6 Designing and Modeling Agile Supply-Demand Networks

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Abstract
Online, on-demand and real-time availability of information to all members of a manufacturing system enables them to be agile and in the best position to react quickly, efficiently, synchronously, and collectively to the changing market. This chapter proposes a design and modeling tool for Agile Supply-Demand Network (ASDN) design. The software is open source and freely available for research and commercial uses. It supports modeling, analyzing and limited optimizing of supply-demand networks. Also the network level logistics analysis that is behind the modeling tool is discussed.

Keywords
Agile manufacturing, Global manufacturing, Logistics information systems, Supply-demand networks

6.1 Introduction
“Supply-demand network” is a relatively new term in the field of supply chain management. It stresses the fact that relationships between different supply, manufacturing and distribution units are more complex than in a supply chain. The supply-demand network perspective has evolved out of two distinct streams: descriptive research on industrial networks, which has provided a general understanding of complex buyer-supplier relationships, and prescriptive research on supply chain management. The latter has been evolving gradually since the 1960s by increasing the scope of academic and managerial attention from a company’s internal chain, through dyadic and second-tier relationships, to supply chains in the late 1980s and recently to supply-demand networks. The supply-demand network perspective reflects a general shift in supply chain management from operational to strategic decision-making (Harland et al., 2001). The strategic level of supply chain management includes decisions on the number and location of companies in each tier, choice of transportation channels, and management of information along the supply-demand network. It has been recognized by practitioners that a great share of supply chain costs are locked in supply-demand network design. Therefore, it is
necessary to pay more attention to strategic decision-making regarding the supply-demand network structure.

According to the design school of strategic management, the organizational structure should follow the strategy. It seems it will not be a mistake to apply the same logic to supply chain management and say that the supply-demand network structure should follow the company’s supply chain strategy. There are many papers that focus on either supply chain strategies or supply-demand network structures. The former usually focus on a specific type of strategy. The latter present models developed mostly in operational research under the rubric of supply-demand network design. Those models seek to find the optimal (or nearly optimal) solution for an objective function and rather facilitate supply-demand network strategic decision-making than discuss supply-demand network structure per se. A coherent discussion of supply-demand network structures is missing in the literature.

The scope of this chapter is to clarify the current situation of the supply-demand network by presenting a modeling tool that helps determining customer demand, inventory levels, lead-times, and routes. A typical industry problem could be stated as: How to develop lead-time and reduce inventory levels in complex global supply-demand networks? This problem may be broken down into the following sub-problems:

- Which node has the biggest impact on the supply-demand network in terms of improvement potential?
- How can the performance of the chain be optimized based on customer demand and service level?
- How can the improvement be measured and verified in financial terms?

In order to answer these questions, an open source software tool is presented in this chapter. The software helps to analyze the structure and performance of dispersed networks and estimate the value of improvement potential. This chapter presents an overview and puts together several supply chain strategies and their decision determinants. Then a discussion of different structures that facilitate implementation of the strategies follows.

6.2 Supply Chain Strategies and Their Decision Determinants

According to Hicks (1999, p. 26) the aim of strategic planning in supply chain management is “to arrive at the most efficient, highly profitable supply chain system that serves customers in a market”. Some markets exhibit similar properties. For example, on some markets the demand is stable, whereas on others it is volatile. On some markets customers value low costs, but on others they prefer a high service level. This grouping suggests that markets with similar properties may require similar strategies. These generic strategies are discussed below.

Supply chain management is the management of five processes that link companies in supply-demand networks: plan, source, make, deliver, and return (Supply Chain Council, 2008). Two groups of supply chain management strategies are recognized: postponement/speculation and leanness/agility strategies (Helo, 2006).