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The benefits and constraints of temporary sourcing diversification in supply chain disruption and recovery

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ABSTRACT

Sourcing diversification is the preferred hedge to supply chain disruption risks, but many companies insist on single-sourcing for long-term strategic benefits. For rare-but-catastrophic disruptions of fortified supply chains, temporary sourcing diversification has been seen as a desirable response strategy. However, little is known about the conditions to temporary sourcing diversification and the situations where it is applicable. Our fieldwork and comparison of two disaster recoveries at Aisin Seiki and Riken Corporation shows that while temporary sourcing diversification worked in the Aisin Seiki case, it was impossible at Riken due to the high degree of specificity required in the design and manufacturing methods of the disrupted product item, suggesting product and process specificity limits recovery alternatives. Unawareness of such constraints to temporary sourcing diversification may result in over-optimism regarding its feasibility and insufficient disaster preparedness. In addition, the case of Riken's recovery from an earthquake in 2007 is systematically documented in this paper for the first time.

1. Introduction

Recently, purchasing and supply management scholars have recognized supply disruption risk management as an important area of research (Schoenherr et al., 2012), especially seeing the increasing number of supply chain disruptions resulting from natural and other disasters (Kleindorfer and Van Wassenhove, 2004) and their huge impacts on firm and sector performances (Altay and Ramirez, 2010; Simchi-Levi et al., 2014). For instance, the 9.0-magnitude quake and subsequent tsunami in March 2011 in Eastern Japan damaged or destroyed many factories and disrupted the world's electronics and automotive supply chains for a significant period of time. A single firm, Renesas Electronics, lost $156 million as a result of damage to its Naka facility, which was designed to withstand an 8.0-magnitude earthquake, and it took three months to put the Naka facility back in operation (Courtland, 2011). The companies relying on their sole suppliers in Eastern Japan had to halt their production for months. In 2012, the hard disk drive industry was severely disrupted by the hundred-year floods in Thailand. Such risks induced by the rare-but-catastrophic disasters are often more severe than the operational risks of supplier unreliability affecting quality and delivery (Speier et al., 2011).

Yet in spite of the increasing disruption risks due to rare but devastating disasters (Simchi-Levi et al., 2014) and a supply diversification strategy being typically advisable to mitigate the risk (Tomlin, 2006; Wang et al., 2010), many companies still insist on concentrated supply of certain components and parts, or as we call it below, fortification—i.e. the use of few suppliers and reliance on vigorous recovery actions. They do so for the value of long-term learning abetted by repeated and deepened relationships, and a deliberate tradeoff of these long-term benefits against some obvious short-term risks (Braunscheidel and Suresh, 2009; Chopra and Sodhi, 2014; Nakamoto, 2007; Sheffi, 2007). Companies that resolve the tension between diversification and fortification by favoring the latter receive considerable criticism from the lay press when a disaster strikes (Allbusiness, 2007; Chozik, 2007a; Reitman, 1997a).

When a crisis occurs, blackout time and economic loss due to disruption can be limited through effective recovery actions (Sheffi, 2007; Tomlin, 2006; Tomlin and Wang, 2010). Some of these recoveries using temporary sourcing diversification, i.e. temporarily using alternate suppliers, become famous, as in the case of the fire in 1997 at Toyota's brake valve supplier Aisin Seiki (Nishiguchi and Beaudet, 1998; Reitman, 1997b; Treece, 1997), where Aisin Seiki temporarily procured brake valve machining from

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a variety of volunteer suppliers before Aisin Seiki fully recovered from that fire. This story has gained somewhat mythic status in supply chain risk management literature. It makes one believe that the availability of temporary sourcing diversification makes Just-In-Time (low inventories, rapid response at low cost, etc.) and single source supply chains *resilient* in an event of disruption, so as to limit losses (Sheffi, 2007). Yet, many recoveries from severe disasters do not involve numerous suppliers rising up to produce the item lost in the disaster, and temporary sourcing diversification may not be a viable option in some situations. Our understanding of the enablers and constraints of temporary sourcing diversification versus concentrated recovery efforts in response to the disruption of single-sourcing supply chains is still limited.

This paper aims to address this specific gap by comparing a pair of cases with the same single-sourcing mode in day-to-day supply chain operations, to reveal how the differences in technical-economic factors, notably product and process specificity, conditioned different post-disaster response modes. Specifically, the Aisin Seiki fire case is compared to another less well-known but more recent recovery case after an earthquake that disrupted production of piston rings at Riken Corporation in Niigata Japan in 2007. Both cases similarly involve fortification in day-to-day supply chain operations: single or nearly single-source arrangements, low inventories, deep supplier relations, and severe disruption. However, after the disruption at Riken, no upwelling of alternate supplier support to make piston rings emerged. The case of Riken's recovery in 2007 is systematically documented in this paper for the first time.

