A Fault Tree Based Approach for Supply Chain Risk Assessment

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Abstract

Supply chains are increasingly exposed to uncertainties arising from supplier unreliability, demand variability, transportation disruptions etc., which significantly affect delivery performance. Fault Tree Analysis (FTA) provides a structured and quantitative approach to analyze such disruptions by identifying root causes and evaluating their combined impact on system-level failures. FTA is a systematic, top-down risk analysis technique used to identify and evaluate the causes of system failures. It models logical relationships between events and quantifies failure probabilities, supporting effective decision-making, reliability improvement, and risk mitigation in complex systems. In this study, we present a simple and lucid example of analysing the risk in a single stage, supply chain. An example of FTA to quantify the risk of "failure to deliver products on time" is considered for illustration purpose. This top event is decomposed into major intermediate events such as a) inventory stockout and b) transportation delay etc. Inventory stockout may further be attributed to events such as supplier delay and forecasting error etc, while transportation delay may arise because of vehicle breakdown and traffic congestion etc. Logical gates are used to model the relationship between events, hence reflecting occurrence of any contributing factor can lead to higher-level failure. The findings demonstrate the ranking of various issues that contribute significantly to delivery failure. This enables managers to prioritize mitigation strategies such as improved route planning, enhanced logistics coordination etc. Overall, the study illustrates FTA as an effective for supply chain risk management, allowing organizations to move from reactive problem solving toward proactive risk mitigation and improved delivery reliability.

Keywords

Supply chain uncertainty, Fault tree analysis, Risk assessment, Mitigation.