Chapter 7

Intelligent Simulation System for Supply Chain Event Management (SCEM)

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ABSTRACT

In this chapter, the authors present an intelligent simulation system for supply chain event management for the purpose of designing and re-engineering the supply chain. The simulation framework mainly composes of component layer, process layer, intelligent execution layer, and output layer. The functional design of the layers is discussed with comments on the contribution of the simulation. Implementation issues are further addressed and an illustrative case study is reported.

1. INTRODUCTION

Supply Chain Event Management (SCEM), sometimes referred to as Supply Chain Process Management (SCPM), is defined by APICS (APICS, 2005) as the application of a special type of software that simulates, controls, and responds to exceptions in a supply chain. SCEM can provide active visibility, and perform the functions such as real-time monitoring, measuring with key performance indicators (KPIs), notifying exceptions to decision makers, performing what-if simulation scenario analysis, and controlling unexpected events such as cancelled orders, supply disruption, and currency fluctuations, etc. The advantage of the application of SCEM is that connected processes can be monitored, even in a global context where the uncertainties are magnified, and that the processes can be modified if necessary (Christopher, 2005). In the global economy that is there today, the supply chain is global in nature and is becoming increasingly complex and dynamic. There are risks inherent in all stages of supply chain processes, from the supply side to the demand side (PRTM, 2005). As a result, global supply chain
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is vulnerable with respect to exceptional negative events, and can be easily disrupted by these negative events. The anticipation and avoidance by management of exceptional negative events becomes an important part of risk management in the global supply chain and of the management of the supply chain in general for effective performance.

2. APPLICATIONS OF INTELLIGENT SIMULATION SYSTEMS ON SCEM

The structure of SCEM as a working software solution is comprised of the following components: event management engine, alert manager, human decision maker, application, and data warehouse, and some other minor support functions (Otto, 2003). The key element known as the event management engine receives messages from the entire supply chain, and then proceeds to analyze these messages to make decisions based on predetermined rules and algorithms in a manner similar to an expert system (ES) as used in decision making and decision support. The ES is a well-known decision support method of using knowledge-based heuristic rules, typically with symbolic literal inputs, and needs no further introduction here. The analysis of the messages and the reporting of the anomalies to the ES is often performed by intelligent agents that monitor the supply chain processes and issue alerts when unexpected events occur.

Uncertainties are inherent in a supply chain, and more so in a global supply chain. The supply chain uncertainty could be from demand side, supply side, or internal operational processes. Examples of the risks from demand side include demand forecast errors, canceled orders, order increase due to promotion, and demand decreases due to the introduction of new product. Examples of risks from supply side include supply disruptions, delivery delay, and quality issues. There are internal risks that include internal operations breakdowns, and quality issues.

In this paper, we will focus on the demand risk management because typically demand uncertainty accounts for 60% of total supply chain uncertainty. We demonstrate the construct of a simulation framework for SCEM in the electronics industry and present the implementation platform. It is well-known that it is typical for an electronics distributor to have a large number of products with rather short life cycles. For products with short life cycle or sometimes referred to as perishables, the costs of mismatch between supply and demand are very high because mismatch can lead to either lost sale or inventory leftover with little salvage value. In addition, the expected mismatch cost increases in demand variability (Cachon and Terwiesch, 2009). Typically, the customer demands for electronic products have large variability, and are thus hard to predict. In addition, when electronic products are supplied by vendors globally, the electronics distributor has very complex supply chain. The process of managing the supply chain and the different types of risks is a sizeable challenge to large electronic distributors (Raman and Ton, 2005).

Simulation plays an important role in practical applications of supply chain event management. However, the traditional simulation models focus on the static information and on modeling based on static information, and are thus unable to respond to risks that occur in real time. The failure of this type of simulation model is that these are designed without an intelligent component, and are therefore neither flexible nor reusable (Hung et al., 2004). Because of the dynamics of the hi-tech supply chain and the lack of intelligence, this type of simulation only can be used once, and has to be frequently redesigned (Yu et al., 2000).

In order to improve the model’s effectiveness and efficiency, it is very important for a simulation framework to be designed for intelligence, thus the simulation model can be integrated with current information systems, such as data warehouse
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