Chapter 9
Supply Chain Design Approaches for Dual Demand Management Strategies

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ABSTRACT

Supply chain management involves efficiently integrating suppliers, manufacturers, warehouses, stores, and customers. To survive in a highly competitive business environment, manufacturing, resource planning and scheduling and distribution operations are the significant drivers that need to be optimized within supply chain management. In this chapter, we design the supply chain system considering dual demand management strategies simultaneously for the same company, both engineer-to-order (ETO) and make-to-order (MTO). This research has been inspired from the window manufacturer which manufactures and distributes vinyl windows to meet new construction and replacement/remodeling sector demand in the State of Ohio. The company manufacturers windows based on make-to-order strategy for new construction projects and at the same time builds replacement windows to individual customer specifications in very small quantities to be used for replacement in homes. In this study, a total of 174 individual customers and six big contractors are considered throughout the State of Ohio. This paper proposes to separate products based on demand management strategy and develop different supply chain networks for each group. The idea is to design bigger facilities for high volume (make-to-order products) as transportation cost per unit is reduced due to economies of scale whereas to place smaller and more facilities for low volume engineer-to-order products to be closer to the clients where it may not feasible to carry a only few products over long distances. All in all, this study provides nested models to integrate both design and operational aspects of supply chain system in the presence high-volume and low-volume of window products. Moreover, all location, design and manufacturing operations are performed by considering

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new mathematical models (mixed-integer and integer mathematical models) and heuristics in engineer-to-order demand management environment. Normally-distributed, probabilistic demand environment is considered in our design and operational phase of the study. Preliminary results show that, each design has its own strategic advantage and outcome and the ultimate objective has been accomplished in our design in this study. Briefly, four manufacturing facilities are established to meet the demand of replacement/remodeling sector and two manufacturing facilities are situated to meet the demand of new construction sector. The results revealed that, 29 layered-cells and a total of 200 machines are opened and utilized for replacement/remodeling sector. Additionally, 15 layered-cells and a total of 104 machines are needed to cover the entire demand of new construction sector. Also for the new construction sector, three distribution centers are needed to facilitate the products over the region. In terms of daily cell loading and scheduling phase, the results are almost doubled in replacement/remodeling sector demand compared to new construction sector demand volume due to having more cells and machines in the new construction design strategy. The supply chain work involves location and number of manufacturing facilities, number and location of distribution centers, detailed design of manufacturing systems and performing scheduling to confirm the validity of the manufacturing system design.

1. INTRODUCTION

Supply chain management (SCM) is described as a "set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses, and stores, so that merchandise is produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimize the systemwide costs while satisfying service level requirements" (Simchi-Levi, 2009).

Simchi-Levi (2009) emphasizes that the objective of supply chain management is to be efficient and cost effective across the entire system. The overview of a supply chain system is illustrated in Figure 1.

Chopra (2007) indicated supply chain network design decisions that include the assignment of facility role, location of manufacturing, storage, or transportation-related facilities and the allocation of capacity and markets to each facility. In this dynamic supply chain, facility location decisions have significant impact on the performance of supply chain (Simchi-Levi, D., 2009). Thus, multiple factors such as distance, transportation cost, land cost, plant capacities and customer demands are considered for the facility location and capacity allocation model in this study.

1.1. Challenges of Supply Chain Network Design

To survive in a highly competitive business environment, manufacturing and distribution operations are the two significant drivers that need to be optimized within supply chain management. To achieve operational excellence in a supply chain, it is critical to integrate these two operations jointly and schedule them accordingly in a coordinated fashion. However, due to the highly dynamic market, it is not that easy for the companies. Due to fierce competition and globalization, overall demand keeps increasing and demand uncertainties become a prominent issue. In order to compensate that, companies start to build more safety stock and hold excess capacity that negatively affects the costs. In both manufacturing

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