Chapter XII
Modeling and Coordination of Dynamic Supply Networks

Petr Fiala
University of Economics Prague, Czech Republic

ABSTRACT

The chapter is devoted to modeling and analysis of supply systems. Supply chain management is more and more affected by network and dynamic business environment. In supply chain behavior there are inefficiencies. Coordination and cooperation can significantly improve the efficiency of supply networks. There are some approaches to model and analyze the supply dynamics. Important features of this environment are established in the proposed approach. The combination of network structure modeling and simulation of dynamic behavior of units in supply network can be a powerful instrument of performance analysis of supply networks. The problem of coordination in dynamic supply networks involves multiple units with multiple goals. Multicriteria analysis of supply network performance includes such criteria as quantity, quality, time, cost, and profit. Simulation approach is an appropriate tool for prediction of real supply situation.

INTRODUCTION

The globalization and technology improvement has changed the business environment. It became more complex and dynamic, but one consequence is that organizations are making efforts to deal with the increasing challenges and to stay competitive. Production will need to find a new role in an extended form with supply and distribution networks (e.g., Vidal & Goetschalckx, 1997). It is necessary to redefine the boundaries of manufacturing and production management. Supply chain management is a philosophy that provides the tools and techniques enabling organizations to develop strategic focus and achieve sustainable competitive advantage. It presents management

with a new focus and way of thinking about how their organization exists and operates within the wider business environment.

Computational intelligence refers to intelligence artificially realized through computation. It has produced a number of powerful tools, some of which are used in engineering to solve difficult problems normally requiring human intelligence. Manufacturing applications play a leading role in modern economics. There are recent advances on the computational intelligence applications in manufacturing, including system design, process planning, process monitoring control, product quality control, and equipment fault diagnosis.

The chapter is devoted to modeling and analysis of supply systems. Supply chain management is more and more affected by network and dynamic business environments. Networking transforms static and isolated resources in a pool of dynamic and connected resources. A network is the infrastructure that allows the information interchange between different points. In supply chain behavior there are inefficiencies. The relation between supply chain management and information and communication technology is key to the development of an integrated supply chain. Fundamental to this approach is the application of appropriate information technologies to facilitate the efficient and effective movement of goods, services, and information along the supply chain. Coordination and cooperation can significantly improve the efficiency of supply networks.

In this chapter, we present applications of computational intelligence to modeling and analysis of supply systems. There are some approaches to model and analyze the supply dynamics. Important features of this environment are established in the proposed approach. The combination of network structure modeling and simulation of dynamic behavior of units in supply network can be a powerful instrument of performance analysis of supply networks. The problem of coordination in dynamic supply networks involves multiple units with multiple goals. Multicriteria analysis of supply network performance includes such criteria as quantity, quality, time, cost, and profit. Simulation approach is an appropriate tool for prediction of real supply situation. Sourcing has come up as a strategic issue in the management of supply chain networks in the modern era of global competition. Modeling framework is demonstrated on solutions of supplier selection problems. The proposed approach can be completed with a three-layer framework for modeling of coordination process of units in the dynamic supply networks. The modeling framework is composed from three inter-related network structures: flow net, Petri net, and neural net.

DYNAMIC SUPPLY NETWORKS

Supply chain management has generated a substantial amount of interest both by managers and by researchers. Supply chain management is now seen as a governing element in strategy and as an effective way of creating value for customers. There are many concepts and strategies applied in designing and managing supply chains (Simchi-Levi, Kaminsky, & Simchi-Levi, 1999). The expanding importance of supply chain integration presents a challenge for research to focus more attention on supply chain modeling (Tayur, Ganeshan, & Magazine, 1999). Supply chain management is more and more affected by network and dynamic business environments. The overall business environment is becoming increasingly dynamic. Demand and supply for custom products can be very dynamic. Supply chains operate in network environment as supply networks. Dynamic information and decision-making models are called to accommodate this new changes and uncertainties.

Supply networks are dynamic multilevel systems with sets of suppliers, manufacturers, distributors, retailers, and customers. The multiple decision makers are interconnected with dynamic structures and dynamic linkages by