UNIVERSITI TEKNOLOGI MARA
Cawangan Kedah
Kampus Sungai Petani

Voice of Academia

Academic Series of Universiti Teknologi MARA Kedah

VoA
Volume 14 Issue 1
June 2019

COMMITTEE PAGE

VOICE OF ACADEMIA
Academic Series of Universiti Teknologi MARA Kedah

e-ISSN: 2682-7840

© Voice of Academia is jointly published by the Universiti Teknologi MARA Caawangan Kedah, Malaysia and Penerbit UiTM (UiTM Press), Universiti Teknologi MARA Malaysia, Shah Alam, Selangor.

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e-ISSN: 2682-7840

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Voice of Academia
Academic Series of Universiti Teknologi MARA Kedah
Available online at http://voa.uitm.edu.my

SURVIVAL-OF-THE-FITTEST: EMBRACING CHANGE THROUGH ENHANCED SUPPLY CHAIN RESILIENCE CAPABILITIES

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ARTICLE INFO

Article history:
Received Oktober 2018
Received in revised form
Accepted December 2018
Published June 2019

Keywords:
Supply Chain Capabilities, Risk, Resilience, Business Continuity

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ABSTRACT

Change is inevitable in today's interconnected, volatile, global economy and high-risk world, where supply chains have become increasingly vulnerable to disruptions caused by natural and man-made events. Resilience is a dynamic capability that emphasizes the ability of an enterprise to embrace and respond to change. However, organizations tend to become less resilient as they grow more complex. Hence, they must learn when to anticipate, absorb and overcome disruptions since one-size-fits-all is not an effective approach to managing supply chains. Supply chain management literature suggests that organizational resilience can be cultivated by understanding their supply chain vulnerabilities and by developing specific managerial capabilities to cope with unpredictable disruptions more effectively than their competitors. Thepurpose of this article is to review and identify the capabilities needed by organizations from contingent and resource-based perspectives. The electronics industry in Malaysia is still highly dependent on sourcing electrical parts from the USA, Japan, China and Thailand although being natural disaster-prone countries. This study will provide important implications for the management in this industry to develop a portfolio of capabilities to address important resilient gaps and thus strengthen overall competitiveness. Supply chain resilience strategies can proactively assist in managerial decision-making under uncertainty, with risk so as to understand how (and if) supply chains can return to an original or different functioning state, for business continuity and survival.

1. Introduction

In recent years, supply chain disruptions have impacted the performance of companies. The case of Ericsson is well known in this domain (Norrman and Jansson, 2004; Ho, Zheng, Yildiz and Talluri, 2015). Due to a fire at a Philips semiconductor plant in 2000, the production was disrupted, which eventually led to Ericsson's $400 million loss (Chopra and Sodhi, 2004). The

earthquake, tsunami and subsequent nuclear crises that occurred in Japan in 2011 caused Toyota's production to drop by 40,000 vehicles, costing $72 million in profits per day (Pettit, Croxton and Fiksel, 2013). Rashid and Loke (2016) in their case study of a dyad relationship between electronics industry players in Malaysia revealed that a new high-end model series launching was delayed for 2 months due to a customised IC was sourced from a supplier in Japan at that time. The catastrophic flooding of October 2011 also affected the supply chains of computer manufacturers dependent on hard discs, and disrupted the supply chains of Japanese automotive companies with plants in Thailand (Chopra and Sodhi, 2014). Roberta Pereira, Christopher and Lago Da Silva (2014) highlighted the upstream of a supply chain as the most critical point in a supply chain exposed to disruptions.

"In todays uncertain and turbulent markets, supply chain vulnerability has become an issue of significance for many companies and appropriate research on resilient supply chain are yet to be conducted" (Christopher and Peck, 2004). Vulnerabilities of the extended supply chains are serious and real as a result of just-in-time and lean production methods (Pettit et al., 2013). Supply chain disturbances can be internal or external, affecting products, services, or resources, but all resulting from some type of change (Christopher and Peck, 2004a). There is evidence that natural and man-made disasters are on the rise (Wagner and Neshat, 2010). Frequent occurrences of natural disasters (Svensson, 2000) and the aftermaths impacts are enormous on firms in terms of financial losses (Hendricks and Singhal, 2005). Tang (2006) noted that disruptions such as hurricanes and earthquakes can become a significant threat to the business continuity. Increased uncertainties and potential losses caused by natural disasters exposes firms to greater level of catastrophic risks.

