Operation Research Mini-Project

A New Approach for Selection of Attributes/Models

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INTRODUCTION

In this report, we have explored the multiple attribute decision-making (MADM) process. Multicriteria Decision-making (MCDM) is an essential branch of operational research that consists of several decision-making parameters. TOPSIS is a crucial tool for dealing with MCDM issues, but there are already some shortcomings. In the face of the MCDM problem, different forms of uncertainty are unavoidable, such as incompleteness, fuzziness, and imprecision arising from the powerlessness of arbitrary judgement by human beings. However, these types of uncertainties cannot be sufficiently solved by the TOPSIS system. This report is focused on a method that contains a combination of the two approaches, TOPSIS(Technique for Order of Preference by Similarity to Ideal Solution) and AHP(Analytic Hierarchy Process). After a detailed study of the combined process, We had tried to illustrate the algorithm with Python Script. This report provides a broad overview of the process and computational methodology of TOPSIS and AHP.

Multiple Attribute decision-making method

Multiple Attribute decision-making methods evolved from operations research theory by solving problems such as the development of computational and mathematical tools to support the subjective assessment of performance criteria by decision-makers. It involves the inclusion of various parameters of a different type, for e.g. If one wants to select a model from the proposed model then, the attribute could Cost, Time required to complete the job, Efficiency, Work Experience and so on. Devising a selection model based on preference could be done using Multiple Attribute decision-making methods.

TOPSIS(Technique for Order of Preference by Similarity to Ideal Solution)

The Technique for Preference by Similarity to Ideal Solution (TOPSIS) is a multi-criteria decision analysis approach that was originally introduced by Ching-Lai Hwang and Yoon in 1981 with further improvements by Yoon in 1987 and Hwang, Lai and Liu in 1993. TOPSIS is based on the concept that the alternative chosen should have the shortest geometric distance from the positive ideal solution (PIS) and the longest geometric distance from the negative ideal solution(NIS).

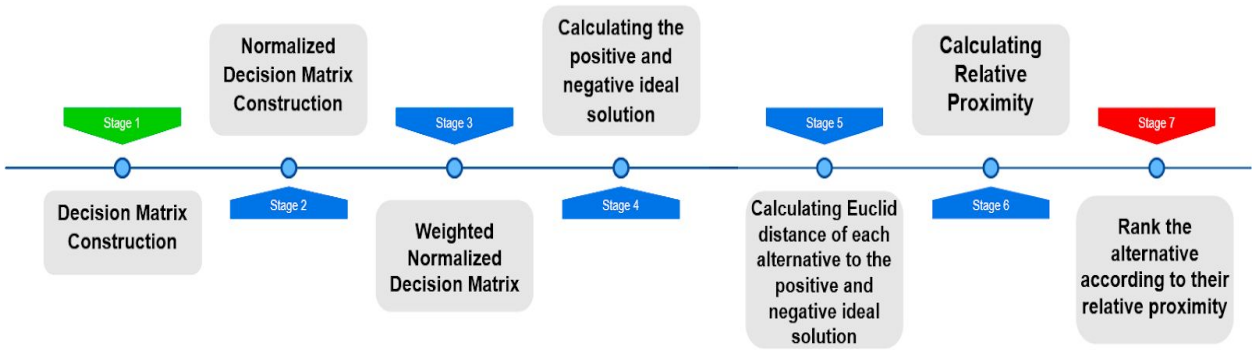

Figure 1. *Flow chart for TOPSIS Algorithm*

AHP(Analytic Hierarchy Method)

The analytic hierarchy method (AHP), developed by Saaty, is a powerful multicriteria decision-making tool that has been used in numerous applications in various fields of economics, politics and engineering.

The AHP method makes it possible to assign a value representing the preference degree for a given alternative to each additional option. Such values can be used to classify and select choices based on a hierarchical structure.

The method is based on the assumption of evaluation consistency; it also relies on the hypothesis that inconsistency occurs mainly in evaluations between alternatives of seemingly minor importance to the decision-maker. By taking as its basis alternatives of apparent greater extent, the method makes a more careful analysis when comparing these alternatives with the other ones. Thus, it is proposed that for each calculation of priorities in each criterion, the alternative that the decision-maker considers the most or one of the most essential options are taken as the basis of comparison.

