

## Master thesis proposal

### Exploration of interacting criteria in Multicriteria Decision Analysis: The case of electricity supply resilience assessment

#### Team

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#### Timeframe

Beginning the latest from March 2020, 6 months full-time

#### Location

Technology Assessment Group, Laboratory for Energy System Analysis (LEA), Paul Scherrer Institute (PSI), Switzerland (6 months)

#### Research background

Decision models nowadays aim at providing support to stakeholders and decision makers, considering multiple conflicting objective functions or criteria. Specifically, in the field of Multicriteria Decision Analysis (MCDA), although evaluation criteria must be independent from each other, there are many instances, in which this is unavoidable. In that case, these criteria are called interacting and have attracted the focus of the scientific community in the recent years (Angilella et al. 2016).

The problem of electricity supply resilience assessment, on the other hand, being highly complex and multifaceted, includes such criteria, which, without the appropriate modelling processing and treatment, can endanger the validity of the decision model and its results (Gasser et al. 2020).

This Master thesis targets to mathematically examine the effect of criteria interactions on the evaluation results, building upon the resilience assessment problem, which includes real data on 18 evaluation criteria for over 30 European countries.

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## Master thesis project context and objectives

This research project will focus on the complementary and fundamental procedure of criteria modelling, in the presence of interactions. Different kinds of interactions will be examined, such as mutual strengthening, mutual weakening and antagonistic, for the case of pairs and/or triplets of criteria.

The research work will be performed at a mathematical level and will be tested on the real world application of resilience evaluation. The interactions and the obtained results on the European countries will be also validated, based on the correlation of the data of the interacting criteria, with a view to building potential mathematical relationships between them.

The practical contribution of this project lies in the facilitation of decision making in a real context, and the construction of theoretically sound models and results, when interactive criteria exist. Recent work in this direction has been advanced by (Grabisch, 1996, Angilella et al. 2018)

## Broader benefits for the student

Decision models and decision support systems are currently of great importance in both the academic and the business sector as they can provide researchers, governmental bodies and stakeholders in depth knowledge of complex and multidimensional problems and guide them in a rational way to selecting their mostly preferred solutions. This project enhances the student's capacity on decision support systems and provides him/her with key analytical and practical consultation skills, of great importance in his/her next academic or industrial career steps.

## Student profile

- Familiarity with mathematical optimization, decision support systems and statistics
- Knowledge of at least one programming language: R, Matlab, Python
- Good familiarity with MS Office and in particular Excel.

## References

Angilella, S., Corrente, S., Greco, S., Słowiński, R. (2016), Robust Ordinal Regression and Stochastic Multiobjective Acceptability Analysis in multiple criteria hierarchy process for the Choquet integral preference model, *Omega*, 63, pp. 154-169.

Angilella, S., Catalfo, P., Corrente, S., Giarlotta, A., Greco, S., Rizzo, M. (2018), Robust sustainable development assessment with composite indices aggregating interacting dimensions: The hierarchical-SMAA-Choquet integral approach, *Knowledge-Based Systems*, 158, pp. 136-153.

Gasser, P., Suter, J., Cinelli, M., Spada, M., Burgherr, P., Hirschberg, S., Kadziński, M., Stojadinović, B. (2020), Comprehensive resilience assessment of electricity supply security for 140 countries, *Ecological Indicators*, 110.

Grabisch, M. (1996), The application of fuzzy integrals in multicriteria decision making, *European Journal of Operational Research*, 89 (3), pp. 445-456.