Strategic Supply Chain Network Optimization : Integrating Risk Management

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Abstract

In today's increasingly globalized and competitive environment, supply chains (SCs) are susceptible to vulnerability and the occurrence of risk events. Managing the supply chain network design (SCND) efficiently becomes crucial in navigating the complexities of the involved network. This paper introduces a mixed-integer linear programming (MILP) model for the SCND problem, addressing economic, environmental, and risk objectives. Economic objectives are considered by minimizing the overall costs of the entire SC. The environmental aspect is integrated by incorporating gas emissions into the SCND, emphasizing sustainability. Given the sensitivity of the network to risks and disruptions, the paper incorporates risk modeling into the SCND model. The objective is to develop a model that strives to find a balance between the total costs associated with the SCN, encompassing disruption risk costs that may occur in one or more nodes of the SCN.To evaluate disruption risks, a Bayesian Belief Network (BBN) model has been developed to predict and assess the marginal probabilities of risk factors and sub-factors. Belief propagation analysis is employed and applied in an automotive case study to derive meaningful managerial insights, identifying the most sensitive factors and sub-factors impacting the SC. The findings underscore the utility of the BBN model in pinpointing factors and their sub-factors with the greatest impact on SC disruption risks. The proposed model serves as a tool for managers to predict disruption risks, formulate mitigation strategies, and develop strategic plans to effectively manage disruption risks and damages associated with SCND.

Keywords: SC network design, Risk management, SC network design, SC risk management, SC sustainability.