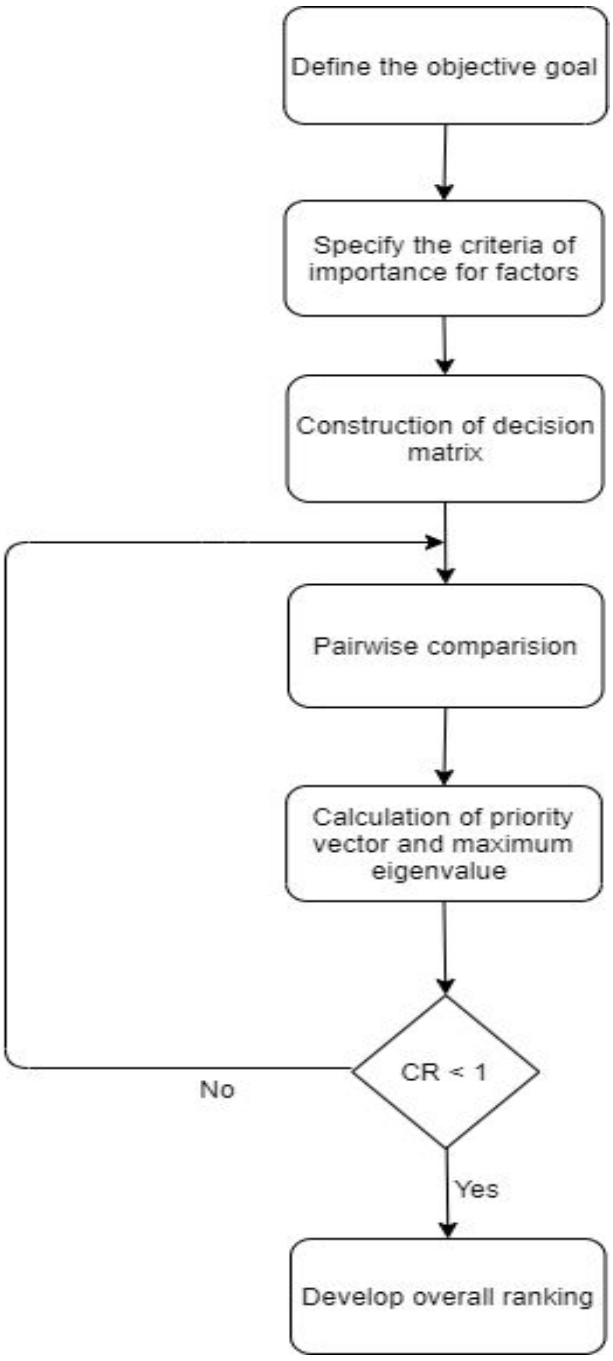

Figure 2. *Flow chart for AHP Algorithm*

ALGO(TOPSIS+AHP combined)

