Chapter 10
A Comprehensive Risk Management Tool Based on Multi-Agents and System Dynamics for Traditional and E-Commerce Supply Chain

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ABSTRACT

Supply chain management paradigms are becoming increasingly common management perspectives all over the world due to violent global competition of trade organizations and rapid changes in technology. In recent years, thanks to the communication improvements, customers have become more conscious about purchasing goods or services. Furthermore, organizations have to be customer oriented and more flexible against the dynamism of supply chain environment which increases uncertainties in supply chain parameters. Although a considerable amount of risk factors appearing in supply chain operations, this study concentrates on detecting key supply chain risks which could cause abnormalities and occur from rapid changes in customer demand, unpredictable price fluctuations, defect variations and delivery delays and provides the correction of these problems automatically. Thus, a system dynamics model is established for determining risks. This combined approach would be helpful for integrated supply chain risk management.

DOI: 10.4018/978-1-5225-2944-6.ch010

INTRODUCTION

In recent years, thanks to the communication improvements, customers have become more conscious about purchasing goods or services. Because of increasing knowledge about products and services, customer requirements are changing rapidly and these changings needs are forcing companies to be speedier to satisfy customer orders with more qualified products at acceptable prices. Furthermore, organizations have to be customer oriented and more flexible against the dynamism of supply chain environment which increases uncertainties in supply chain parameters. Flexibility and customer oriented attitude help organizations to have a chance about making more profit but also bring pressure to take risks such as inventory shortages, decreasing demand, late shipments, quality losses etc. Within this context, supply chain risk management applications are sought after dramatic losses appeared. For example, Toyota recalled automobiles owing to quality and safety problems which led to loss of millions of dollars and reputability. In addition to Toyota, Boeing had intensity problems with their production schedule and it was declared that aircrafts would be delivered with about fifteen-month tardiness. Thus, the main problem in a supply chain appears to be the changes in supply chain behavior with different elements. In addition to the conflicting aims of supply chain elements, supply chains may also be influenced from the of government restrictions such as the purchasing quota, sales limitations etc. (Nagurney et al., 2005). External factors such as tax regulations, high inflation rates, final customer demand etc., cause additional uncertainty, thereby increasing the risk potential in supply chains. In this sense, organizations are in need of cohesive management approaches, like supply chain risk management, against supply chain variances considering the requirements of a supply chain. To consider all of the external and internal factors, supply chain management must reflect the interactions among diversified supply chain elements (Ellegaard, 2008).

First supply chain risk management applications were implemented in financial issues that include cash flows and late payments. From 1995 to 1999, most favorable topics in supply chain risk management were lean production and supplier selection. However, especially from 2000 to 2004, analysts realized that risk was not only in financial issues but also in other supply chain components such as manufacturing and transportation. Besides that, supply chain risk management studies gave rise up to now and recently, due to increasing uncertainties, environmental information management has become a significant issue in risk management (Tang and Musa, 2010).

As realized from the literature review, significant number of models related to supply chain management generally focused on different optimization methods and decision-making tools such as linear programming, stochastic modeling, ANP, SOM and deterministic modeling (Pham et al., 2012, Liang et al., 2012; Azaron et al., 2007). Although sufficient information is provided in most of these models they could not be implemented due to lack of interpretation of the results and excessive computational times (Hanafizadeh et al., 2009). Furthermore, they are also critisized for not considering interactions between the risk elements (Ritchie and Brindley, 2007; Nagurney et al., 2005, Chatzidimitriou et al., 2008). Due to the emerging and dynamic virtual relations between supply chain members, models should acquire sudden changes and cope with uncertainties and provide continuous monitoring. From this perspective, fuzzy based models that formulate supply chains could cope with the difficulties about instant variations and continuous monitoring of the entire system. (Ngai and Wat, 2004) In addition to the static structure, interactions and variations could not be included in the mathematical modeling. Therefore, models based on multi criteria decision making are more suitable for determining causal relationships and control parameters that effects the system behavior.