

Chapter 7

Strategic Approaches for Mitigating Supply Chain Risks

Abstract While many companies recognize serious supply chain risks, they also acknowledge that their actions for managing these risks are not commensurable in part because they find it difficult to justify costly strategies for mitigating potential supply chain disruptions that have occurred rarely in the past and may not occur again in the foreseeable future. Hence, to encourage a firm to adopt supply chain risk mitigation, the supply chain strategies need to be “robust” in the following sense: These strategies should help to efficiently manage the “normal” risks or fluctuations inherent in matching supply and demand and should also help the supply chain become more resilient in the face of “abnormal” risks, i.e., disruptions. This chapter presents various robust supply chain mitigation strategies that many firms have adopted in managing their supply chain risks.

7.1 Introduction

In part I (Chapters 1–6), we presented a general risk management framework (identify, assess, mitigate, and respond) and basic approaches for managing supply chain risks. In this part (Chapters 7–12), we discuss different mitigation approaches that are supply-chain specific (Chapters 7 and 8) and describe how these approaches can be implemented by companies who face different types of supply chain risks (Chapters 9–12).

This chapter presents supply chain risk mitigation strategies that are “robust” in the following two senses: First, these strategies enable a supply chain to manage the “normal risks” or fluctuations inherent in matching supply and demand efficiently. Second, these strategies can help make a supply chain become more resilient in the face of “abnormal risks”, i.e., major disruptions. To be sure, a company implementing these strategies will incur costs but the upside may be additional revenues by acquiring and retaining customers apprehensive about supply chain risk, especially after a major disruption.

Consider the following three well-cited examples in this context, all showing how these companies—Nokia, Li and Fung and Dell—were able to leverage their supply chain strategies to react quickly to disruptions, thus enjoying long-term sales growth as a result:

1. Nokia changed product configurations in the nick of time to meet customer demand during a supply disruption. Both Ericsson and Nokia were facing a shortage of a critical cellular phone component (radio frequency chips) after a key supplier in New Mexico (Philip's semiconductor plant), caught on fire during March of 2000. Ericsson was slow in reacting to this crisis and lost 400 million euros in sales. In contrast, Nokia had the foresight to design their mobile phones based on the modular product design concept and to source their chips from multiple suppliers. After learning about Philip's supply disruption, Nokia responded immediately by reconfiguring the design of their basic phones so that the modified phones could accept slightly different chips from other Philip's plants and from other suppliers. Consequently, Nokia satisfied customer demand smoothly and obtained a stronger market position (Hopkins, 2005).
2. Li and Fung changed its supply plan rapidly to meet customer demand during a currency crisis. When Indonesia Rupiah devalued by more than 50% in 1997¹, many Indonesian suppliers were unable to pay for the imported components or materials and hence, were unable to produce the finished items for their U.S. customers.² This event sent a shock wave to many U.S. customers who had outsourced their manufacturing operations to Indonesia. In contrast, The Limited and Warner Bros. continued to receive their shipments of clothes and toys from their Indonesian suppliers without noticing any problem during the currency crisis in Indonesia. They were unaffected because they had outsourced their sourcing and production operations to Li and Fung, the largest trading company in Hong Kong for such durable goods as textiles and toys. Instead of passing the problems back to their U.S. customers, Li and Fung shifted some production to other suppliers in Asia and provided financial assistance such as line of credit, loans, etc., to affected suppliers in Indonesia to ensure that their U.S. customers would receive their orders as planned³. With a supply network of 4,000 suppliers throughout Asia in 1997, Li and Fung were able to serve their customers in a cost-effective and time-efficient manner. This capability has enabled Li and Fung to grow nearly 25 times from 5 billion Hong Kong dollars in revenues in

¹ Indonesia Rupiah opened the year 1997 at 2363 to the US dollars and closed at 5550 against the dollar. However, in July 1997, Indonesia Rupiah was traded at 10,000 against the US dollars.

² The currency crisis affected Indonesia in a very serious manner in 1997. For instance, Indonesia's national car manufacturer, Astra, suspended their production because they were unable to pay for imported components. Also, 60% of Jakarta's public transport system was suspended, because of the soaring price of the spare parts needed to repair the city's buses. Moreover, 40% of the country's 1500 chemical plants were forced to halt production because of the soaring cost of imported raw materials.

³ Huchzermeyer and Cohen (1996) develop a quantitative model to analyze the value of flexible supply base under uncertain exchange rate.

1993 to 124 billion HK\$ (US \$16 billion) in 2010.⁴

3. Dell changed its pricing strategy just in time to satisfy customer during supply shortage. After an earthquake hit Taiwan in 1999, several Taiwanese factories informed Apple and Dell that they were unable to deliver computer components for a few weeks. When Apple faced component shortages for its iBook and G4 computers, it encountered major complaints from customers after it tried to convince customers to accept a slower version of G4 computers. In contrast, Dell's customers continued to receive Dell computers without even noticing any component shortage problem. Instead of alerting their customers to shortages of certain components, Dell offered special price incentives to entice their on-line customers to buy computers that used components from other countries. The capability to influence customer choice enabled Dell to improve its earnings in 1999 by 41% even during a supply crunch (cf. Martha and Subbakrishna, 2002; Veverka, 1999).

