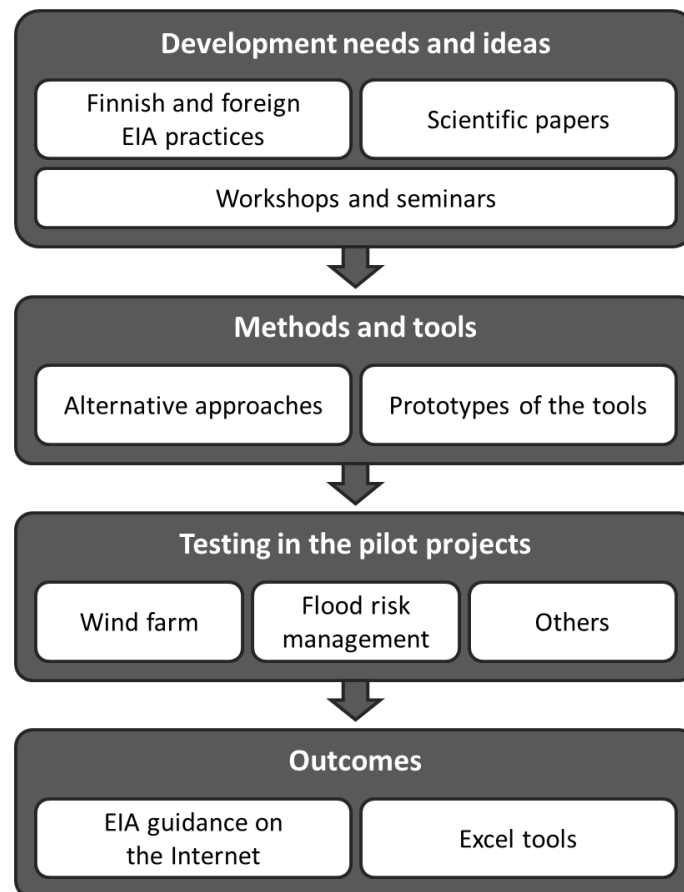


Figure 1. Phases of developing impact significance assessment in the IMPERIA project.

Scoping of the impacts

One main difference of this new approach compared with the current EIA processes in Finland is to focus more on the scoping phase to ensure that the most significant impacts of the project are included in the analysis. This helps to avoid wasted effort on issues of little relevance, and also stimulates early collaboration between different parties of EIA.

In this approach, the assessment group consisting of the key stakeholders is established in the beginning of the scoping phase. The group supports the assessment work in many ways, for example, by bringing local knowledge to the identification of important impacts and to the evaluation of the alternatives. In addition, the group can critically analyze whether the information is presented in an understandable way. In our first pilot project, the group will have six meetings during the whole EIA process; three during the scoping phase and three during the impact assessment phase.

The use of an assessment group can increase deliberation and empowerment of engagement, and consequently enhance the concept of public participation as a process of social learning (Pope et al., 2013). Together with other MCDA tools, the work of assessment group can also improve the effectiveness of EIA, especially by ensuring that key issues are addressed and that the assessment is perceived as fair. The initial

results from the first pilot project confirm our hypotheses: in the scoping phase the most important issues were identified together with the key stakeholders (in the assessment group) and the period of display for public inspection revealed that there were no missing issues. In addition, the liaison authority’s statement about the scoping report was positive. The feedback from the involved stakeholders, consultants and developer has also been positive. A great challenge has been to design and realize the process without increasing the workload of the consultant remarkably.

Impact significance assessment

Impact significance assessment is one of the most difficult phases of EIA including both objective and subjective assessment of several incommensurable criteria. Impact prediction and the assessment should include a consideration of value judgments and whose values they represent. In the IMPERIA project, we will develop and demonstrate a deliberative approach where the impact significance assessment is realized together with experts and stakeholders. This approach is based on a generic significance evaluation framework developed by the experts of the IMPERIA project, in which the impact significance is formed of different dimensions of the impact and the importance of the target (Figure 2).