Based on the on-site interviews and observations during visits to Aisin-Seiki and Riken in Japan, augmented with additional data from public sources, we found that temporary sourcing diversification was and remains impossible at Riken because of the high degree to which piston rings are specifically designed and manufactured for their respective engines, an instance of asset specificity (Williamson, 1981). Such high asset specificity required in the disrupted product item and related development and manufacturing methods of the item makes it difficult to obtain or learn capabilities quickly when needed, thus constraining the availability of temporary alternate suppliers when the disruption took place. For components and parts in complex products, a Riken-like response is more likely than the Aisin-Seiki response as increased competition on quality and cost drives components and parts to be designed more specifically and produced using specific assets.

This paper contributes to a growing body of literature on supply disruption risk management (Altay and Ramirez, 2010; Bode et al., 2011; Ellis et al., 2011; Giannakis and Louis, 2011; Hoffmann et al., 2013; Simchi-Levi et al., 2014), by specifying how product and process specificity may condition disruption recovery modes from rare-but-catastrophic supply disruptions, and in particular the feasible conditions for the highly touted temporary diversification mode for the recovery of single-sourcing supply chains (Nishiguchi and Beaudet, 1998; Sheffi, 2007; Watts, 2003). Although the supply management literature has hinted at the necessity to consider product attributes in disruption risk management (Ellis et al., 2011), in depth and detailed correlations have not been made prior to the present study. Our study adds a specific insight, namely the impact of product and process attributes on supply disruption recoveries, to recently-proposed broad frameworks in the literature that aim to either understand or manage supply chain risks (Braunscheidel and Suresh, 2009; Ellis et al., 2011; Kleindorfer and Saad, 2005; Narasimhan and Talluri, 2009; Simchi-Levi et al., 2014).

Our work also contributes to real business practices. For supply chain managers, ignorance of such technical conditions that influence the availability of temporary sourcing diversification may result in over-optimism and insufficient preparedness. Insights from this paper may also guide insurance firms to assess more systematically the risk and expected loss due to potential supply chain disruptions of their clients, by helping them estimate accurately the speed with which disruptions in supply chains can likely be recovered. Insurance firms are interested in fast recoveries of disruption incidents in order to reduce the claims related to the insurance products and services they offer to protect against extended business interruption risk.

The rest of this paper is organized as follows. We first review the relevant literature in Section 2. Section 3 explains our research methodology and data collection. Section 4 covers the well-known Aisin Seiki fire case and details the new case on the Riken disruption. Section 5 is a cross-case comparison, and it is followed by a broader discussion in Section 6. Section 7 concludes with discussing limitations and future research opportunities.

2. Literature review

2.1. Supply chain disruption risk management

Supply chain risk management is identified as one of the five most intriguing areas of opportunities in purchasing and supply management research, by a panel of leading scholars in this academic field (Schoenherr et al., 2012). According to Kleindorfer and Saad (2005), supply chain risks fall into two broad categories: operational risk from supplier unreliability and the coordination between supply and demand, i.e. quality and delivery issues, and risk from disruption of normal activities due to strikes, terrorist attacks, fires, natural and other disasters. This paper is mainly concerned with disruption risk.

Considering the complex and multidimensional nature of supply disruption risks, a few general frameworks have been proposed to understand and manage supply disruption risks (Ellis et al., 2011; Narasimhan and Talluri, 2009; Simchi-Levi et al., 2014). For example, Braunscheidel and Suresh (2009) suggested that market and learning orientations affect firm practices including internal integration, external integration and external flexibility, so are drivers for augmenting supply chain agility as a risk management initiative. Ellis et al. (2011) surveyed extensive literatures to identify sets of environmental, organizational and individual factors that affect the firms' perceptions of supply disruption risks and the social and psychological factors that drive risk mitigation decisions and actions. The empirical findings of Zsidisin and Wagner (2010) indicate that "grass-roots" supply managers' perceptions of supply-side risks drive their attitudes and ex-ante or ex-post approaches to risk management, suggesting senior management should implement systematic tools to capture the knowledge of supply management professionals.

Disruption risk management is often divided into risk mitigation, i.e. proactive preparedness before the disruption, and responsiveness, i.e. contingency actions once the disruption has occurred (Hoffmann et al., 2013; Knemeyer et al., 2009; Tomlin, 2006). Typical risk mitigation strategies include carrying buffer inventories (Bode et al., 2011; Song and Zipkin, 1996; Tomlin, 2006), diversifying suppliers (Dada et al., 2007; Tomlin and Wang, 2005; Tomlin, 2009) and strengthening customer–supplier relations (Bode et al., 2011; Liker and Choi, 2004; Wagner and Silveira-Camargos, 2012). Typical response strategies include using alternate or standby suppliers (Chopra et al., 2007; Tomlin, 2006, 2009) and demand shift/management (Tomlin, 2009). Each of these strategies may be driven by the cognitive capabilities or specific motivations of the firms (Ellis et al., 2011), and has strengths and limitations, for which Tomlin and Wang (2010) provide a comprehensive review.