Thus, Nokia's, Li and Fung's and Dell's supply chains are not only resilient to major disruptions but are also efficient in responding to normal fluctuations. These companies have created these supply chains following different robust supply-chain strategies.

7.2 Robust Supply Chain Strategies

Supply chain issues can be generally classified into two major categories: supply related, and demand related. Supply related issues include supplier selection, supplier relationship, supply planning, transportation and logistics, etc., while demand related issues include new product introduction, product line management, demand planning, product pricing and promotion planning, etc. Keeping this in mind, we now describe eleven different robust supply-chain strategies that aim to improve a firm's capability to better manage supply and/or demand under normal circumstances and to enhance a firm's capability to sustain its operations when a major disruption hits. Table 7.1 summarizes the key features of these nine robust supply chain strategies.

1. Postponement

Postponement uses product or process design concepts such as standardization, commonality, modular design, and operations reversal, to delay the point of product differentiation. This strategy enables a firm to first produce a generic product based on the total aggregate forecasted demand across all products in a family, and then

⁴ Li and Fung, annual report, 2010.

Table 7.1 Robust Supply Chain Strategies

<i>Robust Supply Chain Strategy</i>	<i>Main Objective</i>	<i>Benefit(s) under normal risk: Improves the company's capability to manage...</i>	<i>Benefit(s) under abnormal risk, i.e., after a major disruption: Enables the company to..</i>
1 Postponement	Increases product flexibility	Supply	Change the configurations of different products quickly
2 Strategic stock	Increases product availability	Supply	Respond to market demand quickly during a major disruption
3 Flexible supply base	Increases supply flexibility	Supply	Shift production among suppliers promptly
4 Make-and-Buy	Increases supply flexibility	Supply	Shift production between in-house production facility and suppliers rapidly
5 Economic supply incentives	Increases product availability	Supply	Adjust order quantities quickly
6 Flexible transportation	Increases flexibility in transportation	Supply	Change the mode of transportation rapidly
7 Revenue management	Increases control of product demand	Demand	Influence the customer product selection dynamically
8 Dynamic assortment planning	Increases control of product demand	Demand	Influence the demands of different products quickly
9 Silent product rollover	Increases control of product exposure to customers	Supply and demand	Manage the demands of different products swiftly
10 Flexible supply contracts	Increase replenishment flexibility	Supply	Shift order quantities across time
11 Flexible manufacturing process	Increase flexibility in producing different products	Demand	Shift production quantities across internal resources (plants or machines)

customize the generic product later on as demand for each specific product becomes known. The postponement strategy has been proven to be a cost-effective mass customization tool to handle regular demand fluctuations under normal circumstances at companies such as Xilinx, Hewlett Packard (HP), and Benetton.⁵

⁵ Recently, Xilinx, the leading innovator of programmable logic chips, revealed their postponement strategy that enables their customers to use software to fully configure the function of their chips (c.f., Brown et al. (2000)). Next, consider HP. In order to produce 500,000 different config-

In the context of recovering from a supply chain disruption, postponement offers a cost-effective and time-efficient contingency plan that allows a supply chain to reconfigure the product quickly in the event of supply disruption. For example, when Philip's informed Nokia that it was not possible to deliver certain components for a certain period after the fire in the Albuquerque plant in March 2000, postponement enabled Nokia to deploy a contingency plan by reconfiguring their generic cell phone quickly. The reconfigured generic phone accepted a component that was slightly different from the one being delivered by the Philip's plant. This product flexibility enabled Nokia to recover from a serious disruption without any significant problem in delivering the different specific products based on the generic call phone.

2. Strategic Stock

In the "pre-JIT" era, a company would consider carrying additional "just in case" safety stock inventories of certain critical components to ensure that the supply chain can continue to function smoothly when facing a disruption or a delay in supply. However, as product life cycle shortens and as product variety increases, the inventory holding and obsolescence costs of these additional safety stock inventories can become exorbitant.

To do this better, instead of simply carrying more safety stock at every location, a firm should consider storing extra inventory only at certain "strategic" locations (warehouse, logistics hubs, distribution centers) where the inventory can be shared by multiple supply chain partners, say retailers or repair centers. For example, Toyota and Sears keep certain inventories of cars and appliances at certain locations so that all retailers in the nearby region share these inventories. By doing so, Toyota and Sears can achieve a higher customer service level without incurring high inventory cost when dealing with regular demand fluctuations.

