

# Chapter 10

## Supply Chain Risk Management

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### ABSTRACT

*During the past two decades, environments surrounding supply chains (SC) have faced many changes, which require SC managers to deal proactively with unknown situations and new risks. Therefore, one of the most important issues in supply chain management is managing uncertainties of a SC and mitigating negative effects of SC risks. In this chapter, an overview of supply chain risk management (SCRM) is given. First, fundamental concepts in SCRM are introduced. Next, sources of SC risks, SCRM and its process, and some robust SC risk mitigation strategies are introduced. Finally, an introduction to several mathematical models for SCRM is given.*

### INTRODUCTION

Risk is a familiar issue for anybody with unpleasant experiences in life such as arriving late to a conference due to a delay in the flight schedule, losing money on a bet, losing one's life savings in a bad investment, or even a rainy weather on the day of an outdoor wedding. In day-to-day life, one might employ different measures to deal with the aforementioned risks such as diversifying one's stock portfolio in the investment case or renting a big tent in the wedding case. Although

risk is a common concept for ordinary people and usually associated with uncertainty, however, understandings of various people from risk differ greatly from each other's. Oxford online dictionary defines risk<sup>1</sup> as a situation exposing someone or something to danger. This definition is based upon a negative understanding of risk, as one will suffer from the risk consequences. As you have possibly heard, one might say, "I'm going to take a risk and bet all my money on that desperate horse." Here, he is hoping to gain a profit from the inherent uncertainties of a horseracing event. Therefore, if he is lucky enough, he might win a lot of money, otherwise he would just lose all

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his money. Therefore, a better common definition of risk seems to be the fluctuations in the result of an event. Here, it must be noted that a common misconception about risk is considering risk and uncertainty to be equal. Uncertainty is the lack of knowledge about the possible outcomes of an event in the future. However, risk is an outcome of uncertainty and it might be positive or negative from the affected/observer's viewpoint. In the horseracing betting case, if you do not bet on any horse in a specific race, you are risk-free considering all the possible outcomes of the race. However, if you bet, you might win or lose money according to your bet money and the race result.

Putting aside the day-to-day examples of risk, risk has greater meaning and effects on a business and its continuity. If a business is not capable of dealing with various types of risks it is exposed to, it might fail after a short period. Examples of risk in a business environment include but are not limited to shortage of raw materials, increase of raw material purchasing prices, decrease of product market prices, lack/excess of demand, labor unions strike, and so on. One must note there is an important difference between methods of dealing with risk in personal life and business environment. Contrasting the horseracing case, business managers usually try to minimize the negative effects of risk, as it is far more important to survive the competition than to make a sudden fortune after a risky decision. The only exceptions are financial institutions, which their foundation of their business is based on taking risks. Although, modern financial engineering techniques are devised to deal with these risky decisions analytically.

Nowadays, along with recent developments in technology, business structures and practices are moving toward increased dynamism and changes in all their aspects, which accelerate and intensify rates and effects of these changes on a business. Supply chains (SC) are no exception, and unsurprisingly they face these changes (i.e. risks) during their lifetime. Risks in a supply chain are the possible changes in the potential output of its

different stages, which usually reduce the value added of the SC members. The most important types of supply chain risks are supply, demand, quality, process, and environment risks (Tang, 2006a).

As stated by Waters (2007), the main challenge of supply chain risks is that they might occur in so various and diverse forms. The diversities of risks include point of occurrence in the supply chain (e.g. affecting limited member of the SC or the whole SC), types of risks (e.g. supply, demand, quality, and so on), origin of risk (e.g. failure of supplier to deliver on time or a natural disaster), and intensity of risk with short-term or long-term effects. There are many examples in the supply chain management (SCM) literature where companies were affected with the huge negative effects of risk. For example, in 1998, Dole revenue declined after Hurricane Mitch destroyed their banana plantations. Ford was forced to shut down five plants after the September 11 event. Many hardware manufacturers such as Dell, Apple, and IBM suffered greatly from lack of supply due to the power shortage in the semiconductor plants after the 1999 Taiwanese earthquake halting production of memory chips, circuit boards, flat-panel displays, and other computer components. A Motorola cell phone factory in Singapore closed after an employee came down with SARS. Finally, Ericsson suffered a huge loss after a fire in the Philips chips manufacturing plant in Albuquerque, New Mexico due to a thunderstorm. See Martha and Subbarkrishna (2002) and Monahan, Laudicina, and Attis (2003) for more details on examples of risks effects on supply chain performance.

For dealing with the above risks or other similar ones, a branch of SCM has emerged during the last decade known as the supply chain risk management (SCRM). SCRM is the management of external and internal supply chain risks through a coordinated approach between supply chain members to reduce supply chain vulnerability. This is done by identifying, assessing, prioritizing, and eliminating or mitigating SC risks and

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