

## The Importance of Downstream Supply Chain in Supply Chain Risk Management: Multi-Objective Optimization

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**Abstract :** One of the efficient ways in supply chain risk management is avoiding the interruption in Supply Chain (SC) before it occurs. Although the majority of the organizations focus on their first-tier suppliers to avoid risk in the SC, studies show that in only 60 percent of the disruption cases the reason is first tier suppliers. In the 40 percent of the SC disruptions, the reason is downstream SC, which is the second tier and lower. Due to the increasing complexity and interrelation of modern supply chains, the SC elements have become difficult to trace. Moreover, studies show that there is a vital need to better understand the integration of risk and visibility, especially in the context of multiple objectives. In this study, we propose a multi-objective programming model to avoid disruption in SC. The objective of this study is evaluating the effect of downstream SCV on managing supply chain risk. We propose a multi-objective mathematical programming model with the objective functions of minimizing the total cost and maximizing the downstream supply chain visibility (SCV). The decision variable is supplier selection. We assume there are several manufacturers and several candidate suppliers. For each manufacturer, our model proposes the best suppliers with the lowest cost and maximum visibility in downstream supply chain. We examine the applicability of the model by numerical examples. We also define several scenarios for datasets and observe the tendency. The results show that minimum visibility in downstream SC is needed to have a safe SC network.

**Keywords :** downstream supply chain, optimization, supply chain risk, supply chain visibility

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