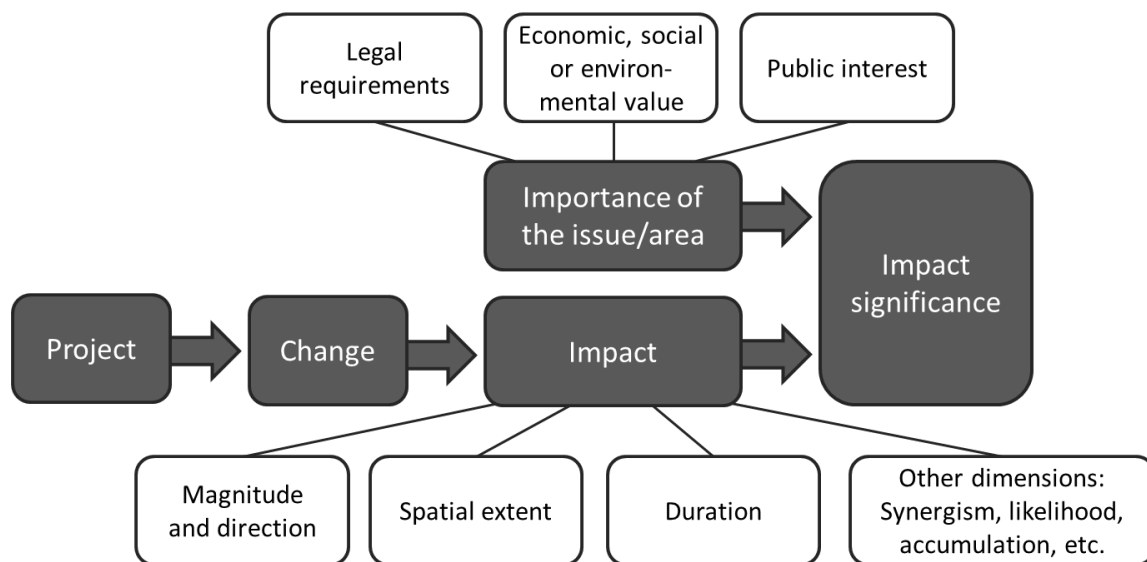


Figure 2. Initial evaluation framework for impact significance assessment.

The process of using the framework is as follows. First, the potential impacts of the alternatives are identified and discussed in the assessment group and necessary refinements to the assessments are made. If the stakeholders have different opinions, these will be documented. Then, the experts choose relevant criteria for impact significance assessment and evaluate each impact against them. Both the experts and stakeholders holistically evaluate the overall impact significance based on these criteria. Mathematical models for aggregating the dimensions to the overall impact significance have also been used for this (Cloquell-Ballester et al., 2007). These can be used as additional information, but we think that the assessment should not rely only on these, as the characteristics of the impacts can vary considerably between the impacts and the cases. We believe that the structured framework helps both experts and stakeholders to better understand the subjective multi-criteria nature of the assessment and to increase the consistency of the assessment.

We will use tables and graphs to summarize the results, facilitate discussions and pinpoint the issues of agreement and disagreement. In this analysis phase, all parties can also revise their earlier assessments.

Comprehensive evaluation of alternatives

One challenge in the evaluation of alternatives is to identify and describe key trade-offs between alternatives. Articulating trade-offs explicitly helps decision makers to make rational choices and citizens to better understand why certain alternative was selected. For the comprehensive evaluation of the

alternatives, we propose a two staged approach (Figure 3) in which we ask each stakeholder to separately evaluate the significance of the alternatives' impacts with the framework described above. The evaluations of the stakeholders are analyzed and, if there are differences in these, we identify different views and form possible stakeholder groups sharing similar views and value profiles. The overall rankings of the alternatives are calculated for all value profiles using MCDA software. If there are diverging opinions about the best alternative, the analysis can be deepened by comparing two alternatives at a time, for example, with an impact matrix with an aim to identify the most essential trade-offs between them. This matrix is discussed in the assessment group, where both the experts and the representatives of the stakeholder groups can present their views of the impact significance. The discussion is synthesized, for example, in terms of the biggest differences between the alternatives and the valuations of the criteria between the stakeholders. Finally, we compile recommendations from these.

