

# The worth index based on the credibility index

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## Abstract:

Usually, MCDA methods are used to compare actions in order to resolve the classical decision problems: choosing, ranking, and sorting. It exists some circumstances where the decision-maker may be interested by advising him in his improvement strategy from an existing solution. In this case, we are faced to another decision problem: how to act in the existing solution considering the decision-maker feasibility constraints? For instance, one may be interested to determine the criteria whose performance improvement will lead to the best overall gain in improvement while minimizing the cost for the decision-maker. The resolution of this problem depends on the MCDA method considered. Some approaches were proposed to solve this problem in the context of aggregation methods based on the concept of worth index (M. Grabisch and C. Labreuche 2001), (C. Labreuche, 2004) and (Montmain et al. 2015). In this context, the problem is stated as follows. Let  $H: [0,1]^n \rightarrow [0,1]$  be an aggregation operator,  $N = \{1,2, \dots, n\}$  the set of criteria indices,  $I \subset N$ , and  $x^0$  the starting solution. The worth index  $w_H(x^0, I)$  represents the worth for the solution  $x^0$  to be improved in the criteria among  $I$  using the operator  $H$  and is defined as follows:

$$w_H(x^0, I) = \int_0^1 \frac{H((1-\lambda)x_I^0 + \lambda, x_{N \setminus I}^0) - H(x^0)}{E_I(x^0, \lambda(1 - x_I^0))} d\lambda \quad (1)$$

where  $z = ((1 - \lambda)x_I^0 + \lambda, x_{N \setminus I}^0) \in [0,1]^n$  means  $z_i = (1 - \lambda)x_i^0 + \lambda$  if  $i \in I$ , and  $z_i = x_i^0$  otherwise,  $E_I(x^0, \lambda(1 - x_I^0))$  is the effort to go from  $x^0$  to  $(\lambda 1_I, \lambda x_{N \setminus I}^0)$ .

The aim of this work is to present a version of the worth index using an outranking method based on pairwise comparisons. Let consider  $\omega$  the vector of criteria importance,  $p(g(x^0))$ ,  $q(g(x^0))$ ,  $v(g(x^0))$  respectively the vectors of preference, indifference and veto thresholds associated to  $x^0$ . Subject to the existence of the integral of (2), the worth index based on credibility index can be stated as follows:

$$W_{\omega, p(g(x^0)), q(g(x^0)), v(g(x^0))}(x^0, I) = \int_{\Omega} \frac{\rho((x_I, x_{N \setminus I}^0), x^0)}{E_I(x^0, (x_I, x_{N \setminus I}^0))} dx \quad (2)$$

where  $\Omega$  is the domain of actions. In this context of outranking methods, performances of actions on criteria could be qualitative or quantitative.