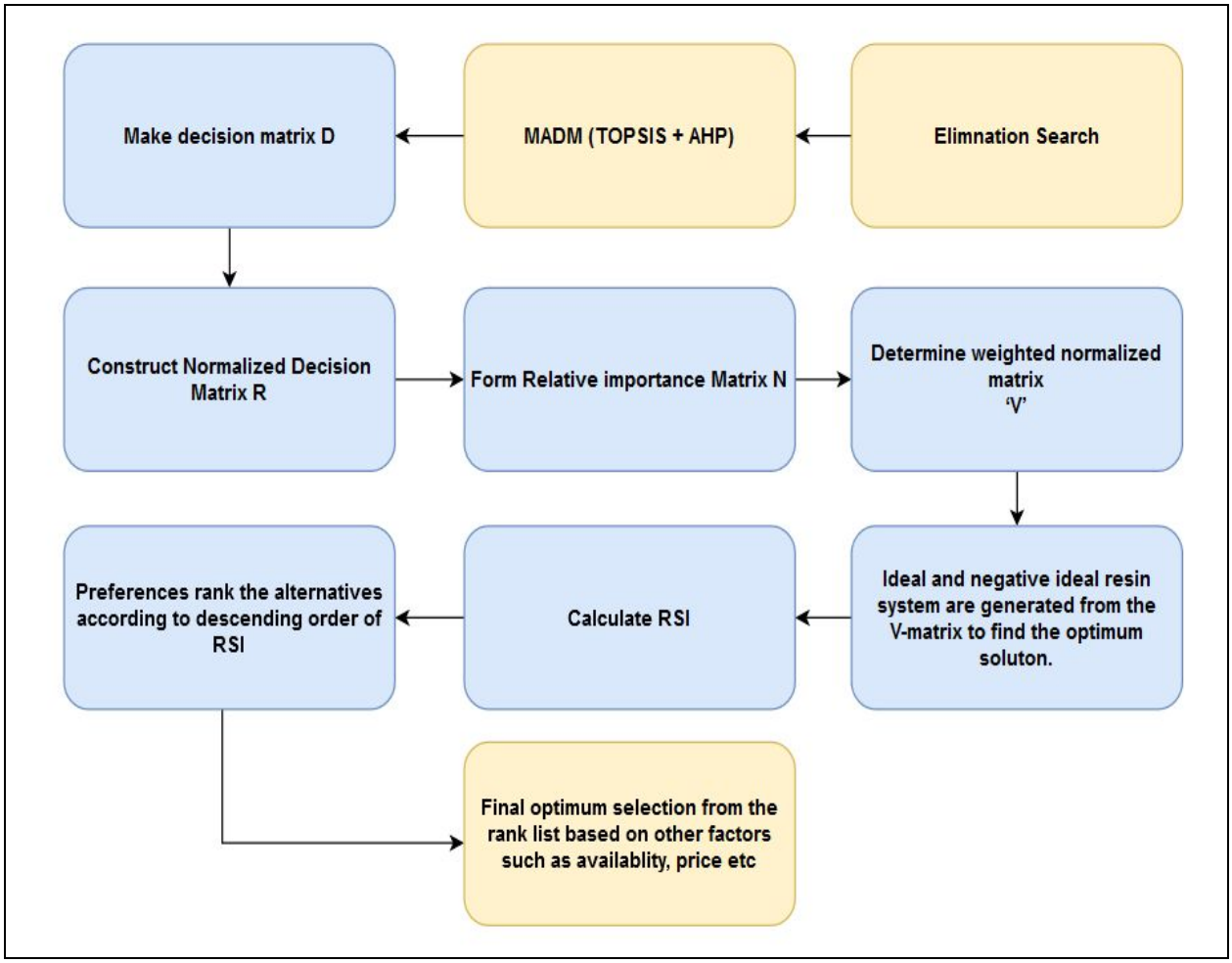

Figure 3. *Flow Chart of New Method(TOPSIS + AHP)*

Suggestions

1. We could have used Statistical distances in place of Euclid distance in combined methodology.
2. Using the Cosine similarity method to calculate the S* and S^- and in return calculating RSI.

Conclusion

This method can be verified with various case studies, where this selection method suits best for MADM. This method can be optimised further, and the working script for the same could provide different insights as well.

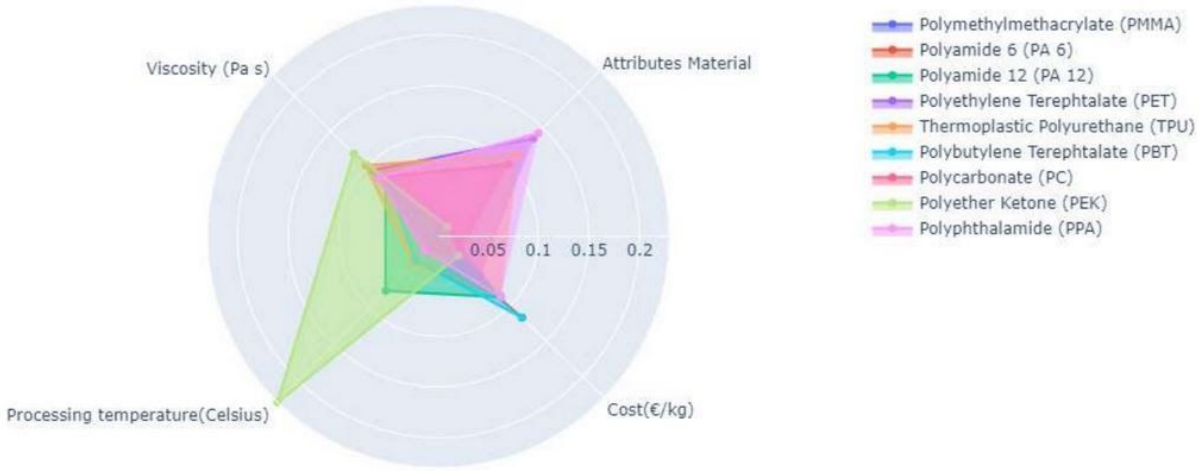

Figure 4. *Case Study (HYPOTHETICAL) of Resin Selection*

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