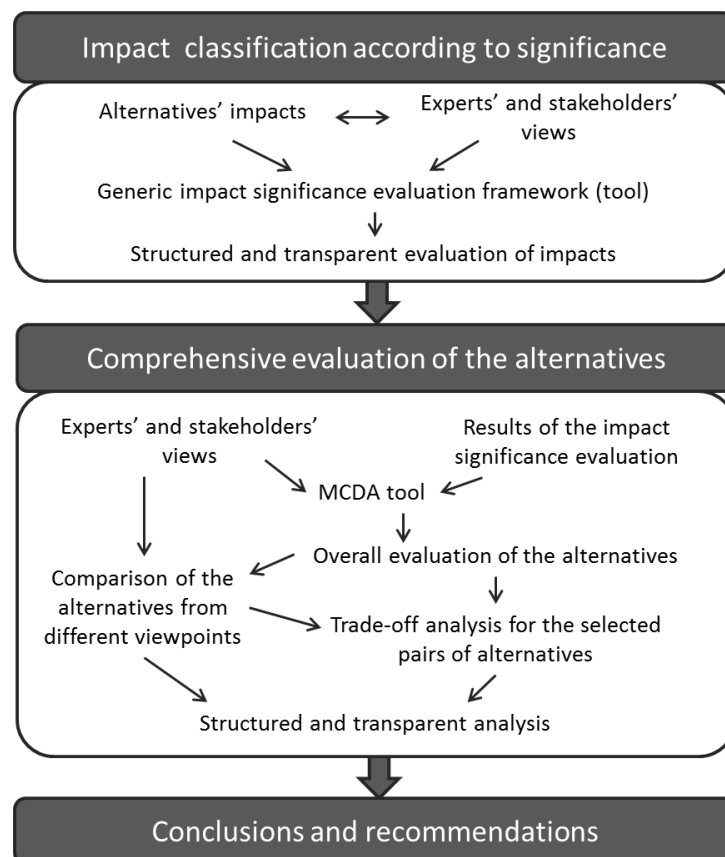


Figure 3. Framework for the comprehensive evaluation of the alternatives.

MCDA software for supporting the EIA process

One of our objectives is to develop MCDA software to support the EIA process. Here, one challenge is that the responsible use of MCDA methods and tools require good knowledge of MCDA theory (Anderson and Clemen, 2013). Although being experts in EIA, the EIA practitioners are usually not very familiar with the MCDA methodology. Thus, the software should be easy-to-use, which, however, is not straightforward to implement, as the software should simultaneously provide advanced methodological support.

The application areas of EIA can vary considerably from each other, but the EIA processes are usually quite similar regardless of the project types. We think that this similarity makes it possible to develop software that guides EIA practitioners not familiar with MCDA hand-in-hand through the process without compromising the sophistication of the support. In practice, this would mean that on each phase, the system provides the user focused information that is needed to carry out this particular phase properly.

Another need that has come up in our study is the need for the structured realization of the process. At best the whole planning process is implemented according to the principles of MCDA (Marttunen et al., 2013). Based on all these needs, we have preliminary designed three Excel based tools to support 1)

scoping phase, 2) impact significance assessment, and 3) evaluation of the alternatives. The sheet-based interface of Excel provides a certain course of the process to follow, but still allows room for variation between the projects. Another important feature is to support integrating the views of the stakeholders in the model.

Conclusions

In this paper, we have identified the needs and possibilities for applying the methods and tools of MCDA to support EIA processes, and based on these, outlined approaches to apply MCDA in various tasks of EIA. The use of the structuring tools from the early phases of the EIA process can considerably support gathering information from the stakeholders and communicating with them. This is, naturally, expected to take some extra resources, but hopefully these can be compensated for by the reduced workload in the later impact assessment phase.

We also propose an approach for applying MCDA to support the impact significance assessment and the evaluations of the overall significance of the alternatives. Experts' and stakeholders' opinions about the significance may differ because of differences in their knowledge, values as well as spatial and temporal assessment frames. One advantage of the proposed approach is that it enhances interaction and learning among experts and stakeholders during the process.

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