

# Chapter 27

## Fuzzy Structural Models and Based Applications in Digital Marketplace

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### ABSTRACT

*One of the well-known topics of decision making is Multi-Criteria Decision Making (MCDM). Fuzzy set theory helps to provide a useful way to address a MCDM problem. Without models, MCDM methods cannot be practiced effectively, therefore, it is interesting to clarify the structure among criteria. But the shortcoming of MCDM is unable to capture imprecision or vagueness inherent in the information. Fuzzy set theory has great potential to handle such situations and fuzzy structural models have been developed. In this chapter widely used structural models i.e. Interpretive Structural Modeling (ISM), Decision Making Trial and Evaluation Laboratory (DEMATEL), and Cognition Maps (CMs) are first summarized briefly along with their mathematical formulation and then diffusion these models into fuzzy set theory is explained along with a literature review of the based applications of these models in the digital marketplace.*

### INTRODUCTION

The marketing researchers have been very much concerned about the emerging areas of research in the behavioural as well as the structural aspects of marketing (Lee et al., 2011; Rouhani et al., 2013; Kumar & Dash, 2013) Many conceptual models have been developed in this regard by the researchers to calculate the outcome of different concepts (Lee et al., 2011; Huang et al., 2011). To establish a structural model within factors is very significant for a marketing manager to under understand their customer behaviour well (Lee et al., 2011; Huang et al., 2011). The modeling is the representation of a real world object or system in a mathematical framework and methodology for resolving essential problems that

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can be used to describe and analyze the behaviour of a system, to ask what if questions and to provide information to assist in the design and development of the real system. The models are useful to analyze the complex relationships between system components and structure the information about the technical and economic characteristics of the system (Lee et al., 2011).

In any case if multi criteria decision making are without models can work effectively (Lee et al., 2011; Kumar & Dash, 2014) what we know or think and where our knowledge is needed for effective decision making, with help of models we can assess. Imperatives mechanism to perform quantitative multi criteria decision making is mathematical modelling (Tzeng & Huang, 2011). Through mathematical models, we can help decision makers to better understanding about interdependent system and relationship (Tseng & Lin, 2009; Patil & Kant, 2014). But the shortcoming of MCDM is unable to capture inherent vagueness of information. Fuzzy set theory has great potential to handle such situations. Professor Lotfi A. Zadeh (1965) first has come with the concept of “Fuzzy Sets”. This concept is base on “membership” among criteria. In the last forty five years, his work has been recognized by researchers to handle of imprecision and uncertainty.

This chapter is organized into four sections. In first section introduction and background of the study have been explained. The second section deals with fuzzy set theory and some important definitions. In section of structural models in decision making and fuzzy sets, ISM, DEMATEL, and Cognition Maps (CMs) are described with mathematical formulation and their diffusion into fuzzy sets. Conclusion is given in the last section.

## **FUZZY SET THEORY**

The substantial universe there is a number of situations where uncertainty can find in information (Zadeh, 1965). When decision-making in a fuzzy environment, the result of decision making is greatly affected by subjective ratings that are obscure and vague. There are many ways of imprecision includes unquantifiable, incomplete information, the information cannot be obtained, and the partial ignorance (Chen et al., 1992). To cope with this type of problem vague and imprecise and manage these problems mathematically, in year of 1965, Zadeh has come with the concept of fuzzy set theory. In this theory, each number indicates a partial truth while crisp sets correspond to the binary logic 0 or 1 (Zadeh, 1965). To address the vagueness of feeling and expression in human decision-making, fuzzy set theory is really useful (Zadeh, 1965). Some important concepts of fuzzy are described:

**Def.1:** A fuzzy set  $\tilde{A}$  of the universe of discourse  $X$  is Convex if  $\mu_{\tilde{A}}(\lambda x_1 + (1-\lambda)x_2) \geq \min(\mu_{\tilde{A}}(x_1), \mu_{\tilde{A}}(x_2)) \forall x \in [x_1, x_2]$ , where  $\lambda \in [0, 1]$ .

**Def.2:** A fuzzy set  $\tilde{A}$  of the universe of discourse  $X$  is convex if  $\max \mu_{\tilde{A}}(x) = 1$ .

**Def.3:** The  $\alpha$ -cut of the fuzzy set  $\tilde{A}$  of the universe of discourse  $X$  is defined as  $\tilde{A}_{\alpha} = \{x \in X \mid \mu_{\tilde{A}}(x) \geq \alpha\}$ , where  $\alpha \in [0, 1]$ .

**Def.4:** A triangular fuzzy number  $\tilde{N}$  can be defined as a triplet  $(l, m, r)$ , and the membership function  $\mu_{\tilde{N}}(x)$  is defined as:

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