

# Sensitivity Analysis for Multiple Criteria Decision Making Methods: TOPSIS and SAW

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## Abstract

The quantitative multiple criteria decision making methods are practical to use in decision support systems. In this paper we analyse the quantitative multiple criteria decision making methods and sensitivity analysis methods usage in decision support systems. Both species of these methods are strongly mathematically based. We take notice of these sensitivity methods for initial data. Monte Carlo method is applied for the generation of initial data. The sensitivity analysis of methods TOPSIS and SAW is presented in this paper.

**Keywords:** decision support systems, decision making, quantitative methods, multiple criteria evaluation, TOPSIS, SAW, sensitivity analysis, Monte Carlo method.

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## 1. Main text

The various activity fields' database has the data of quantitative form. Accordingly, quantitative multiple criteria decision making methods (MCDM) are practical to use in decision support systems. In this paper the quantitative multiple criteria decision making methods are proposed to use in decision support systems. These methods are strongly mathematically based. Quantitative multiple criteria decision making methods are the following: Linear assignment method, Simple additive weighting method, Hierarchical additive weighting method, ELECTRE methods, TOPSIS method.

Often data in multiple criteria decision making (MCDM) problems are not exact and changeable. Therefore, an important step in many applications of MCDM is to perform sensitivity analysis according to the input data.

The significance of quantitative criteria is usually determined with some errors. If measurements are not accurate, the result obtained is not accurate either, but sensitivity of the result may be checked by varying the parameters Borcherding (1995).

If we scrutinize the standard decisions relevant to construction technology and management, we shall become certain that deficiency of information is very often ignored. Experts make use of unfavourable initial data, their

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values applied are exaggerated, work is executed with poor quality models which, in case of need, are a bit corrected on the basis of practical experience, however reflect the actual situation insufficiently. Acting in such a way, experts make allowable decisions, but most often these decisions are unfavourable. While researching into regularities, deficiency of information is attempted to evade. Application of regularities enables to evaluate results of necessary actions and to present the direction of their selection. Simple evaluation of all possible actions is not always sufficient. Each action may cause several sometimes contradicting each other results. As the actual result is not known, solutions criteria are necessary, which could take into consideration the totality of possible results. Triantaphyllou (1997). If we want to take more accurate decision results, so it must make sensitivity analysis to a method, which is used in decision making.

A possible definition of sensitivity analysis (SA) is the following: The study of how uncertainty in the output of a model (numerical or otherwise) can be apportioned to different sources of uncertainty in the model input Saltelli (2008).

In this paper we analyses the quantitative multiple criteria decision making methods and sensitivity analysis methods usage in decision support systems. It is submitted analysis sensitivity of methods TOPSIS (*Technique for Order Preference by Similarity to Ideal Solution*) and SAW (*Simple Additive Weighting method*).

When the requirements to the initial data to be used in multiple criteria evaluation methods are not defined, it is hardly possible to say that the result obtained in using these methods is reliable. In the present work, it is offered to carry out sensitivity analysis for quantitative decision-making methods, and produce decision-making result with its probability of occurrence. Only then, the methods discussed may be used in decision support system.

When slight variations of the initial data parameter result in the considerable changes in the final results, it is stated that the latter are sensitive to this parameter. This usually implies that either the parameter should be determined very accurately or that the alternative should be redesigned for lower sensitivity.

The paper is intended to the problem of determining sensitivity of quantitative methods SAW and TOPSIS. The performed sensitivity analysis with respect to initial data allowed the authors to draw the following conclusions:

1. If the initial data (values of the criteria) differ by 10% from the average criterion values, TOPSIS method is more sensitive, than SAW method;
2. The authors suggest performing sensitivity analysis of decision making methods with respect to the initial data, which may be not sufficiently accurate. This applies both to the values and weights of the criteria used. The final decision should be provided alongside with the results of sensitivity analysis;
3. Using quantitative multiple criteria decision making methods, it is important to do sensitivity analysis for these methods. It must be taken into account when developing decision support systems.

In future, we want to do the analysis of the multiple criteria decision making problems, to determine which methods (more or less sensitive) for the chosen problems are most effective.

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