Intangible resources in building supply chain resilience

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Abstract

We propose a theoretical model of supply chain resilience that includes human capital resources, physical capital resources, and organizational capital resources. In this article we have proposed a model of supply chain resilience, building on prior research, that emphasizes "soft" intangible factors over the tangible factors. Intangible factors include: leadership and top management commitment, culture, lessons learned, empowerment, involvement, and commitment.

Keywords: Resilience, Supply Chain, Disaster Recovery

Introduction

Disruptions are a significant challenge for today's fragmented, extended and inter-connected supply chains. They threaten organizations' ability to fulfil their most immediate role as a provider. They also can have significant negative impact on their value and profitability. As a consequence, companies are more than ever concerned with building resilience, which can be defined as "the ability to bounce back from a disruption" (Sheffi and Rice Jr, 2005).

Resilience has been has been studied in a wide variety of academic disciplines (Ponomarov and Holcomb, 2009). The context of this study is *firm's supply chain resilience*. Two definitions from the literature capture this context. The adaptive capability of the firm's supply chain to prepare for unexpected events, respond to disruptions, and recover from them by maintaining continuity of operations at the desired level of connectedness and control over structure and function (Scholten et al., 2014). Resilience is not only the ability to maintain control over performance variability in the face of disturbance, but also a property of being adaptive and capable of sustained response to sudden and significant shifts in the environment in the form of uncertain demands (Datta et al., 2007).

Supply chain resilience studies have convincingly established the operational and supply chain resources it builds on, such as those embedded in the supply network. There is also a convergence

of these resources that support supply chain resilience, such as flexibility, visibility and redundancy (Ambulkar et al.. 2015; Blackhurst et al., 2011). Intangible factors, while acknowledged have not received in-depth attention. Yet, when supply chain resilience is conceptualized as a dynamic capability, one also needs to consider the 'soft' factors. For organizations the ability to reconfigure is a 'learned organizational skill' that benefits decentralization and local autonomy (Ojha et al., 2014). Organizational capabilities then are "not only manifestations of observable corporate structures and processes, but also reside in the corporate culture and network of employee relations" (Collis, 1994). Research suggests that learning will need to be supported by various organizational factors including but not limited to organizational culture, leadership, social network, and employee training (Ojha et al., 2014). These have been ignored in the supply chain resilience literature. Yet, it is these factors that cannot be acquired in the market but are internally built and therefore might explain a significant portion of why some organizations have high supply chain resilience and others not. These supporting organizational factors have received limited and fragmented attention. Our goal is the address this gap by addressing the following research questions.

Research Question 1:

What are the organizational characteristics that contribute to the supply chain resilience of a firm?

Research Question 2:

What capabilities do organizations have in place to enable a resilient response to supply chain disruption?

Supply Chain Resilience as a Dynamic Capability: A Gap Analysis

A dynamic capability can be defined as "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (Teece et al., 1997). It is a higher-level capability that builds on or supplants operational capabilities (Helfat and Winter, 2011). While operational capabilities build on transformational processes that convert inputs into output (Collis, 1994; Grant, 1996), dynamic capabilities focus on the transformation of the transformation processes themselves. They depend on reconfiguration of existing resources but also may require the need for new ones.

These capabilities are frequently associated with dynamic environments. Environmental dynamism has predominantly been conceptualized through the innovative pressures that firms experience. Yet, dynamism may mean disruptions as much as technological change and the dynamic capabilities needed under these different scenarios are not necessarily one and the same. Makkonen et al. (2014) argued that dynamic capabilities are most critical when they can unlock operational rigidities during shocks. This is also the challenge in supply chain resilience; daily operations motivate companies to create well-established supply chain routines that can be counter-productive during times of crises when a novel, untested response is needed. From a theoretical perspective, supply chain resilience also satisfies the two conditions of dynamic capabilities, as defined by Teece et al. (1997): it is time-sensitive, since it is really dormant except for times of disruption and it involves reconfiguration of existing and new resources. Thus, supply chain resilience can be considered as a dynamic capability as it entails the reconfiguration of current or new supply chain resources to cope with a disruption experienced (Leidner et al., 2009; Ponomarov and Holcomb, 2009).

Similarly, while dynamic capability has received significant empirical attention, little of it is in the context of crises and disruptions. Makkonen et al. (2014) investigating the 2008 financial crises, found that renewing capabilities that help modify their resources base proved more valuable during the financial crisis than regenerative capabilities. Ojha et al. (2013) investigated the use of logistical business continuity planning as a dynamic capability and conclude that it does relate positively to disaster immunity. They build on Eisenhardt and Martin (2000) argument of the need of simplicity, rather than a rigid set of processes, in highly dynamic markets. This, they suggest, reduces the trade-off between the need of efficiency during normal times vs. the need of flexibility during disruptions.

In the works by both Chowdhury and Quaddus (2017) and Brusset and Teller (2017) supply chain resilience is discussed extensively from a dynamic capability perspective, yet the studies are limited to tangible supply chain resilience factors.

