Journal of Operations Management 33–34 (2015) 111–122

Contents lists available at ScienceDirect

Journal of Operations Management

journal homepage: www.elsevier.com/locate/jom

Firm's resilience to supply chain disruptions: Scale development and empirical examination

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ARTICLE INFO

Article history:
Received 13 August 2013
Received in revised form
30 September 2014
Accepted 7 November 2014
Available online 18 November 2014

Keywords:
Supply chain
Resilience
Scale development
Risk management

ABSTRACT

This paper expands our understanding of factors that contribute to development of firm resilience to supply chain disruptions. In doing so, we operationalize firm resilience to understand how supply chain disruption orientated firms can develop resilience to supply chain disruptions. We find that supply chain disruption orientation alone is not enough for a firm to develop resilience. Supply chain disruption oriented firms require the ability to reconfigure resources or have a risk management resource infrastructure to develop resilience. The way in which supply chain disruption oriented firms develop resilience through resource reconfiguration or risk management infrastructure depends on the context of the disruption as high impact or low impact. In a high impact disruption context, resource reconfiguration fully mediates the relationship between supply chain disruption orientation and firm resilience. In a low impact disruption context, supply chain disruption orientation and risk management infrastructure have a synergistic effect on developing firm resilience.

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1. Introduction

In today's turbulent and uncertain environment, every firm in the supply chain is susceptible to disruption events (Knemeyer et al., 2009). As such, an understanding of how firms can manage supply chain disruptions has become an important topic for both academics and practitioners (Craighead et al., 2007; Blackhurst et al., 2011). A supply chain disruption is an event that disrupts the flow of goods or services in a supply chain (Craighead et al., 2007). It can have severe negative consequences on the financial, market and operational performance of the firm (Hendricks and Singhal, 2003; Hendricks and Singhal, 2005; Wagner and Bode, 2008; Narasimhan and Talluri, 2009). In a recent study by the World Economic Forum and Accenture, 80% of firms reported that resilience to supply chain disruptions has become a top priority (World Economic Forum Report, 2013; Wright, 2013). Firms, realizing that disruptions in the supply chain can have negative consequences, are now focusing on building resilience in order to mitigate the impact of disruptions (Juttner and Maklan, 2011; Melnyk et al., 2010; Wieland and Wallenburg, 2013).

The importance of resilience in the face of supply chain disruptions should not be understated. Resilient firms are less vulnerable to supply chain disruptions and are more capable of handling supply chain disruptions when they do occur (Sheffi and Rice, 2005; Ponomarov and Holcomb, 2009; Zsidisin and Wagner, 2010; Blackhurst et al., 2011; Pettit et al., 2013). Resilience allows firms to manage the supply chain disruption and continue to deliver their products and services to the customer. Sheffi and Rice (2005) note that it is important for firms to build resilience in order to deal with unforeseen and unquantifiable risks. Therefore, we identify factors which are antecedents impacting firm resilience to supply chain disruptions.

Extant research suggests that resiliency is an effective way to manage risk and recover from a supply chain disruption (Chopra and Sodhi, 2014; Hora and Klassen, 2013; Blackhurst et al., 2011; Juttner and Maklan, 2011; Zsidisin and Wagner, 2010). Hendricks and Singhal (2005) note that is it critical to develop resilience as firms face disruptions and call for more research in this area. While resiliency may be the key to a firm's ability to manage supply chain disruptions, there is limited research on how firms develop resilience to supply chain disruptions (Blackhurst et al., 2011; Juttner and Maklan, 2011). This study seeks to fill this gap by examining factors that help firms develop resilience to supply chain disruptions. Prior to examining factors that contribute to development of resilience to supply chain disruptions in a firm, it is important to provide a unified definition of firm resilience. However there is a lack of agreement regarding the definition of resilience in the literature (Bhamra et al., 2011; Ponomarov and Holcomb, 2009). Definitions of resilience at the firm level are shown in Table 1.

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http://dx.doi.org/10.1016/j.jom.2014.11.002
0272-6963/Published by Elsevier B.V.

Table 1
Definitions of resilience at the firm level.

Definition	Reference
The capability to anticipate and overcome supply chain disruptions.	Pettit et al. (2010, 2013)
A firm's ability to recover from supply chain disruptions quickly.	Blackhurst et al. (2011)
The capacity of organizations to cope with unanticipated dangers after they have become manifest.	Weick et al. (1999) and Wildavsky (1991)
The ability to respond to disruptions and restore normal operations.	Rice and Caniato (2003)

The lack of a unified definition of resilience has contributed to ambiguity of the concept of resilience related to supply chain disruptions noted by Bhamra et al. (2011), Ponomarov and Holcomb (2009) and Wieland and Wallenburg (2013). In this study, we contribute to the resilience and supply chain disruption literature by defining, operationalizing and validating firm resilience to supply chain disruptions as well as examining the factors that contribute to the development of resilience to supply chain disruptions in firms.

