Business Horizons (2014) 57, 483—495

Available online at www.sciencedirect.com

ScienceDirect

KELLEY SCHOOL OF BUSINESS
INDIANA UNIVERSITY

www.elsevier.com/locate/bushor

An improved method for managing catastrophic supply chain disruptions

James R. Bradley

Mason School of Business, The College of William and Mary, P.O. Box 8795, Williamsburg, VA 23187, U.S.A.

KEYWORDS
Supply chain management;
Supply chain risk management;
Risk;
Catastrophe;
Natural disasters;
FMEA;
RPN

Abstract This article analyzes the differences between frequent and rare risks for supply chain disruptions, and proposes a new, improved risk measurement and prioritization method to account for the characteristics of rare risks. The varying idiosyncrasies of decision makers are integrated into this method such that risk management can be brought into alignment with an individual manager's preferences. Also woven into this tapestry is the notion of detection, which is familiar to those who have applied failure modes and effects analysis (FMEA), but novel in the arena of supply chain risk management. Rare risks in the supply chain are, by their nature, unsettling: unforeseen disruptions are always present, probability estimates are imprecise, and comprehensive data collection is impossible. These difficulties are taken into account by the presented risk management framework. While the proposed ordinal scales are perhaps unsettling to many who desire greater precision, measurement methods must fit the precision that is possible. By considering rare risks along with frequent risks, managers can be better positioned to deal with the unforeseen.

1. Supply chain disruptions: An introduction

Supply chain disruptions interrupt the flow of goods, causing delays for customers and lost revenue for companies whose supply chains are disrupted. Disruptions can be minor in nature, such as those arising from sudden and short-lived absenteeism, machine breakdowns, or late deliveries; or they can be major in nature, such as from plant fires or tsunamis that level buildings and destroy infrastructure. One oft-cited example of a major disruption is the Philips wafer fabrication operation (fab) fire in Albuquerque, New Mexico, which caused Ericsson an estimated $400 million loss and—arguably—a much weakened position in the cell phone market (Sheffi, 2005; "When The Chain," 2006). Experts have suggested that supply chain disruptions have become more frequent, possibly because increasingly global

E-mail address: james.bradley@mason.wm.edu

0007-6813/$ — see front matter
http://dx.doi.org/10.1016/j.bushor.2014.03.003

supply chains make companies vulnerable to risks around the world (Handfield, Blackhurst, Elkins, & Craighead, 2008; Sheffi, 2005). For example, the following recent events have had significant impact on supply chains:

- Taiwan earthquake (1999)
- 9/11 attack (2001)
- West Coast dock strike (2002)
- Hurricane Katrina (2005)
- Changes in import quotas (2005, apparel)
- Fukushima earthquake (2011)
- Piracy of ocean cargo vessels (ongoing)

Many of these events would not have been on North American companies' radar screens if supply chains weren't global.

Catastrophic events can disrupt supply chains for extended periods. For example, parts shipments across the U.S.-Canada border were slowed for at least a week following the 9/11 attacks due to heightened security inspection of vehicles; this slowdown led to the intermittent closing of many auto assembly plants (Ball, Heinzl, & Millman, 2001). During this period, 47,123 of 346,034 units of production scheduled in North America were lost, a 13.6% shortfall in production (Kachadourian, 2001). Likewise, the previously mentioned Philips Albuquerque wafer fab fire halted production for approximately 6 weeks (Latour, 2001; Swaminathan & Tomlin, 2007; "When The Chain," 2006). The Fukushima earthquake disrupted automobile production schedules for up to 3 months and delayed the introduction of Apple's iPad2 (Abe & Hoontrakul, 2012). A contract dispute between Ford and Navistar halted production of Ford trucks and caused reduced schedules in 2007 over a 14-day period (Krisher, 2007). That same year, a 3-week strike at Harley Davidson halted production at its largest plant in York, Pennsylvania (Raffaele, 2007). The West Coast dock strike of 2002 closed port terminals for 10 days ("Dock Strike," 2002). Some authors, including Sheffi (2005), have suggested that these rare but catastrophic disruptions are different from frequent, smaller disruptions.

This article presents a close comparison of frequent versus rare disruptions, suggesting they are different and should be managed accordingly. A process for managing catastrophic risks, taking these challenges into account, is proffered.

2. A common method for managing catastrophic supply chain risk

Processes for supply chain risk management commonly include the following steps:

- Identify risks
- Measure risks
- Prioritize risks for mitigation
- Evaluate risk mitigation tactics
- Implement mitigation tactics

The first three of these steps are explored herein, as they are the foundation for evaluating and implementing mitigation tactics.

2.1. Identifying supply chain risks

Identifying risks may be accomplished via interviews (Peck, 2005), brainstorming (Elkins, Kulkarni, & Tew, 2008), and evaluating supply chain maps (Neiger, Rotaru, & Churilov, 2009), among other tactics. However, little guidance is published regarding how best to complete the task. This article seeks to fill that gap.

2.2. Measuring supply chain risks

The literature uniformly measures the criticality of a potential disruptive event using the *probability* of a particular disruption and its *impact* if it occurred. Frequency with which an event occurs is positively correlated with probability and is sometimes used in place of probability. These two measures are natural because events that occur with greater frequency or that have greater impact when they do occur will have a greater impact over time. Another possible metric for risk is the likelihood of an event being detected either before or after it occurs. The Philips fire provides an example of two different manufacturer detection rates: Nokia detected the problem quickly whereas Ericsson seemingly did not. The fortunes of these two companies post-disruption highlight the importance of quick response.

The estimation of probabilities is based either on extant data or expert opinion. Using extant data, probabilities of disruption can be numerically estimated providing sufficient data is available. However, people can also develop non-numeric perceptions of probabilities based on observation;