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Multi-criterial Evaluation – General Overview

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Abstract. The main aim of this paper is to provide basic knowledge background for further work. The basis is classification of available methods for multi-criterial evaluation. This classification will serve as a support of project (Comparison of methods of multi-criteria evaluation with user ratings of ITIL tools). In first part of this paper are described different approaches to multi-criterial evaluation and decision-making. Second part presents basics of methods of determining criteria strength and mainly their classification and division into categories.

Keywords: multi-criterial, evaluation, decision-making, criteria, assessment, fuzzy methods.
PACS: 89.65.Gh, 02.60.Gf, 07.05.Mh, 02.50.Le

INTRODUCTION

What do we actually imagine under the term evaluation? It is an assessment which has a comparative dimension, and includes the sorting of each variant according to obtained results. Sorting is mostly in relation to criteria that are associated with the problem. Evaluation responds to predetermined goals that we are trying to accomplish. Also we must take into account resources for an evaluation. Criteria are an important element of an evaluation because an evaluation is performed on the basis of these criteria. In a multi-criteria evaluation we use a number of criteria greater than one. Consequently, an evaluation may looks more difficult Very often criteria have contradictory character. That is mean, that individual criteria may be mutually exclusive, and thus they may affect the final result. Multi-criteria evaluation methods are used to eliminate this problem. An evaluation is closely connected with the term decision-making [1, 2, 3].

Decision making is a choice between several variations of behaviors which lead to the fulfillment of predetermined goals. A need to decide accompanies each person. Every day we have to make some decisions. Mostly it is minor decision that is made on the basis of intuition or our habits.

A Multi-criterial evaluation, as mentioned above, uses multiple criteria. For its application, it is necessary to deal with the complexity of choice of more options. A Multi-criterial evaluation has few specific features:

- Multi-criteria decision-making nature of the problems;
- Non-additive criteria;
- Mixed set of criteria.

More aspects, including assessment of their nature, are taken into account for this type of evaluation. A difficulty of evaluation is proportional to number of criteria – each criterion increases the difficulty of evaluation. Multi-criteria evaluation works with more criteria. However, some features of these criteria cannot be united or even added – non-additive criterion. It is also possible to encounter with a mixed set of criteria. This means that some of criteria are quantitative and some qualitative. Quantitative criteria should be expressed numerically and by a specific unit. In contrast, qualitative criteria are usually described verbally [4, 6, 8].

APPROACHES FOR MULTI-CRITERIAL EVALUATION

Multi-criterial evaluation has several approaches. Effort of evaluator will attempt as much as possible to simplify the evaluation of specific variants. Also his attitude to multi-criterial evaluation should help him. Further important is a relationship of individual criteria. According to these facts, it is possible to distinguish these several multi-criterial approaches:

- Reduction of the number of criteria;
- Conversion to the same measurement unit;

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- Conversion to the dimensionless expression;
- Compensatory method.

Reduction of Number of Criteria

A large number of criteria and their divergence usually lead to very complicated evaluation. Because of this fact, an evaluator will reduce the number of criteria. Mostly, an evaluator excludes less important criteria. But he must be aware to not exclude more criteria then it is necessary or even all criteria except one. This is totally unacceptable simplification. Thus multi-criterial evaluation loses the effectiveness of decision making [6].

Conversion to Same Measurement Unit

Another approach to a multi-criterial evaluation is conversion on the same unit of measure. In some cases it is emphasized that all criteria must be converted to the same unit. This procedure is very often performed because it is necessary to express the value criteria. These adjusted criteria can be easily converted to a single criterion.

Conversion on Dimensionless Expression

In this case all criteria are converted to a single dimensionless expression. Below that is possible to imagine, for example, expressed as a percentage or benefit. The approach is based in the previous method. The only difference is that all the criteria are expressed in dimensionless.

Compensatory Method

Compensation method is based on the principle of equivalent exchange and dominance. It should be interchanged each item so that there is a gradual elimination of variants and evaluation criteria. But it is important to think about supremacy or predominance of some criteria that play a crucial role [5].

METHODS OF DETERMINING CRITERIA STRENGTH

More important criteria have greater strength. Criteria strength (strength) expresses its relative importance in the evaluation with *m* criteria. For the possibility of mutual comparability criteria strength, which are calculated by using various methods, it is necessary to standardizing these strengths according to this formula:

$$v_i = nv_i \sum_{n}^{m} nv_j \text{ ; for } i \text{ and } j = 1,2,\ \ldots,\ m\ . \qquad (1)$$

v_i is standardized and n_v is not standardized strength of i^{th} criterion
m is number of criteria

The most of methods for multi-criterial evaluation need information about relative importance of individual criterion which is expressed by vector of standardized criterion strength v = {v1, v2, … vm}

$$\sum_{i=1}^{m} v_i = 1 \text{ ; for } i = 1,2,\ \ldots,\ \mathrm{m}\ . \qquad (2)$$

Obtaining values of strength directly from the user is very difficult, almost impossible. However, there are some methods that create estimates of these strengths. These methods are based on subjective information from a user. The application of methods for determining criteria strength of solutions with the intention of determining the optimal variant (respectively. determination of preferential ranking of the options) assumes the knowledge of criteria strengths that reflect the relative importance of different variants. Nowadays there are multiple methods to determine criteria strength in a decision-making process. It is possible to divide methods of determining criteria strength into two groups from the perspective of needed information (Fig. 1):

- Methods without knowledge of consequences of variations.
- Methods with knowledge of consequences of variations.

