2nd National Conference on Industrial Engineering & Systems
Islamic Azad University, Najafabad Branch
25-26 February 2014

Production-distribution planning in a supply chain considering disruption and resilience factors

Seyed Mohammad Khalili, Fariborz Jolai, Maziyar Yazdani, Morteza Shiripour

Department of Industrial Engineering, College of Engineering, University of Tehran, Iran

Abstract

Nowadays resilience has become a critical aspect of infrastructures. Supply chains have been increasingly exposed to the risk of unpredicted disruptions causing significant economic forfeitures. At the same time, the existing literature features a limited number of studies, which consider resilience of facilities for improving production-distribution network ability. In this paper, we expand on traditional integrated production-distribution models by including pre-disruption investment options, in addition to post-event recovery activities, as means to network resilience. The network under consideration includes three layers; manufacturing sites, distribution centers and customers' zones. The problem is formulated as a three objectives stochastic optimization model. The model minimizes total expected cost and worst-case cost as well as maximizes the resilience of the production-distribution network simultaneously. The model seeks investment-recovery combinations that optimize the overall resilience of the production-distribution networks. In this study the Reservation Level driven Tchebycheff Procedure (RLTP) which is one of the reference point methods, is used to find the non-dominated solutions of our model. To approve the capability of our model a set of numerical experiments illustrates how changes to disruption scenarios probabilities affect the optimal resilient design investments.

Keywords; Production-distribution, Resilience, Conditional value-at-risk, Mixed integer programming.

1- Introduction

A supply chain can be defined as an integrated process, which includes a group of organizations, such as suppliers, producers, distributers and retailers that work together to acquire raw materials and converting them into products, which are distributed to the retailers (Mula et al., 2010). Over the past decades, growth in global trade has witnessed. According to economically well-connected world, exposes firms to multiple and high magnitude risks (Kouvelis et al., 2011). The normal set of business risks is expanded as firms are now often facing unfamiliar events like uncertain demand and supply markets, unanticipated commodity price shocks and currency exchange rate fluctuations. Also previously perceived unusual business risks, such as unexpected supplier bankruptcies in a turbulent global economy, and supply disruptions as a result of physical disasters and terrorist attacks, have been intensified and cannot be neglected any longer, as the frequency of these events has been increasing and threatening business continuity. The supply chain risk management framework has two stages: a planning stage and an execution stage (Kouvelis et al., 2011). In the planning stage, carefully proactive actions and thought-full plans should be put in place to ensure business continuity and to sustain profitability in the event of an undesirable scenario. The main actions encompasses identifying the prospective supply chain risks, assessing the likelihood of risk occurrence and the severity of consequences, and devising risk mitigation plans and putting counter measures in place to avoid or reduce the probability of risk events and to reduce the damages/disruptions to the supply chain. In this paper network resiliency is increased by regarding three related capabilities – providing absorptive capacity so that the network can withstand disruptions, providing adaptive capacity so that flows through the network can be accommodated via alternate paths and providing restorative capacity so that recovery from a disruptive event can be accomplished quickly and at minimum cost. There is considerable literature on system recovery in networks aftermath of a disruptive event. As a few samples, see the works of (Xu et al., 2006) on electric power restoration, (Clausen