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A State of the Art Review of Analytical Hierarchy Process

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Abstract

In today's competitive world most of the problems composes multiple conflicting criteria's. Therefore, it is necessary to use suitable multi criteria decision making (MCDM). Analytical hierarchy process (AHP) is one of the most widely used MCDM technique by researchers from around the globe due to its simplicity and versatility with higher accuracy. In order to systematize available information, this paper is an attempt to review the work conducted by various researchers in applications and improvement areas of AHP.

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Keywords: MCDM; Decision Making; AHP; Material Selection; Maintenance.

1. Introduction

Rapid technological and economic growth over the last fifty years has changed human lives and made modern society to face complex decision making problems that [1, 2, 3, 4 and 5] are not easy to solve because they involve many criteria, sub criteria and alternatives. Therefore, to conduct a natural choice would be almost impossible without the help of mathematical science which formalizes the way we think in order to take better decisions and also assures the transparency of all its aspects.

Multiple-Criteria Decision Making (MCDM) [5, 6 and 7] is useful when alternative with best values is not available as each alternative scores has multiple conflicting criteria's. The motivation behind development of MCDM methods has been not only by a variety of real-life problems requiring the consideration of multiple criteria, but also by practitioners' desire to propose enhanced decision making techniques using recent advancements in

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mathematical optimization, scientific computing, and computer technology. There are two possible ways to do such a decision making process:

- **Individual Decision Making – It** involves only one specialist which gives the ranking to alternatives on the basis of criteria's.
- **Group Decision Making -It** involves a certain number of specialists and considers weightages of each individual decision maker to rank alternatives on the basis of criteria's.

MCDM methods [8, 9] have two categories: discrete MADM (Multi-attribute Decision Making) and continuous MODM (Multi-Objective Decision Making) methods (Figure 1).

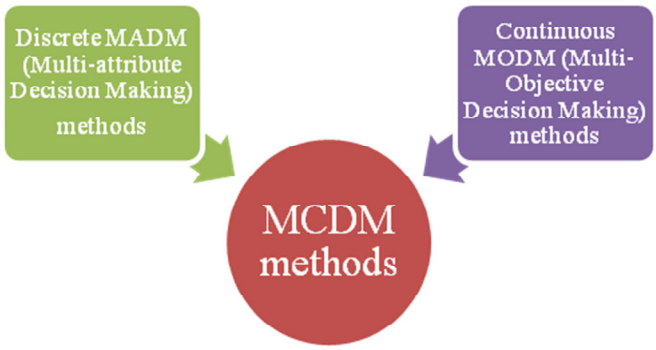

Fig.1. Types of MCDM Methods

The association of MADM is with problems where alternatives are predetermined and when the model cannot be stated in mathematical equations. The association of MODM methods is with problems where alternatives are non-predetermined and the aim of the problem is to identify the best alternative by considering a set of well-defined criteria's. However, the use of terms MADM and MCDM are to indicate the identical class of models and are confused in practice.

2. Literature Review

The objective [1, 5, 10, and 11] of using an analytic hierarchy process (AHP) is to reduce complex decision problems in a systematic and analytic manner by addressing each aspect of the failure in the hierarchy for helping the analysts to identify the preferred alternative.

Generally, a typical AHP [3, 4, 5, 10, 12, and 13] problem starts by defining the problem proceeded by identifying the goal to achieve, pair wise comparison of components with respect to criteria's and at last structure them as a hierarchy that resembles with family tree which is viewed as a logical and organized form in representing the problem. The best part in this type of analysis is that multiple criteria give a balanced view of the problem. It looks at the problem in totality by incorporating all the relevant criteria.

- **Goal** - A goal is needed in order to determine the criteria.
- **Criteria**–These are used to evaluate a predetermined number of alternatives.
- **Alternatives**- Alternatives to choose from in order to achieve the goal.