In the wake of the events, the issue of uncertainty caused by exposures to catastrophes has raised the need to develop business continuity planning (Rashid and Loke, 2016). The Council on Competitiveness (2007) argues that "managing this rapidly changing risk landscape is an emerging competitive challenge" and meeting that challenge demands resilience. Hence, building resilience enables the company to embrace change in a turbulent and complex business environment by expanding their portfolio of capabilities. Indeed, an effective and efficient supply chain leads to greater competitiveness (Manuj and Mentzer, 2008). According to the Association for Operations Management (APICS, 2011), risk management helps to generate best practices within the supply chain environment and firms that are embracing such practices are able to react rapidly and derive competitive advantage. One important aspect of risk management in supply chain is the timing of management actions. Hence firms must learn when to anticipate, absorb and overcome disruptions (Pickett, 2006) since one-size-fits-all is not an effective approach to managing supply chains (Fisher, 1997). Recent studies call for more research on how firm reacts to risk incidents that strike its supply chain (Sodhi et al. 2012).

Supply chain risk management (SCRM) remains a key managerial challenge that affects the performance of organizations (Altay and Ramirez, 2010). SCRM relates to the coordination or collaboration efforts in managing supply chain risks among the partners in order to ensure the firm's profitability and continuity (Brindley, 2004). According to Wieland and Wallenburg (2012), SCRM is the implementation of strategies to manage risks along the supply chain based on continuous risk assessment, with the objective of reducing vulnerability and ensuring continuity. SCRM involves the firm's effort to (1) recognize and identify the risk (2) evaluate and assess the risk, (3) mitigate the risk and (4) respond to risk incident for both operational risks and catastrophic (Sodhi, Son, and Tang, 2012). The uncertainty caused by exposures to catastrophes has raised the need to develop a disaster recovery and business continuity planning, Hauser (2003) argued that SCRM is dissimilar to disaster response and it focuses more on keeping the complex process moving efficiently with minimum costs

so that the product quality or customer satisfaction can be maintained. The ability to respond to a real time risk event is a must to lower the impending impact and it can hasten the recovery process. When a firm failed in curbing a risk incident from occuring, it must be responded in a creative and swift manner. Highlighted by Sodhi et al. (2012), only a few studies (e.g., Kleindorfer and Saad, 2005; Norrman and Jansson, 2004) have studied the catastrophic risks. Contingency theory is the appropriate lens for investigating how environmental variables influence the behaviours of organizations (Lawrence and Lorsh, 1967 as cited in Chang, Ellinger and Blackhurst, 2015). Although supply chain resilience has been clearly defined, the underlying elements of the concept differ within theory (Scholten, Sharkey-Scott and Fynes, 2014).

Sodhi (2005) found that the electronics industry is more exposed to greater risk because of shortened product life cycle as well as constant fluctuation on customer demands. Blos, Quaddus, Wee, and Watanabe (2009) highlighted that "Apparently, the electronics companies are more vulnerable to supply chain risks. One reason is that the high dependence on Asian market and due to the nature of the products, there is a need for careful packaging, fragile handling and transportation" (p. 250). Vavany, Zailani and Pujawan (2009) in their comprehensive review on the SCRM demonstrated that SCRM is mostly being applied in the automotive, electronics and aerospace sectors. Through a systematic literature review (SLR) on SCRM, Kilubi and Haasis (2015), highlighted the different terms being used to refer to SCRM strategies as antecedents (Braunscheidel and Suresh, 2009; Jüttner, Peck and Christopher, 2003), or moderators (Manuj and Mentzer, 2008). Others call them activities (Chen, Sohal and Prajogo, 2013; Sheffi and Rice, 2005) or principles (Kleindorfer and Saad, 2005). Kilubi and Haasis (2015) have adopted the term enablers and have revealed through their SLR 12 top enablers across various journal articles namely (1) visibility, (2) flexibility, (3) relationships, (4) redundancy, (5) coordination, (6) postponement, (7) multiple sourcing (8) collaboration, (9) risk awareness, agility, (10) avoidance, contingency planning, (11) risk monitoring, (12) transferring and sharing risks.

