Impact of Organizational Capabilities on Supply Chain Resilience: An Empirical Investigation

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Abstract

The purpose of this paper is to understand the impact of organizational capabilities on creating and improving supply chain resilience (SCRES). A theoretical model of organizational capabilities and related SCRES constructs was developed and a survey were created to test the relationships proposed in the model. The findings presented here are based on the pilot study. The findings show the magnitude and type of relationships between antecedents to SCRES capabilities, SCRES capabilities, and financial and resilience outcomes. This research contributes a theoretical model and comprehensive measurement scales for constructs employed in the model.

Keywords: Supply Chain Resilience, Organizational Capabilities

Introduction

With growing volatility and uncertainty in supply chains, research in the area of supply chain resilience (SCRES) has gained widespread attention (Jüttner and Maklan, 2011; Melnyk *et al.*, 2014; Fiksel *et al.*, 2015). While multiple definitions of supply chain resilience exist, the basic elements remain the same: (a) the ability to proactively prepare for unexpected disruptive (negative) events, (b) respond to disruptions while maintaining continuity of operations and control over structure and function, and (c) restore a robust state of operations, possibly better than before the event occurred (Christopher and Peck, 2004; Ponomarov and Holcomb, 2009; Ponis and Koronis, 2012).

The body of knowledge on SCRES continues to grow; however, two gaps stand out. First, much of the existing research is theoretical. Further research is needed to validate SCRES constructs and relationships between them as proposed in the literature (Hohenstein *et al.*, 2015; Kamalahmadi and Parast, 2016). Second, the extant literature identifies a long list of capabilities necessary for improving SCRES (Christopher and Peck, 2004; Pettit *et al.*, 2010; Ponomarov and Holcomb, 2009). However, the understanding of which capabilities are most effective for which parts of the supply chain remains is limited (Kamalahmadi and Parast, 2016).

Based on the two gaps identified above, the overarching question driving this research is: which organizational capabilities contribute to creating and improving SCRES? In this research, we focus on capabilities specific to supply, operations, and inbound and outbound logistics management that are likely to have a strong impact on SCRES.

The paper is structured as follows. First, the relevant theoretical background is described. Next, the methodology used in this research is presented followed by the preliminary findings. Finally, the main conclusions are presented and potential future research areas including the next steps are identified.

Theoretical background

Based on the definition of SCRES presented earlier, there are three components of resilience: proactive preparation, response to an adverse event, and restoration of operations. All components require organizational capabilities, many of which are related to supply chain management.

Supply Chain Resilience

When risks are highly unpredictable, unknown and have limited or no statistical information, SCRES is proposed as a concept complementary to the traditional risk management process in firms (Fiksel *et al.*, 2015). The concept of SCRES has been defined by many researchers. For our research we rely on the widely cited definition of Ponis and Koronis (2012); they define SCRES as "the ability to proactively plan and design a supply chain network for anticipating unexpected disruptive (negative) events, respond adaptively to disruptions while maintaining control over structure and function and transcending to a post event robust state of operations, if possible, more favourable than the one prior to the event, thus gaining competitive advantage" (pp. 925-926). Resilience is therefore a capability of supply chains to respond to disruptions, which are defined as events, foreseeable or unforeseeable, that has direct impact on operations and the stability of a firm or supply chain (Barroso *et al.*, 2011). For our research study, we defined a disruption as an event that is characterized by uncertainty and disrupts the normal flow of goods and services within the supply chain.

In the last few years, the research in SCRES has extended to identifying SCRES capabilities and understanding the antecedents of SCRES (Kamalahmadi and Parast,

2016). Many researchers have identified organizational capabilities relevant to SCRES (Christopher and Peck, 2004; Pettit *et al.*, 2010; Blackhurst *et al.*, 2011; Wieland and Wallenburg, 2013), although the authors have used different terms (e.g. dimensions, capabilities, elements, principles, etc.) to describe those attributes.

Several SCRES researchers have focused on the identification of SCRES strategies, like proactive, concurrent and reactive strategies (Hollnagel, 2013). These three main strategies refer to the competencies needed in the different phases of SCRES. The phases of SCRES is another research stream focused on the phases of pre-disruption, during-disruption and post-disruption (Sheffi and Rice, 2005); the fourth phase, called growth phase was added later. Growth phase refers to the phase in which companies aim to seek growth by opportunities that may emerge in the post-disruption phase.

Previous publications suggest that certain strategies enable SCRES. These include redundancy and flexibility (Sheffi and Rice, 2005), supply chain agility (Braunscheidel and Suresh, 2009), velocity (Jüttner and Maklan, 2011), visibility (Jüttner and Maklan, 2011), robustness (Wieland and Wallenburg, 2013), and collaboration (Scholten and Schilder, 2015).