Following Gilliam and Voss's (2013) procedure for developing a construct definition based on prior literature, we compare the extant definitions of firm resilience and develop a preliminary definition. This preliminary definition is then used to develop measurement items that conceptualize firm resilience. The measurement items are subjected to an expert judging process via a substantive validity test. This is followed by an exploratory factor analysis to identify reflective measures that reduce the confusion surrounding the conceptualization of firm resilience to supply chain disruptions. These measurement items are then used to develop a refined inclusive definition of firm resilience. Firm's resilience to supply chain disruptions is defined as the capability of the firm to be alert to, adapt to, and quickly respond to changes brought by a supply chain disruption. This definition is in accordance with Gilliam and Voss's (2013) criteria of reducing ambiguity and vagueness surrounding the construct and addressing the imbalance between conceptualization and empirical validation of the construct. The details on the development of measurement items, substantive validity test and exploratory factor analysis are provided in the methodology section.

We investigate three antecedents to developing firm resilience to supply chain disruptions. First, we examine supply chain disruption orientation, which is characterized as the firm's recognition and awareness of pending disruptions and how firms analyze and learn from prior disruptions (Bode et al., 2011). Bode et al. (2011) note that firms can improve disruption response by cultivating a strong supply chain disruption orientation. In this study, we expand our understanding of supply chain disruption orientation, noting that though it is a necessary precursor it may not be sufficient by itself for developing firm resilience. Therefore, we propose a more nuanced set of antecedents to developing firm resilience to supply chain disruptions by considering two additional factors: a firm's resource reconfiguration capabilities and a firm's risk management infrastructure. We define resource reconfiguration as the ability of a firm to reconfigure, realign and reorganize their resources in response to changes in the firm's external environment (Wei and Wang, 2010; Helfat et al., 2007; Marsh and Stock, 2006; Zahra et al., 2006). Risk management infrastructure describes a firm's structure of resources designed to manage risk in the supply chain (Blackhurst et al., 2011). In addition to the antecedents to developing firm resilience to supply chain disruptions, we also examine the importance of resilience when firms face high impact disruptions and low impact disruptions. We measured extent of the negative impact using firm's overall operational efficiency, procurement costs and delivery reliability to the customer.

In the following sections, we present the development of our hypotheses. We propose a new model with an expansive view of firm resilience to supply chain disruptions. This is followed by a discussion of our research methodology, including a summary of the process used for developing the scale for resilience. We then offer a discussion of the results of our results and implications for researchers and managers. We conclude with a summary of the research.

2. Hypothesis development

In this study, we postulate that supply chain disruption oriented firms are better able to reconfigure resources. This, in turn, enhances firm resilience to supply chain disruptions. We note that this postulation is contingent on the level of disruption impact faced by the firm.

2.1. Resource reconfiguration and supply chain disruption orientation

The ability to manage resources and reconfigure them according to the environmental setting is critical to firm survival and superior firm performance (Sapienza et al., 2006; Sirmon et al., 2007; Davis et al., 2009). Supply chain disruptions are events that are characterized by high uncertainty (Bode et al., 2011) and disrupt the normal flow of goods and services within the supply chain (Craighead et al., 2007). The high uncertainty shrouding supply chain disruptions creates ambiguity about the value and utility of existing resources to generate capabilities that aid in recovering from a disruption. Facing disruptions, firms may sense new threats or opportunities and may need to renew, reconfigure or realign its risk management infrastructure to mitigate threats and exploit opportunities. In situations of high uncertainty such as new product development or new market entry, the ability of the firm to restructure and reconfigure its resource base has been shown to be crucial in developing capabilities that contribute to firm survival and growth (Tushman and Anderson, 1986; Sirmon et al., 2007). Marsh and Stock (2006) and Helfat et al. (2007) note that to respond to changes in the market, firms have to reconfigure and realign existing innovation resources and processes in order to enhance their innovation capacity. Similarly, Sirmon et al. (2007) note that when firms face environmental shock due to discontinuities in the industry, firms need to restructure their resource base. In other words, firms need to acquire, shed and reorganize their existing resource base to develop capabilities that allow them to adapt to the changing environment. A firm that is able to reconfigure and reorganize its resource base (Sirmon et al., 2007; Eddleston et al., 2008) in a dynamic environment may have a greater chance to develop capabilities that mitigate the impact of disruption (Blackhurst et al., 2011).

Having argued above that firm's ability to reconfigure resources is significant for firm to be resilient to supply chain disruptions, we expect to find that supply chain disruption oriented firms are more likely to engage in resource reconfiguration. Firms with a supply chain disruption orientation are aware that disruptions can occur based on past experience and are motivated to learn from disruptions. They proactively configure and manage resources to respond to a supply chain disruption (Bode et al., 2011). Ramaswami et al. (2009) note that firms that spend time scanning and learning from the environment are better able to develop capabilities that improve responsiveness (market oriented firms possess market-based capabilities that increase their responsiveness to changing customer demands). Helfat and Peteraf (2003) also note that firms that learn from the external environment are able to reconfigure and realign their resources and processes to develop capabilities that provide a sustainable advantage. Bode et al. (2011)

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