Chapter 74
Application of DEMATEL and MMDE for Analyzing Key Influencing Factors Relevant to Selection of Supply Chain Coordination Schemes

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ABSTRACT

Any selection decision of supply chain coordination schemes (SCCS) is essentially affected by the environment where the schemes are to be implemented, the necessary conditions required for their implementation, the risk associated with the implementation, and the impact on the performance of the supply chain. Because of the multi-dimensional characteristics; the selection of appropriate SCCS in a given situation remains a challenging task for supply chain managers. This study explores relevant factors that influence this selection process. A structural model is proposed to capture relationships among these factors for development of Impact Relationship Maps (IRM) by applying Decision Making Trial and Evaluation Laboratory (DEMATEL) and Maximum Mean De-Entropy (MMDE) algorithm. A study has been conducted and the outcome leads to add significant value to the decision making process with knowledge on the roles of the factors and inter-factor relations which helps in taking meaningful decision on SCCS selection and implementation.

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1. INTRODUCTION

Supply chain coordination (SCC) seems to be the current area of focus of management researchers, as the new global order emphasizes on the need for coordination instead of competition for achieving excellence. Coordination among all Supply Chain (SC) members is also important in facing the challenges of global dynamics and uncertainty. Although it has gained significant popularity among practitioners, the exact definition of SCC is yet to be formalized precisely (Ballou et al., 2000; Lee, 2000; Giannoccaro & Pontrandolfo, 2004; Xu & Beamon, 2006; Arshinder et al., 2006). But the most widely accepted definition of SCC still remains as "the act of managing dependencies between entities and the joint effort of entities working together towards mutually defined goals" (Malone & Crowston, 1994).

Various coordination schemes have been developed to capture different managerial scenarios. Quantity discount models have been proposed for supply chains with multi-period inventory systems in which upstream parties mitigate the overstocking risk of downstream parties by proposing a discount (Weng, 1995). Research reports in recent past, covers variations of discount model as per the policies formulated under different situations. These include quantity discounts under demand disruption (Qi et al., 2004), discount policies under demand and production cost disruptions (Xiao & Qi, 2008), discount models under uncertain demand (Li & Liu, 2006), quantity discounts considering retailer's expectations on the basis of their partial information (Karabat & Sayın, 2008), and model for scheduling of discounts (Shin & Benton, 2007). In coordination schemes for revenue sharing contract; the supplier initially charges the buyer a low wholesale price at the beginning of a period and the buyer shares a fraction of the revenue generated from the sales at the end of the period (Giannoccaro & Pontrandolfo, 2004; Cachon & Lariviere, 2005).

Like other decision making situations, selection and implementation of effective supply chain coordination schemes (SCCS) is characterized as a multi-dimensional decision process. The most important issue is the environment of the supply chain, which broadly covers internal and external factors showing strengths and weaknesses on the one hand opportunities and threats on the other. The second most important aspect is the set of enablers or essential conditions for implementing a particular scheme. Attention is required to check the existence of the conditions or requirements at the stage of selection of a scheme, failing which implementation is expected to be affected adversely or ineffective. Further, risks associated with each schemes and the expected gain or benefits are the other important issues to be considered in this decision process.

While focusing on the above mentioned issues, authors could notice that these are mostly interrelated and a meaningful decision on SCCS essentially requires understanding the role of the issues and the pattern of their relationship and impacts. The primary objective of this paper is to create framework of relationships among the relevant issues, so that decision makers can develop deeper understanding of their roles and influences which will ultimately help them in taking appropriate decisions.

The relevant issues and factors, which influence this decision making process are mostly interrelated. Critical search has been carried out for structural modeling of this decision situation. Subsequently DEcision MAking Trial and Evaluation Laboratory (DEMATEL) (Fontel & Gabus, 1976; Gabus & Fontela, 1972; Zhou et al., 2006; Tzeng et al. 2007) is identified as the technique, which has been effectively used to understand the complex structure of the causal relationship among various related factors. Subsequently Maximum Mean De-Entropy algorithm (MMDE) (Li & Tzeng, 2009; Chen et al., 2012) is also applied to set the consistent threshold value, which is necessary for building the influence diagram or Impact Relationship Map (IRM) among various factors.