To mitigate the effect of disruptions at different stages and to execute strategies that enable SCRES, companies need to develop capabilities (Pettit *et al.*, 2013).

Organizational Capabilities

Consistent with Craighead *et al.* (2007), we define capability as a combination of activities and processes that enable an entity (such as an employee, department, or organization) to handle turbulent changes caused by disruptions. A multitude of capabilities affect different aspects of supply chain management. Please see Pettit *et al.* (2013) for overall discussion of organizational capabilities relevant to SCRES and how to measure SCRES using a tool called Supply Chain Resilience and Assessment and Management.

In this research, five capabilities are investigated, namely, process, communication and coordination, collaboration, human resources, and information technology capabilities (Day, 1994; Grant, 1999). These capabilities were chosen for their strong relevance to resilience in supply, operations, and inbound and outbound logistics functions, as proposed in the extant literature (Pettit *et al.*, 2010). These five capabilities are then tied into a nomological network consisting of existing supply chain constructs. Figure 1 depicts the theoretical model developed and tested in this research. The model shows the relationships between the five selected capabilities, and their antecedents and consequences. Overall, we argue that strategic focus and SC disruption orientation impact how much the organizations will invest in the five capacities and that the five capabilities affect both resilience and financial outcomes in a supply chain.

Model and hypotheses

Figure 1 presents the theoretical model of SCRES developed in this research and grounded in the extant literature. The model depicts the relationships between strategic focus, SC disruption orientation, organizational capabilities, resilience outcomes, and financial outcomes. The remainder of this section is focused on the development of hypotheses that are subsequently tested in this research.

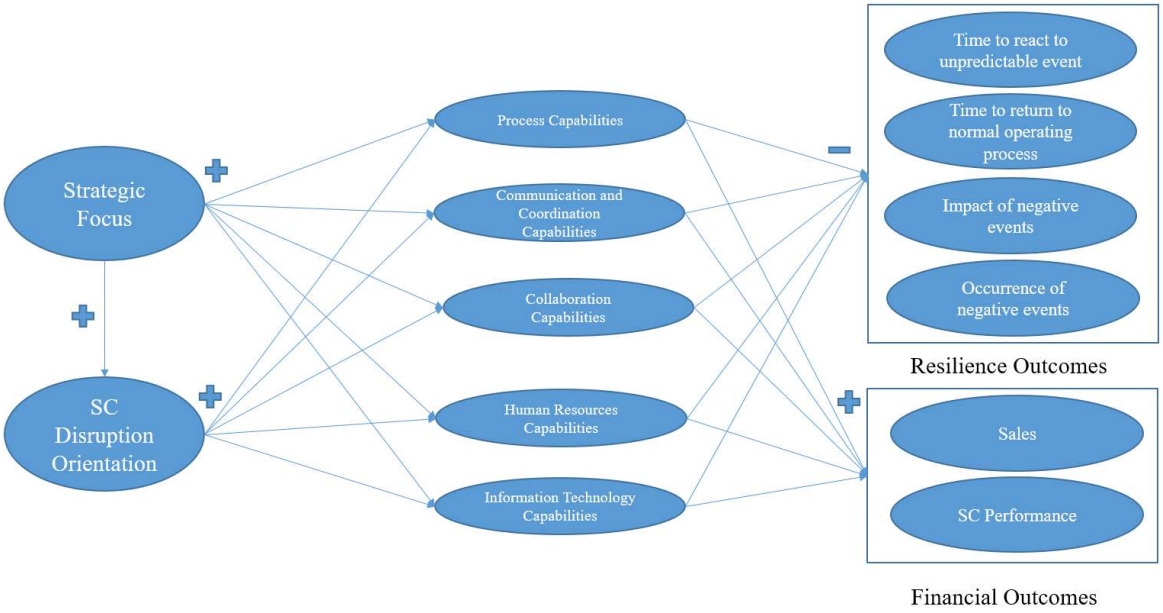

Figure 1 – Theoretical Model of Supply Chain Resilience

Strategic focus is defined as the orientation (either leaning towards minimizing costs or maximizing service) of a company. Much of SCRES is an outcome of investment in capabilities that directly affects service (or responsiveness) of a company. Companies that focus more on service will have stronger SCRES capabilities as compared to those that focus more on cost.

Therefore, we propose:

Hypothesis 1: There is a positive relationship between strategic focus and organizational capabilities.