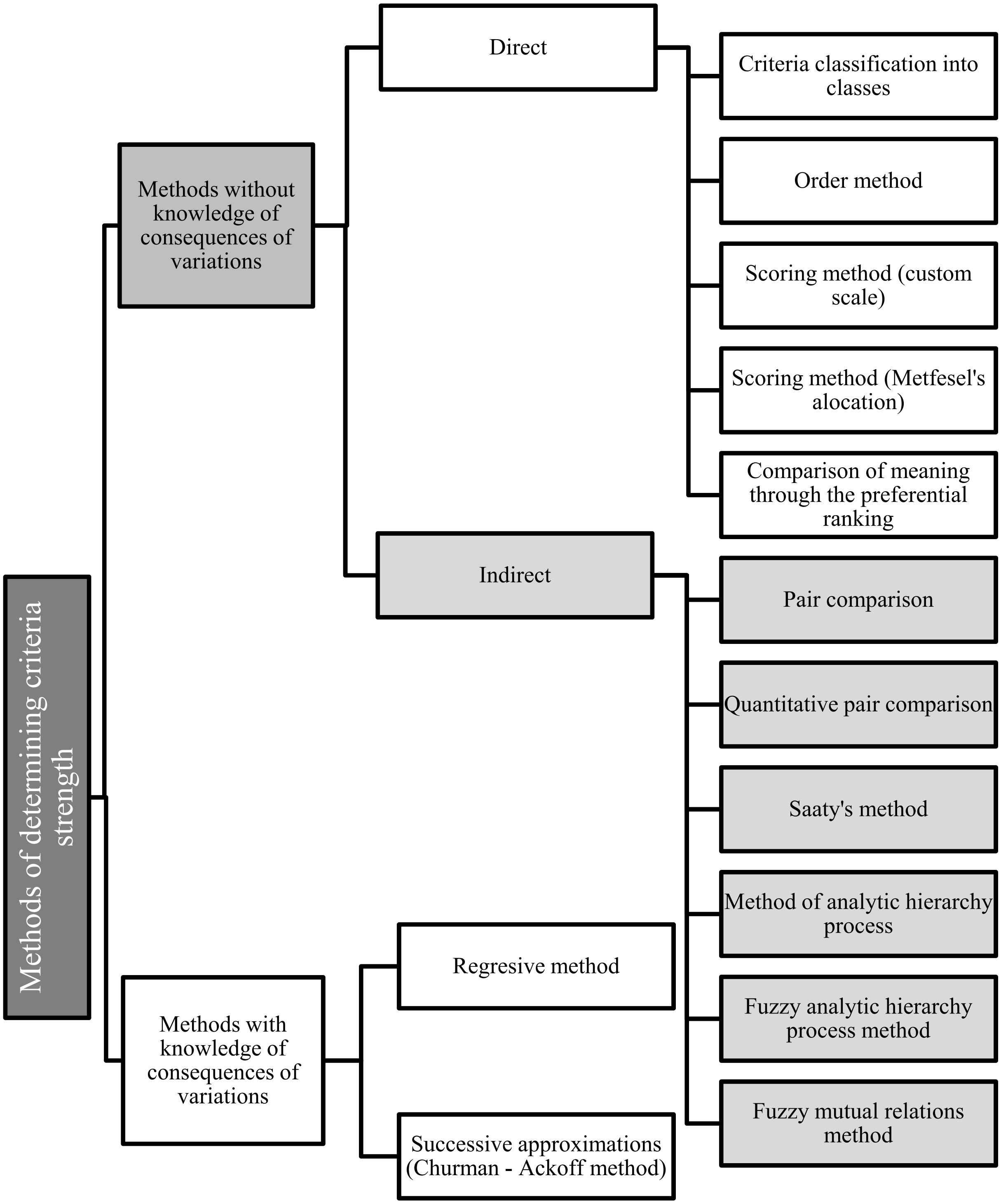

FIGURE 1. Classification of methods of determining criteria strength

Methods without Knowledge of Consequences of Variations

It is possible to divide these methods into two categories – direct and indirect methods. Direct methods are very simple and they determining non-standardized strength of each criterion (eg. criteria classification into classes). Indirect methods are more difficult and complicated then indirect and comparison of meaning for all criteria is used for determining of criteria strength. This category for indirect methods should be extended by methods for determining of optimal alternative. Further, these methods work with indeterminacy, which is essential for decision-making process, and use fuzzy logic (Method of fuzzy analytic hierarchy process or Method of fuzzy mutual relations).

Methods with Knowledge of Consequences of Variations

For example it is a regression method, which assumes a relationship between criteria strength on one side and their consequences on the other. Churman - Ackoff method has a specific position between these methods and it is based on preliminary knowledge of criteria strength. Its aim is to correct the balance in consistent with preferential system of evaluator [7].

CONCLUSION

It is difficult to answer the question "Which is the right method of multi-criterial decision making?" It always depends on the field where the method is implemented, on the capabilities of evaluator (software, achieved education, experience with analysis and synthesis methods of decision-making), the target audience for which it is analyzed decisions like. It is possible to say that in the field that relates to the real decision-making problems need to work with multi-criterial decision-making methods that are able affect uncertainty. These methods include methods like **Fuzzy analytic hierarchy process method** or **Fuzzy mutual relations method**.

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