

Chapter 21

Quantitative Risk Management Models for Newsvendor Supply Chains

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ABSTRACT

As the practices of offshoring and outsourcing force the supply chain networks to keep on expanding geographically in the globalised environment, the logistics processes are becoming more exposed to risk and disruptions. Thus, modern supply chains seem to be more vulnerable than ever. It is clear that efficient logistics risk and security management emerges as an issue of pivotal importance in such competitive, demanding and stochastic environment and is thus vital for the viability and profitability of a company. In this context, this chapter focuses on a set of stochastic quantitative models that study the impact of one or more supply chain disruptions on optimal determination of single period inventory control policies. The purpose of this research is to provide a critical review of state-of-the-art methodologies to be used as a starting point for further research efforts.

INTRODUCTION

During the last decade globalization has provided new challenges for supply chain management and the logistics industry. As the practices of offshoring and outsourcing force the supply chain networks to keep on expanding geographically in the globalized environment, the logistics processes are becoming more exposed to risk and are ever more prone to disruption. Almost all industries strive

for making their business processes and supply chains either more efficient or more responsive by outsourcing many core business activities, like transportation, warehousing, research and development (R&D), etc. Although these initiatives have great potential to make operations agile, leaner and more efficient in a low risk and variability environment, at the same time they tend to increase the vulnerability of supply chains to disruptions. However, the traditional decision-making processes and software tools used most often by industry and the methodological models

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and the paradigms covered by academia, in many cases, have been proven quite incapable of addressing satisfactorily many relevant practical real-world risk management supply chain and logistics issues.

Thus, it is clear that efficient logistics risk and security management emerges as an issue of pivotal importance in such competitive, demanding and stochastic environment and is thus vital for the viability and profitability of a company. The explosion in long distance sourcing and supply is exposing supply chains and shareholder value at ever increasing risks. The development of new methodologies that would attempt to combine acceptable logistics security protection with acceptable efficiency, while attaining an acceptable economic value added would be of great merit. Moreover, it is important to consider the entire supply chain, across all countries, when selecting and implementing risk-management strategies, as it is highly possible that an event affecting one supply chain entity or process may interrupt the operations of other supply chain partners.

Recent trends in managing global supply chain risks focus on the development of robust (effective performance for a range of operations risks) and resilient (quick to recover from disruption) supply chain systems. However, there is still a clear lack of contingency strategic policies and the appropriate analytical methodologies for the determination of their optimal parameters, when considering the different modes of disruptions in a supply chain. Definitely, risk management is a decision making process that needs extensive decision analysis in order to reach effective and applicable results. In fact, sometimes the process is so complicated, that not only a single technique but a set of quantitative methods is needed for selecting the best course of action among several alternatives. Several of these methods are widely used and an extensive classification according to the type of application, industry, problem formulation, desired output, perspective, disruption, information, etc. is beyond the purposes of this chapter.

In this context, this chapter examines supply chain management methodologies that quantify the impact of supply disruption on optimal determination of inventory control policies for stochastic environments; thus capturing the trade-off between inventory policies and disruption risks for supply networks with unreliable sourcing. Specifically, this chapter first provides a review and a new classification of related literature, combining the traditional inventory control policies with the new research field of methodologies based on game theory. Then, the chapter focuses on single period (newsvendor-type) problems and analyzes specific typical methodologies for systems with multiple unreliable suppliers due to production or distribution disruptions. The reason for narrowing down the chapter scope is on one hand that single period models can be used for inventory decision-making for a wide range of SKUs ranging from high tech items (with limited shelf life due to obsolescence) to fashion items of limited life (“one shot deals” in the retailing business) and on the other that it is not possible a single chapter to cover typical methodologies for all the paper appear in the literature review.

Thus, the contribution of this research is two-fold: first to provide a critical review of general state-of-the-art quantitative methodologies in the research area under study and then, to demonstrate typical models for single period systems that can be used as a starting point for further research efforts. Moreover, the discussion of the most popular methods for supply chain risk management can be a practical guide to mitigate risks.

The chapter content is organized as follows: the following Section presents the current environment of supply chain risk management, the types of interventions for reducing vulnerability of supply chains and improving their resilience and a review and taxonomy of the up-to-date literature. Selected single period supply chain risk management problems are discussed in Section 3 together with their solution methodologies. Finally, the last Section summarizes the content of this work and provides future research directions.

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