Supply chain disruption orientation (SCDO) is defined as a company's awareness and consciousness of disruptions and its analysis of and learning from past SC disruptions (Bode *et al.*, 2011). Ambulkar *et al.* (2015) have operationalized enterprise resilience in order to understand how companies with SCDO can enhance resilience to SC disruptions. SCDO may have a positive impact on organizational capabilities, if a company is aware of disruptions, analyse them and establish a process of learning from past SC disruptions. Therefore, we propose:

Hypothesis 2: There is a positive relationship between the strategic focus and SCDO.

Companies with stronger focus on service will attempt to reduce any disruptions and are more likely to adopt SCDO measures. Therefore, we propose:

Hypothesis 3: There is a positive relationship between SCDO and organizational capabilities.

Process capabilities are defined as the ability of a process to produce and generate output within the customer expectation and within the required specification limits, close to the target value (Chan *et al.*, 1988). According to a resource based view the development of capabilities may lead to performance outcomes (Peteraf, 1993; Teece *et al.*, 1997).

Strong process capability affects resilience outcomes by reducing reaction time, time to return to normal operating conditions, impact of negative events, and frequency of negative events. Furthermore, strong process capability also helps to improve sales and service performance (Liu and Lee, 2018) and the related supply chain performance.

Therefore, we propose:

Hypothesis 4: There is a negative relationship between process capabilities and resilience outcomes.
Hypothesis 5: There is a positive relationship between process capabilities and financial outcomes.

Communication and coordination capabilities allow companies to communicate internal within the company to share information and ideas within the organization and external to supply chain partners. The ability to share information and ideas fluently internal and external to suppliers and customers impacts resilience and financial outcomes. It leads to a decrease of the resilience outcomes and an increase of the financial outcomes.

Therefore, we propose:

Hypothesis 6: There is a negative relationship between communication and coordination capabilities and resilience outcomes.
Hypothesis 7: There is a positive relationship between communication and coordination capabilities and financial outcomes.

Collaboration capabilities are defined as the ability of an organization to join efforts and work effectively with other supply chain partners for mutual benefits. In the context of SCRES it emphasizes the importance of internal and external communications (Scholten *et al.*, 2014).

The strong ability of an organization to cooperate has a positive impact on financial results and a negative impact on resilience outcomes.

Therefore, we propose:

Hypothesis 8: There is a negative relationship between collaboration capabilities and resilience outcomes.
Hypothesis 9: There is a positive relationship between collaboration capabilities and financial outcomes.

Human resource capabilities are defined as the ability of an organization to recruit, maintain and develop their human resources (Gibson and Cook, 2001). Major importance to this capability are the knowledge, skills, and abilities of employees, including their education (Gammelgaard and Larson, 2001). Human abilities help with better decision making and influence both financial and operational outcomes.

Therefore, we propose:

Hypothesis 10: There is a negative relationship between human resource capabilities and resilience outcomes.
Hypothesis 11: There is a positive relationship between human resource capabilities and financial outcomes.

Information technology capabilities are defined as an organizational capability, which enables companies to mobilize and deploy resources based on information technology in

combination with other resources and capabilities. The main aspects are the interaction of IT infrastructure, human IT resources and IT-enabled intangible resources (Bharadwaj, 2000). IT helps with better, faster, and accurate decision making and influences both financial and operational outcomes.

Therefore, we propose:

Hypothesis 12: There is a negative relationship between information technology capabilities and resilience outcomes.
Hypothesis 13: There is a positive relationship between information technology capabilities and financial outcomes.

Methodology

The survey was developed in stages as per accepted rigorous scale and survey development techniques (Dillman *et al.*, 2014). This process included an extensive literature review, continuous development of measurement items together with industry professionals, and a review by researchers not engaged in survey development. A few scales are adopted from the extant literature (e.g. SCDO), most are adapted (e.g. different capabilities and outcomes). The pilot test, currently in progress, uses a convenience sample of respondents in positions and industries similar to the target population.

For measuring SCDO we adopted the scale by Bode *et al.* (2011) which includes items such as the need to be alert for possible SC disruptions all the time, the use of disruptions for improvements, the recognition of SC disruptions, the attitude to and the analysis of a SC disruption. For measuring capabilities, we build upon existing research. For process capabilities, we included items such as process transparency, ability to create new supply chain processes, reconfiguration of SC processes, employees' responsibilities, employees' action knowledge and the level of standardization of the escalation procedures. The main aspects of communication and coordination are measured by the ability to share a common process understanding with customer and supplier, proactive information sharing, timely information exchange and common information sharing about events or changes. Collaboration capabilities are measured by problem sharing and joint responsibilities for them, taking unfair advantage of a strong bargaining position, willing to make cooperative changes with customers and suppliers. Human resource capabilities are measured using employee experience in disruption management, involvement of new employees, employees training, trust between management and stuff, and usefulness of employees training in times of disruption. Information technology items include an IT system's ability to respond quickly on both supply and customer side, training for IT systems and the integration of the IT system with other systems.

