Chapter 49
Construct a Multi Criteria Decision Making Tool:
DEMATEL and MMDE Methods

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ABSTRACT

When dealing with multi-criteria decision-making problems in both engineering and management research fields, DEMATEL is one of the common methods applied by the researchers. However, so far there is no any easy-to-use DEMATEL application software. Moreover, for DEMATEL, the threshold value setup may vary in different researchers. Later MMDE method was developed, which could obtain clear threshold value. However, its concept and complicated computing process hinder the common researchers to use it quickly. Without any related application software either, it is quite inconvenient to the researchers. Therefore, the study develops an application software that combines with these two methods and incorporates with friendly interfaces. In the paper, it takes how to develop Taiwan into a passenger transport center of East Asia as an example, to illustrate the operation and application of the software. It provides the researchers using DEMATEL and MMDE methods with an excellent and easy-to-good tool.

1. INTRODUCTION

The Decision Making Trial and Evaluation Laboratory (DEMATEL) method was developed by the Battelle memorial association of the Geneva research center (Fontela and Gabus, 1976; Gabus and Fontela, 1973). Initially, the DEMATEL method was used to study the complex world problems regarding things like: race, hunger, energy, and environmental protection (Fontela and Gabus, 1976). In recent years, there are many researches have widely applied DEMATEL to solve problems in different fields successfully (Chen, 2012a; Chen, 2012b; Hajime, Kenichi and Hajime, 2005; Kim, 2006; Lee, Chen and Chung, 2012; Chen, Lee, Yang, and Lee, 2013; Chen, Lee and Wu, 2012).

In the DEMATEL method, an appropriate threshold value is necessary to obtain a suitable effect-relations map and adequate information for further analysis or decision-making. Following the traditional method, the researchers set a threshold value by conducting discussions with experts. The researcher set up an appropriate threshold value and then outlines the effect-relations map to assess whether the effect-relations map is suitable for the structure of the problem. If not, the threshold value is substituted with another value, and another effect-relations map is redrawn until a consensus is achieved amongst the researchers. It is difficult to choose a consistent threshold value, especially if there are too many experts contributing an opinion to the same study. When the problem has many factors, the work involved to achieve the same threshold value becomes more complex (Lia and Tzeng, 2009).

Li and Tzeng (2009) propose using maximum mean de-entropy (MMDE) to solve the above threshold problems, which obtains the threshold by objective computation means. Currently, many researchers have used the combination of DEMATEL and MMDE (Chen, 2012a; Chen, 2012b; Chen, Lee, 2012; Chen, Lee and Wu, 2012). However, neither of these two methods has been equipped with direct application software, which brings much inconvenience to the researchers. Therefore, the primary purpose of the study is to develop easy-to-use software. It takes the example of developing Taiwan into tourists' transport center of East Asia (Chen and Lee, 2012) to instruct the operation of the software.

2. THE METHODS OF MCDM

2.1. The Popular Methods of MCDM

Multi-criteria decision making (MCDM) meant dealing with decision situation if decision maker had sever conflicting objectives (Babenicht, Scheubrein, B. and Scheubrein, R., 2002). MCDM may be considered as a complex and dynamic process including one managerial level and one engineering level (Duckstein and Opricovic, 1980). MCDM could help decision maker making decisions to make sequences, and evaluations according to attributes and then selected the best results which conformed decision maker's idea (Lin, 2013). There are some popular methods of MCDM such as PROMETHEE, ELECTRE, TOPSIS, AHP, ANP and DEMATEL.

The performance ranking organization method for enrichment evaluation (PROMETHEE) is proposed by Brans, Vincke and Marshal (1986). The PROMETHEE family of outranking methods, including the PROMETHEE I for partial ranking of the alternatives and the PROMETHEE II for complete ranking of the alternatives (Behzadiana, Kazemzadehb, Albadvib and Aghdasib, 2010; Lin, 2013). The elimination and choice translating reality method (ELECTRE) is proposed by Benayoun, Roy and Sussman (1966). The ELECTRE was an approach to choose the best actions from a set of actions and its concepts were outranking relations, the ELECTRE was used to pairwise comparison among alternatives under each one of the criteria separately to deal with outranking relations (Triantaphyllou, 2000; Lin, 2013).

The technique for order preference by similarity to ideal solution (TOPSIS) is developed by Hwang and Yoon (1981). This method is based on the concept that the chosen alternative should have the shortest geometric distance from the positive ideal solution and the longest geometric distance from the negative ideal solution. An assumption of TOPSIS is that the criteria are monotonically increasing or decreasing. Normalisation is usually required as the parameters or criteria are often of incongruous dimensions in multi-criteria problems (Yoon and Hwang, 1995; Zavadskas, Zakarevicius and Antucheviciene, 2006). The analytic hierarchy process (AHP) is proposed by Saaty in 1991 (Saaty, 1994). Base on the pair-by-

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