We aim to summarise the existing research findings to provide a clear overview. The purpose of this paper is to review and identify the resilience capabilities needed by organizations in order to cope with unpredictable disruptions. The paper at hand is structured as follows: Firstly the literature that is related to supply chain resilience and business continuity is summarised to set a background for the topic discussed. Secondly the literature review leading to the identification of the resilience capabilities are presented in order to have a better understanding. After a brief discussion of the research methodology, the paper finishes by providing a brief conclusion.

2. Literature Review

Supply chain resilience

Supply chain resilience derives from the foundations of many disciplines, including ecology (Folke et al. 2002, 2004; Perrings 2006), psychology (Bonanno 2004; Gorman et al. 2005), sociology (Adger 2000), risk management (Starr, Newfrock and Delurey, 2003; Wagner and Bode 2008), and network theory (Callaway et al. 2000). Because of its wide application to different subjects, resilience has become a multidimensional and multidisciplinary phenomenon in the last 40 years (Ponomarov and Holcomb, 2009) before being adopted to the supply chain field (Ponis and Koronis; Pettit et. al., 2013). Following a series of major disruptive events in global economies, several in-depth studies were conducted to better understand how supply chains can more effectively adapt to change (Cranfield University, 2003; Sheffi 2005). Business scholars and researchers then

investigated enterprise attributes that contribute to supply chain disruptions and attributes that assist enterprises in preventing and coping with those disruptions (Hamel and Valikangas 2003; Rice and Caniato 2003; Christopher and Peck 2004; Kleindorfer and Saad 2005; Tang 2006; Blackhurst et al. 2011).

The author has found in the literature some of the definition: The concept of resilience in supply chains can be found along with studies of supply chain vulnerabilities, defined by Svensson (2002) as "unexpected deviations from the norm and their negative consequences." Coutu (2002) termed resilience as "the ability to bounce back from hardship". According to Cranfield School of Management (2003), "resilience is the ability of a system to return to its original or desired state after being disturbed". Based on the empirical research conducted by the Cranfield University in 2003, Christopher and Peck (2004b) developed an initial framework for a resilient supply chain with four underlying principles (1) resilience can be built into a system in advance of a disruption (i.e.,re-engineering), (2) a high level of collaboration is required to identify and managed risks, (3) agility is essential to react quickly to unforeseen events and (4) the culture of risk management is a necessity. In parallel to the Cranfield studies, researchers at the Massachusetts Institute of Technology (MIT) analysed many case studies of supply chain disruptions with a focus on identifying vulnerability characteristics and management responses such as flexibility, redundancy, security and collaboration (Sheffi, 2005).

Fiksel (2006) defines "Resilience as the capacity for an enterprise to survive, adapt and grow in the face of turbulent change". Based on research in management, economics, ecology and sociology, the concept resilience has emerged as a critical characteristics of a complex, dynamic systems such as business enterprises. Sheffi (2008) states that resilience is "the ability to bounce back from large-scale disruptions" while Flynn (2008) defines resilience with the "four Rs"—robustness, resourcefulness, recovery, and review. Rice and Caniato (2003) and Sheffi (2005, 2008) focus resilience on redundancy and flexibility, recommending leaders to develop a "flexibility DNA" through communications, distributed authority, passion for the mission, deferring to experience, and conditioning for disruptions. In our paper, we adopted the definition provided by Pettit, Fiksel and Croxton (2013) in the business context as "the capacity for an enterprise to survive, adapt, and grow in in the face of change and uncertainty". Supply chain resilience is an operational capability that enables a disrupted or broken supply chain to reconstruct itself and be stronger than before (Brusset and Teller, 2017). Supply chain resilience specifically enhances manufacturer's ability in the preparation for unpredictable circumstances; in responding to interferences and ultimately to recover from these situation (Ponomarov and Holcomb 2009). Scholars relied on the assumption that some risk events are inevitable when examining the supply chain resiliency (Jüttner and Maklan 2011). Organizations tend to become less resilient as they grow more complex. However, they can cultivate resilience by understanding their supply chain vulnerabilities and developing specific capabilities to cope with disruptions. Resilient systems do not fail in the face of disturbances; rather they adapt. Depending on the type of disturbances, the adaptation can be rapid or gradual.