Data collection is currently in progress. Scale measurement reliability and convergent as well as discriminant validities will be assessed by using appropriate and rigorous methods. The unit of analysis is the supply chain of a firm. Several control variables such as company size, industry etc. are also included.

For pilot survey test for this research, we are tapping into a convenience sample of key organizational informants. Typically, these survey respondents are senior in the organization and the support of their use stems from their knowledge of the organization, processes and supply chain partners. These individuals must also be able to describe a supply chain disruption they have experienced within the last two years. Therefore, the respondent profile considered as ideal for this study is a senior executive with experience in managing supply chain disruptions.

Preliminary Findings

We expect to have the results of the pilot study by mid of May 2018 and refine and finalize the instrument by mid of June 2018.We expect to provide improved and comprehensive measurement scales for constructs employed in the model. Consequently, with additional data collection, we will establish the magnitude and type of relationships (i.e., positive or negative) between antecedents to SCRES capabilities, SCRES capabilities, and SCRES outcomes; consequently, we expect to posit a theory of SCRES.

Relevance/Contribution

This research contributes to the body of knowledge in several ways. The existing research is largely focussed on overall SCRES. In this research, a theoretical model of SCRES is developed comprising of antecedents, SCRES capabilities, and outcomes in the specific context of supply, operations, and inbound and outbound logistics management. Second, while reasonable body of knowledge exists on SCRES, majority of the research is conceptual. The empirical testing of the relationships between the constructs will help expand the theory of SCRES. Finally, normative guidance for managers can be drawn from this research. The testing of hypotheses provides insights into overall capabilities most relevant to supply, operations, and logistics aspects of SCRES. The items used to measure capabilities provide deeper insights into how to measure and improve these capabilities with reference to resilience and financial outcomes.

Areas for future research include replicating this study in different countries. Future studies could incorporate additional capabilities and outcomes. The next steps in our research are 1) to finish the pre-test; preliminary findings based on the pre-test will be presented in the conference, and 2) to continue with data collection, data analysis of the full survey response and test the hypothesis.

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References

Ambulkar, S., Blackhurst, J.V. and Grawe, S. (2015), “Firm's resilience to supply chain disruptions. Scale development and empirical examination”, *Journal of Operations Management*, 33-34, pp. 111–122.

Barroso, A.P., Machado, V.H. and Machado, V.C. (2011), “Supply Chain Resilience using the mapping approach”, in InTech (Ed.), *Supply Chain Management*, pp. 161–184.

Bharadwaj, A.S. (2000), “A Resource-Based Perspective on Information Technology Capability and Firm Performance: An Empirical Investigation”, *MIS Quarterly*, Vol. 24, No. 1, p. 169.

Blackhurst, J.V., Dunn, K.S. and Craighead, C.W. (2011), “An Empirically Derived Framework of Global Supply Resiliency”, *Journal of Business Logistics*, Vol. 32, No. 4, pp. 374–391.

Bode, C., Wagner, S.M., Petersen, K.J., Ellram, L.M., Bode, C., Wagner, S.M., Petersen, K.J. and Ellram, L.M. (2011), “Understanding responses to Supply Chain disruptions: insights from information processing and resource dependence perspecitves”, *Academy of Management Journal*, Vol. 54, No. 4, pp. 833–856.

Braunscheidel, M.J. and Suresh, N.C. (2009), “The organizational antecedents of a firm’s supply chain agility for risk mitigation and response”, *Journal of Operations Management*, Vol. 27, No. 2, pp. 119–140.

Chan, L.K., Cheng, S.W. and Spiring, F.A. (1988), “A New Measure of Process Capability: C pm”, *Journal of Quality Technology*, Vol. 20, No. 3, pp. 162–175.

Christopher, M. and Peck, H. (2004), “Building the Resilient Supply Chain”, *International Journal of Logistics Management*, Vol. 15, No. 2, pp. 1–14.