When a disruption occurs, these shared inventories at strategic locations will allow a firm to deploy these strategic stocks quickly to the affected area as well. For example, Center for Disease Control (CDC) keeps large quantities of medicine and medical supplies known as Strategic National Stockpile (SNS) at certain strategic locations in the United States. This strategic stockpile is intended to protect the American public if there is a public health emergency like a terrorist attack, flu out-

urations of workstations at HP in an effective manner, HP used postponement by mass producing a generic version of the workstation in a make-to-stock manner. This enabled HP to respond to customer orders quickly by inserting certain product specific components into these generic workstations (c.f., Feitzinger and Lee (1997)). Finally, consider Benetton. By re-sequencing the dyeing and knitting process at Benetton, Benetton was able to postpone the color specification of the sweater by knitting the undyed sweaters first and then dye the sweaters into different colors after receiving customer orders (c.f., Haskett and Signorelli (1984)). For technical evaluation of different postponement strategies, the reader is referred to Lee (1996), Lee and Tang (1997), Lee and Tang (1998a) and Swaminathan and Tayur (1999) for details.

break, or earthquake that is severe enough to cause local or regional supplies to run out.⁶

3. Flexible Supply Base

Although sourcing from a single supplier will enable a firm to reduce cost (lower supply management cost, lower unit cost due to quantity discount, etc.), it could create problems for managing inherent demand fluctuations or major disruptions. To mitigate the risk associated with sole sourcing, Billington and Johnson (2002) described how HP used their plants in the state of Washington and in Singapore as their supply base to produce inkjet printers. HP used the Singapore plant for the base volume production and used the Washington plant to produce the excess on top of the base volume, thus handling regular demand fluctuations, i.e., the “normal” risks, smoothly.

Besides enabling a firm to handle regular demand fluctuations, a flexible supply base can help maintain continuity in supply of materials if a major disruption were to occur. For example, Li and Fung’s 4000-supplier network offers Li and Fung great flexibility to shift production among suppliers in different countries quickly when a disruption occurs at a particular country as we described earlier in this chapter.

An extreme form of such flexibility is to help create or join an existing *supply alliance network*. Suppliers (contract manufacturers, airlines cargo companies, trucking companies, logistics providers) can proactively form strategic alliances with other suppliers in different countries. These alliances can serve as a “safety net” for each member, who will receive help from other members if a disruption strikes.

4. Make-and-Buy

When facing potential supply disruptions, a supply chain is more resilient if certain products are produced in-house while other products (or a proportion of the same products) are outsourced to other suppliers. This enables production to be shifted to different locations and/or demand to be shifted to other products depending on whether the outsourced products are from the same family or are entirely different. For instance, HP used to make some of their DeskJet printers at their Singapore factory and outsourced the rest of the products in the DeskJet family to a contract manufacturer in Malaysia (c.f., Lee and Tang (1996)). Apparel-makers Brooks Brothers and Zara produce their fashion items in-house while outsourcing basic items to low-cost suppliers in China or elsewhere (c.f., Ghemawat, 2003).

⁶ This emergency medical supply is loaded on a wide-body aircraft that can be sent to a disaster area within a 12-hour time window. The reader is referred to <http://www.bt.cdc.gov/stockpile/> for more details.

Such make-and-buy strategies not only help match supply and demand efficiently under normal risks, they also offer flexibility to shift production quickly should a supply disruption occur (when the same product or product family is outsourced) or at least allow some revenues continue (when outsourcing entirely different products) during the period of recovery.

However, outsourcing introduces its own risks and we shall discuss ways to mitigate outsourcing risks in Chapter 10.

5. Economic Supply Incentives

In many instances, the buyer does not have the luxury to shift production among different suppliers because of the limited number of suppliers available in the market. To gain the flexibility of shifting production among suppliers, the buyer can offer economic incentives to cultivate additional suppliers. For example, due to the uncertainties of producing a specific flu vaccine formula in any given year, uncertain demand, and price pressure from the U.S. government, many flu vaccine makers exited the market. The number of flu vaccine makers dropped from 25 in the 1970s and 1980s to only 3 in 2003.

In 2003, Chiron entered this market acquiring another company with European plants and became one of US government's two suppliers. However, in October 2004, British regulators (MHRA) suspended operations at Chiron's Liverpool plant after finding bacterial contamination to be excessive. The US regulators (FDA) concurred in December, issuing a warning to Chiron about its inability to meet its commitments. Facing a shortage of 48 million flu shots from Chiron, the U.S. government could initially offer flu shots only to those who belonged to certain high-risk groups (c.f., Brown (2004)). Moreover, being unable to meet its commitments, Chiron allowed itself to be acquired by Switzerland-based Novartis a few months later.⁷

To avoid this kind of fiasco in the future, the U.S. government could consider offering certain economic incentives to entice more suppliers to re-enter the flu vaccine market. For instance, the government could share some financial risks with the suppliers by committing to a certain quantity of flu vaccine in advance at a certain price and to buying back the unsold stocks at the end of the flu season at a lower price.⁸ With more potential suppliers, the U.S. government would have the flexibility to change their orders from different suppliers quickly when facing major disruptions.

Even without major disruptions, economic supply incentives can be beneficial. For example, when Intercon Japan became concerned about the "monopoly" mindset of their key supplier, Asahi Metal, they offered economic incentives to entice

⁷ A. Shanley, 2004. "Chiron's curse", *Pharmaceutical Manufacturing*, accessed at <http://www.pharmamanufacturing.com/articles/2004/187.html> on 15th May 2011.

⁸ The issues of "risk sharing" and "revenue sharing" has been studied by Narayanan and Raman (2004) in the context of aligning the incentives among supply chain partners so that the entire supply chain can focus on the performance of the entire supply chain.