Supply chain resilience specifically enhances manufacturer's ability in the preparation for unpredictable circumstances; in responding to interference and ultimately to recover from these situations (Ponomarov and Halcomb, 2009). Early adopters of resilience thinking have demonstrated how they can enhance traditional risk management practices with new capabilities that help them to anticipate, prepare for, adapt to and recover from disruptions. Hence, periodic assessment of the resilience of the supply chain is necessary. Managers therefore can develop a

portfolio of capabilities to address important resilience gaps and strengthen overall competitiveness. Pettit et al., (2013) suggested a correlation between increased resilience and improved supply chain performance.

A resilience approach demands undertaking a set of processes consisting of (1) sensing, (2) anticipate, (3) adaptation, and (4) learning (Park, Seager, Rao, Convertino, and Linkov, 2013). Based on the empirical findings, previous researchers such as Rice and Caniato (2003), Christopher and Peck (2004) and Sheffi (2005) concluded that a firm's capability to overcome the disruptive changes require inputs from the resilience strategies. Strategic resilience imperatives call for supply chains to be less brittle and more adaptive to change through (1) supply chain design, (2) focus on business process management to enhance capabilities across the supply chain, (3) visibility to demand and supply throughout the supply chain, (4) supplier and customer relationship management, and (5) infusing a culture of resilience (Wisdomnet, 2006).

Business continuity

Organizations are at a greater risk of system failure because of the massive interdependency throughout the supply chain, hence continuity is the main concern of any supplier. Business continuity involves effective strategy formulation and implementation to provide alternatives to modulate operational interruption (Hiles a Barnes, 2001). According to Herbane, Elliott and Swartz (2004) another risk management process known as business continuity management (BCM), incorporates elements from disaster recovery planning and crisis management including how to respond to disruptions and maintain backup capacity for operational systems. BCM aims at getting interrupted businesses restarted (Norrman and Jansson, 2004). Business continuity management includes crisis management (overall processes to manage the incident), disaster recovery (recovery of critical systems, applications, data and networks), business recovery (recovery of critical business processes) and contingency planning (recovery from impact external to the organization) (CMI, 2002). According to Cerullo and Cerullo (2004), there is no single recommended plan for business continuity; instead, every organization needs to develop a comprehensive Business Continuity Planning (BCP) based on its unique situation. BCP is planning to ensure continued operations in case of a catastrophic event. But it goes beyond disaster-recovery planning, since it includes the actions to be taken, resources required, and procedures to be followed to ensure the continued availability of essential services, programs and operations in the event of unexpected interruptions (Norrman and Jansson, 2004). According to Dean Becker, the president and CEO of Adaptive Learning Systems, "More than education, more than experience, more than training, a person's level of resilience will determine who succeeds and who fails" (Coutu, 2002). Unless resilience is instilled into the subsystms of a firm, one could not expect to have a resilient enterprise. Resilience is embedded in within the culture of an organization. To have a resilient organization, the managers should have a complete understanding of the environment and its patterns of change (Kamalhadi and Parast, 2016). In the face of unexpected changes in the environment, the firm should have the ability to survive, adapt and respond to changes. This requires the development of certain organizational capabilities. Since disruptions are inevitable, firms need to develop capabilities to mitigate the effects of disruptions (Pettit et. al., 2013). Firms must fully understand the environment, and adapt to changes to ensure continuity of their business (Starr et. al., 2003, McDonald, 2006; Madni and Jackson, 2009). Managing supply chain resilience of a firm is a proactive method that can complement and enhance traditional risk management and business continuity planning (Pettit, Fiksel and Croxton, 2010). While firms have no control over environmental variables such as natural disasters and catastrophic events, adoption of risk

management practices provide a safety net in buffering firms from operational disruption and business discontinuity (Rashid and Loke, 2016).

3. Methodology

There is extensive study and literature on Supply Chain Risk and Resilience in the past. To identify and review the capabilities in managing Supply Chain Risk, we have searched in online databases such as SCOPUS, Science Direct (Elsevier), Emerald Insight, Taylor & Francis Group, Business Source Complete (EBSCHO Host) and ProQuest as well as Google Scholar. The search phrases included "supply chain", "risk", "resilience", "resiliency", "resilient", "supply chain capabilities" and "business continuity". We have removed the duplicates and eventually reviewed 43 articles selected and grouped according to the relevance to the research review.

