Flexibility Considerations for Supply Chain

Abstract

Flexibility has always been considered a highly valued capability by the business firms all over the world. Broadly, it can be defined as the ability of a system to adapt to different kinds of uncertainty and environmental changes. Flexibility in the field of operations management is a well-explored area. For a long time, the notion of flexibility in operations management was limited to manufacturing. Depending on the manufacturing context various notions of manufacturing flexibility have been proposed such as process flexibility, machine flexibility, volume flexibility etc. With the increased relevance of the supply chain management in the last two decades, the notion of supply chain flexibility (SCF) has gained its popularity. Various notions of SCF corresponding to different parts of a supply chain are evolving with time such as product flexibility, logistics flexibility, information systems flexibility etc.

The present work deals with issues of flexibility in operations management. The work can be broadly divided into two parts viz., issues related to replenishment flexibility (Chapters 3 & 4) and issues in manufacturing flexibility (Chapters 5,6, & 7).

The first part focus on the issue of replenishment flexibility in a single supplier multiple retailers VMI supply chain. One of the market uncertainty in this context is

in terms of the heterogeneity among retailers that gets changed every time the number/type of retailers gets added/removed from the network. The existing replenishment policies have not been designed keeping this in view, and as such may result in higher system cost under different retailer configurations. In this regard, we propose two flexible policies viz., Periodic Non-Nested policy and Integer Ratio Policy for the VMI context. The policies are relevant for the successful implementation of VMI practices in real life while preserving the benefits of the supplier and the retailers (irrespective of size) in every possible heterogeneous VMI scenario.

The other part of the thesis deals with the various manufacturing flexibility strategies used under different environments for reducing the supply-demand mismatches (SDM). One of the primary goals of a supply chain operating in the uncertain supply-demand scenario is to reduce the SDM associated costs. Low SDM cost is a good indication of effective and well-managed supply chain, and hence, a significant portion of the company's initiatives revolve around this goal, especially for those operating in an uncertain environment. From managerial perspective it becomes important to determine the appropriate flexibility investment in manufacturing to reduce SDM. We consider flexibility investment strategy for both price setting as well as price taking firms. The work is particularly linked to three flexibility tools viz., process flexibility, modular product architecture and dynamic pricing.

The first two works (chapter 5 & 6) in this regard are related to the manufacturing flexibility strategies for the price taking firms, particularly the manufacturing start-ups. We try to study the benefits realized by the process flexibility structure of a firm in the presence of modular product architecture. The results show that for a given

process flexibility structure, production policy with modular product architecture minimizes the SDM cost more as compared to that with integrated architecture. Another important result is the reduced requirement for the number of process flexibility chains under the modular product architecture. The results are very relevant given the expensive activity of investing in process flexibility structures.

The last work (chapter 7) is related to the flexibility strategies for the price-setting firms. We try to study the impact on the dynamic pricing strategy of a firm (with a given process flexibility structure) under the presence of the modular product architecture. The result shows that the price difference between the products remains constant for a larger initial state space region in the presence of modular product architecture than in the case of integrated architecture.