Craighead, C.W., Blackhurst, J.V., Rungtusanatham, M.J. and Handfield, R.B. (2007), "The Severity of Supply Chain Disruptions: Design Characteristics and Mitigation Capabilities", *Decision Sciences*, Vol. 38, No. 1, pp. 131–156.
Day, G.S. (1994), "The Capabilities of Market-Driven Organizations", *Journal of Marketing*, Vol. 58, No. 4, p. 37.
Dillman, D.A., Smyth, J.D. and Christian, L.M. (2014), *Internet, phone, mail, and mixed-mode surveys: The tailored design method,* 4th edition, Wiley, Hoboken.
Fiksel, J., Polyviou, M., Croxton, K.L. and Pettit, T.J. (2015), "From Risk to Resilience: Learning to Deal With Disruption", *MIT Sloan Management Review*, Vol. 56, No. 2, pp. 79–86.
Gammelgaard, B. and Larson, P.D. (2001), "Logistics Skills and competiencies for Supply Chain Management", *Journal of Business Logistics*, Vol. 22, No. 2, pp. 27–50.
Gibson, B.J. and Cook, R.L. (2001), "Hiring practices in US third-party logistics firms", *International Journal of Physical Distribution & Logistics Management*, Vol. 31, No. 10, pp. 714–732.
Grant, R.M. (1999), "The Resource-Based Theory of Competitive Advantage: Implications for Strategy Formulation", in Zach, M.H. (Ed.), *Knowledge and Strategy*, Butterworth-Heinemann, pp. 3–23.
Hohenstein, N.-O., Feisel, E., Hartmann, E. and Giunipero, L.C. (2015), "Research on the phenomenon of supply chain resilience: a systematic review and paths for further investigation", *International Journal of Physical Distribution & Logistics Management*, Vol. 45, No. 1/2, pp. 90–117.
Hollnagel, E. (2013), *Resilience engineering: Concepts and precepts,* Reprinted., Ashgate, Aldershot.
Jüttner, U. and Maklan, S. (2011), "Supply chain resilience in the global financial crisis: An empirical study", *Supply Chain Management: An international Journal*, Vol. 16, No. 4, pp. 246–259.
Kamalahmadi, M. and Parast, M.M. (2016), "A review of the literature on the principles of enterprise and supply chain resilience. Major findings and directions for future research", *International Journal of Production Economics*, Vol. 171, pp. 116–133.
Liu, C.-L. and Lee, M.-Y. (2018), "Integration, supply chain resilience, and service performance in third-party logistics providers", *International Journal of Logistics Management*, Vol. 29, No. 1, pp. 5–21.
Melnyk, S.A., Closs, D.J., Griffis, S.E., Zobel, C.W. and Macdonald, J.R. (2014), "Understanding Supply Chain Resilience", *Supply Chain Management Review*, pp. 34–41.
Peteraf, M.A. (1993), "The cornerstones of competitive advantage: A resource-based view", *Strategic Management Journal*, Vol. 14, No. 3, pp. 179–191.
Pettit, T.J., Croxton, K.L. and Fiksel, J. (2013), "Ensuring Supply Chain Resilience: Development and Implementation of an Assessment Tool", *Journal of Business Logistics*, Vol. 34, No. 1, pp. 46–76.
Pettit, T.J., Fiksel, J. and Croxton, K.L. (2010), "Ensuring supply chain resilience: Development of a conceptual framework", *Journal of Business Logistics*, Vol. 31, No. 1, pp. 1–21.
Ponis, S.T. and Koronis, E. (2012), "Supply Chain Resilience: Definition of Concept and its Formative Elements", *The Journal of Applied Business Research*, Vol. 28, No. 5, pp. 921–930.
Ponomarov, S.Y. and Holcomb, M.C. (2009), "Understanding the Concept of Supply Chain Resilience", *International Journal of Logistics Management*, Vol. 20, No. 1, pp. 124–143.
Scholten, K. and Schilder, S. (2015), "The role of collaboration in supply chain resilience", *Supply Chain Management: An international Journal*, Vol. 20, No. 4, pp. 471–484.
Scholten, K., Sharkey Scott, P. and Fynes, B. (2014), "Mitigation processes – antecedents for building supply chain resilience", *Supply Chain Management: An international Journal*, Vol. 19, No. 2, pp. 211–228.
Sheffi, Y. and Rice, J.B. (2005), "A supply chain view of the resilient enterprise", *MIT Sloan Management Review*, Vol. 47, No. 1, pp. 40–48.
Teece, D.J., Pisano, G. and Shuen, A. (1997), "Dynamic capabilities and strategic management", *Strategic Management Journal*, Vol. 18, No. 7, pp. 509–533.
Wieland, A. and Wallenburg, C.M. (2013), "The influence of relational competencies on supply chain resilience. A relational view", *International Journal of Physical Distribution & Logistics Management*, Vol. 43, No. 4, pp. 300–320.