4. Results and Discussion

Pettit, et. al., (2010) argued that supply chain vulnerabilities are fundamental factors that makes an enterprise supply chain susceptible to disruptions. In order to counteract vulnerabilities, research has shown that a supply chain can develop capabilities that assure long-time survival. Capabilities are attributes that enable an enterprise to anticipate and overcome disruptions. Lee (2004) presents methods to overcome both short and long-term change based on three key capabilities: agility, adaptability and alignment. Other important capability include flexibility in sourcing, flexibility in order fulfillment, capacity, efficiency, visibility, adaptability, anticipation, recovery, dispersion, collaboration, organizations, market position, security and financial strength (Pettit, et. al., 2010). Kilubi and Haasis (2015) highlighted the top enablers (or capabilities) in SCRM research from 2000 to the beginning of 2015 are in the following order of frequency (1) visibility, (2) flexibility, (3) relationship, (4) redundancy, (5) coordination, (6) postponement, (7) multiple sourcing, (8) collaboration, (9) risk awareness, (10) agility, (11) avoidance, (12) contingency planning, (13) risk monitoring and (14) transferring and sharing risks.

It is important for the management to have insight of their strengths, weaknesses and priorities. By identifying highly rated capabilities, managers will have a detailed information on their strengths. This is in line with the resource-based approach to strategy analysis as noted by Grant (1991), where firms must identify their current strengths. McManus, Seville, Brunsdon and Vargo (2007) acknowledged that under certain circumstances where the firm is forced to deal with unexpected disruption in its supply chain, its ability to survive can be demonstrated through the level of supply chain resilience. The higher the level of a firm's resilience, the greater the ability is for the firm to bounce back to its original functioning state (Christopher & Peck, 2004). Organizations must learn to anticipate, absorb, and overcome disruptions (Pickett, 2006). Hence, a resilient supply chain enables firms to quickly return to its initiate state even when its operational functions are interrupted. Previous empirical finding showed that resilience strategies are required for firms that are challenged by disruptive changes (Christopher & Peck, 2004; Sheffi, 2001). According to Ponomarov and Halcomb (2009), these supply chain resilience strategies are useful for dealing with unexpected events so that firms can return to its initiation stage. Moreover, resilience can be a source of competitive edge if the firm responds better and faster than its rivals. This could greatly enhance the firm's competitiveness and survival.

Brusset and Teller (2017) in a survey of 171 managers tested a conceptual model that proposes a relationship between supply chain capabilities and resilience as well as the moderating

role of supply chain risks revealed that the perception of supplier risk helps motivate supply chain manager to enhance integration capabilities and thus achieve higher resilience. Other operational capabilities included in the study were external capabilities and flexibility capabilities. Overall, resilience is a critical capability for success needed in supply chain redesign and re-engineering and it is important to have the right mix of capabilities to build resilience in the type of environment best suited for the industry.

5. Conclusion

Globalization has made anticipating disruptions and managing them when they do occur becomes more challenging. The potential risks of disruptions are often out of sight, and the potential impacts may not be comprehended. This often results in "black swan" events that can be understood only after it happens (Taleb, 2007). A well-managed firm continually examines its turbulent environment and realigns its resources faster than its rivals (Hamel and Valikangas, 2003; Lummus, Duclos and Vokurka, 2003). Disruptions "can offer an opportunity to impress customers and win their loyalty" (Knemeyer, Corsi, and Murphy, 2003), and "successful recovery and adaption to new market forces can lead to competitive advantage" (Rice and Caniato, 2003). Eventhough change not only presents threats to business continuity, but also embracing change creates opportunities for business value creation. When disruption change the competitive landscape, a resilient company can often take advantage by introducing business innovations, increasing market share, and enhancing its reputation. Risk interventions through resilience techniques, necessary capabilities, competencies and flexibilities deriving from deep understanding of the operating phenomenon are warranted and needs to be further explored. This will eventualy lead to sustainability, an increase in profitability and competitive advantages over their rivals who are less resilient (Mensah and Merkuyev, 2014). It would also further enhance the ability to anticipate, the ability to respond and bounce back to resume operations in the shortest possible time and the ability to adapt to changes for business continuity and survival.

Acknowledgement

The author would like to thank the editors and reviewers for suggestions that notably improved this paper.

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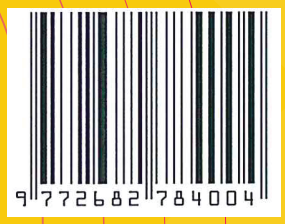

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e-ISSN: 2682-7840