

Chapter 9

The Fuzzy–AHP and Fuzzy TOPSIS Approaches to ERP Selection: A Comparative Analysis

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ABSTRACT

The proposed chapter aims at explaining theoretical frameworks of the Fuzzy AHP and Fuzzy TOPSIS extension approaches and also summarizes the recent research around these two concepts. To help reader understand the practical usage of the two approaches, it also demonstrates their applications on the significant problem of ERP Selection. The techniques are further illustrated with the help of an organization case study located in NCR, Delhi (India). Further, a comparative analysis will be made between the two techniques by taking into account their time complexities.

INTRODUCTION

Multi criteria decision-making (MCDM) is a modeling and methodological tool for dealing with the complex engineering problems. Multi-attribute decision-making (MADM) is the most well-known branch of decision-making. It is a branch of a general class of operations research models that deal with the decision-making problems under the presence of a number of decision-making criteria. The MADM approach requires the selection to be made among decision alternatives described by their attributes. MADM problems are assumed to have predetermined, and limited number of decision alternatives. Solving a MADM problem involves sorting and ranking.

Fuzzy Analytic Hierarchy Process (Chang, 1996) solves multicriteria decision making problems by hierarchical decomposition method while accommodating uncertainties of information sets (Zadeh, 1965).

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Humans are often uncertain in assigning the evaluation scores in crisp AHP (Saaty, 1980). Fuzzy AHP can capture this difficulty. On the other hand, Fuzzy Technique for Order Performance by Similarity to Ideal Solution (TOPSIS) (Hwang & Yoon, 1981) selects the best alternative on basis of it being nearest to fuzzy ideal solution and farthest from negative ideal solution. The positive ideal solution is a solution that maximizes the benefit criteria and minimizes the cost criteria, whereas the negative ideal solution maximizes the cost criteria and minimizes the benefit criteria. In other words, the positive ideal solution is composed of all best values attainable of criteria, whereas the negative ideal solution consists of all worst values attainable of criteria.

The ERP selection is a multi-criteria decision making problem with evaluation of multiple conflicting conditions for selecting best option from all of feasible alternatives. The problem is of significance as organization-wide ERP implementation is a high-risk undertaking involving substantial financial risk coupled with organization wide transformation. Owing to the complexity of the business environments, limitations of available resources and the diversity of ERP alternatives, ERP system selection is tedious, precarious and a time consuming activity. Since ERP systems usually impose their own constraints on companies' processes, strategies and culture, it is imperative that the ERP selection decision be conducted with great care.

The criteria used in ERP selection study are critical success factors (CSFs). These are considered vital for risk aversion in ERP implementation projects. The CSFs for ERP implementation bring a concept that helps an organization identify the critical issues that affect the process of implementation. These factors are believed to have crucial role to play in successful ERP implementation with their monitoring and control if carried out effectively.

It is however notable that, that none of the CSFs listing proposed by the researchers so far has found a straightforward application in the ERP selection process. This clearly indicates inadequacies in the research output achieved so far. Another concerning issue, which adds to this limitation, is infeasibility on part of organizations to devote attention to all the listed CSFs for selection purposes. It would be appreciable if an effective method of selecting CSFs on basis of organizational ERP selection requirements was available.

Thus the objectives of the proposed chapter are to discuss the techniques of Fuzzy AHP and Fuzzy TOPSIS extension approach to the problem of ERP selection. The chapter would give requisite theoretical details of the two approaches with a recent literature review survey. The framework for bridging the gap between the CSFs studies and the ERP selection problem is also discussed. A sample illustration of application of the above discussed techniques to a company case as an illustration is also demonstrated. The computational efficiency of the techniques is done using their time complexities. The results indicate that the proposed Fuzzy TOPSIS technique fare better than the popular technique of FAHP, when utilized for the same problem.

Hence, it is expected that the chapter will enable the reader develop good understanding of the concepts involving Fuzzy AHP and Fuzzy TOPSIS along with ERP Selection problem and appreciate the practical realization of the algorithms.

BACKGROUND

AHP (Saaty, 1986) uses the concepts of fuzzy set theory and hierarchical structure analysis for the selection of the most appropriate alternative among a set of feasible alternatives. AHP is a widely used

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