

Chapter 11

Analytical Hierarchical Process in Decision Making

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ABSTRACT

In the introduction, what decision making is and the significance of the decision making was introduced. Few popular decision-making techniques were listed out and three rational techniques were discussed in a nutshell. Then Professor Saaty's seminal work, Analytical Hierarchical Process (AHP) was described, starting with the evolution of AHP and moving towards its practice through a four-step process. The AHP generates weights on a relative ratio scale with an input of measurements on a standard scale and due to the normalization process linearity of the results was destroyed. Finally, the four-step analytical hierarchical process was illustrated through an example of the selection of a job. During the progression, outcomes of the key theoretical aspects have been touched on without providing proof.

INTRODUCTION

Decision-Making and Its Significance

Decision-making is a fact-based judgmental process made to select one among many alternatives after careful evaluation of each of them and it is rarely a choice between right and wrong. The decision-making process is generally a managerial function

DOI: 10.4018/978-1-6684-6859-3.ch011

though it is imperative everywhere. Decision-making has only a significant impact in certain contexts, but it inevitably becomes crucial and critical in other scenarios. On one hand, decisions have an enormous impact on success or failure, while in another way it can be seen as a creative task. The complexity of the decision-making process varies from a simple binomial decision to a complex hierarchical structural decision underlined with multi-decision criteria.

Decision-Making Techniques

Ample numbers of decision-making methods could be found in the literature and only a few mile-stone decision-making processes would be briefed under this section. The techniques such as Nominal Group Technique, Delphi technique, Brain-storming, Multi-voting, Step Ladder technique, SWOT analysis, and Pareto analysis are a few famous practical techniques used, however, some of them are not based on solid mathematical background and hence lack in deductive nature. Most of the techniques are subjective, and heuristic in nature but very much useful in a practical context. The nutshell of the three objective criteria is outlined in the following paragraphs.

The decision tree evolved as a rational means of taking decisions. Based on the potential outcomes, the probabilities of such potential outcomes, and their associated costs, the consequences of a complex decision are evaluated in the decision tree analysis technique. The tree approach is particularly useful in the analysis of quantitative data and its usage is limited due to the amount of information required as well as the existence of such information may not be quite obvious in nature. However, with the advent of machine learning algorithms, the decision tree approach was transformed into a type of supervised machine learning technique used to categorize or make predictions.

The Decision Matrix is one of the most popular Multiple-Criteria Decision Analysis (MCDA) techniques. It is used to select the best option based on weighted criteria with their importance (Salmerona & Smarandacheb, 2010). In the Decision Matrix approach, the list of options/choices available is used as rows on a table, while the factors/criteria need to be considered as columns with factors/criteria ratings. Then fill the element of the matrix with the weights of each option based on each factor/criterion. Then calculate the overall score for each option by taking the sum of the product of factors/criteria and weights (relative importance of the factor). Based on the overall scores, decisions are made.

In 1970, a rigorous form of multi-criteria decision analysis tool termed as Analytic Hierarchy Process (AHP) was added to the scientific knowledge base. The Analytic Hierarchy Process (AHP) is a structured technique for organizing and analyzing complex decisions, using mathematics and psychology. It allows making decisions in complex environments in which many variables or criteria are

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