Therefore, we conceptualize the firm's supply chain resilience as a dynamic capability and argue that past research ignores some of the fundamental challenges in building resilience. Capabilities are created by three types of resources (Barney, 1991): tangible physical capital resources, intangible human capital resources and intangible organizational & inter-organizational capital resources. The tangible factors of a firm's supply chain resilience such redundancy, flexibility, and visibility build on physical capital resources (e.g. inventory, redundant capacity, volume/mix flexibility) or inter-organizational resources (redundant suppliers, inter-organizational information sharing, etc.). Thus, the discussion on the physical capital resources have dominated the supply chain resilience literature with acknowledgement of the organizational capital resources and just cursory acknowledgement of human capital resources.

Theory Development

Building on Barney (1991) and Blackhurst et al. (2011), we categorize the concepts we identified in literature. We argue that these concepts are usually a combination of different forms of resources. In Blackhurst et al. (2011) concepts identified as organizational resource capital are primarily discussed with respect to the underlying processes or tangible assets rather than the 'soft factors'.

Human Capital Resources

Barton and Christianson (2006) underlined the importance of organizational- and people-oriented soft processes to create resilience, and called for more studies on the topic. Seville et al. (2006) pointed out that resilience issues often relate more to the softer, less tangible aspects of an organization, such as its culture, leadership, vision, and soft managerial practices such as effective communication and relationships within the organization and with key customers and stakeholders. Ates and Bititci (2011) studied the role of culture and change management in resilience in SMEs. Their findings showed that incorporating, developing, and implementing change capabilities is paramount to making progress toward sustainability and resilience in organizations.

The following intangible factors have been suggested as being key to understanding resilience: human resource structures, policies, skill, culture, leadership, and learning (Pettit et al., 2010). These studies do cover some aspects of these factors, but at a relatively limited and cursory level. In this paper, we consider the following: Top management support and leadership, culture, lessons learned and employee empowerment, involvement and commitment. As we will see in the following sections, these concepts are often intertwined.

Top Management Support & Leadership

For changing the culture of an organization, the role of leaders and top managers are critical. Christopher and Peck (2004) noted that within the process of cultural change at the organizational level, nothing is possible without the support and commitment from the leadership. Wilding (2013) stated that instilling a risk management culture requires the leadership to review company policies and practices, to determine their impact on the risk profile of the supply chain.

Top management can support several initiatives that signalled its support for resiliency. The first was to move ownership of the response process from a support function to a line function. Top management also supported that the most capable team closest to the scene would lead the response (Knapp 2016). This is in keeping with the findings of Roberts, Stout, and Halpern (1994) who argued that locus of decision-making also has important implications for organizational resilience. Organizations in which top management centralizes decision making will be less resilient than organizations in which decision-making authority is allowed to migrate downwards and outwards, closer to the actual site where decisions have to be made (Lampel et al., 2014). In today's complex unpredictable environment, responsiveness is more essential for success than efficiency (Nold and Michel, 2016).

Culture

The results of an empirical study by Mandal (2012) showed that a culture of risk management must be embedded in the focal firm and across its supply chain partners. Soni et al. (2014) reported risk management culture as one of the major enablers of resilience.

Culture is difficult to define and even more difficult to change (Sheffi, 2005). Schein (1992) defined organizational culture as the pattern of basic assumptions that a group has created in order to cope with its problems of external adaptation and internal integration. Thus, organizational culture may influence not only how the firm responds internally but also how they contend with the external disruption. Kotter and Heskett (1992) found that culture significantly influenced organizational performance when it either helped the organization to anticipate or adapt to environmental change or interfered with its adaptation.

As resilience contends with a response to unexpected and unanticipated events, the connection between culture and environment made by Trice and Beyer (1993) is pertinent in that organizational culture is a collective response to uncertainty and chaos. "It is important not to underestimate the contribution of culture to an organization's flexibility and resilience. There are many cases in which responses to disruptions cannot be prescribed in a well-defined process, where there is a need for situational awareness and initiative at levels closest to the event and furthest from the headquarters-based strategic planners" (Sheffi & Rice 2005, page 47).

During times of trauma, organizational integrity is disrupted, in order to regenerate the whole system, there needs to be persistent and commonly held dispositions among all organizational members (Kantur and Iseri Say, 2012; p. 766).

Lessons Learned

Lessons learned is a critical part of building resilience (Ponomarov and Holcomb, 2009; Scholten et al., 2014). Learning in the context of crisis can be defined as "identification and the assimilation of practices and behaviours by the crisis unit to improve crisis response" (Chebi and Pundrich, 2015). They can also be considered along what is being learned, how the learning occurs and how learning is distributed and institutionalized (Lalonde, 2007).

Lessons learned can take two forms: a reflection on past failures and an emphasis on near-miss events. Past failures tend to be a strong motivator for change and a good learning opportunity (Chebi and Pundrich, 2015). Studies on lessons learned also emphasize the soft skills that help employees to build internal and external relationships as well as how to effectively during the recovery over technical skills (Crichton et al., 2009).

While learning from the past is considered crucial in building resilience, there are significant barriers against it. The post-crisis analysis period can be too short as organizations lose their focus as they move further away from the crisis period, it is a difficult exercise in self-reflection, day-to-day management issues start to take precedence, people try to offload the responsibility of the analysis or use it for political gain, lessons learned are not considered applicable during normal times and the experiences are considered to be very context specific limiting intra- and inter-organizational learning (Lalonde, 2007). With respect to the last point, organizations tend to take a silo approach to learning. Yet, there is considerable room to identify best practices from cross-sector analyses (Crichton et al, 2009; Lagadec, 1997).

Research on near misses is less developed. The basic premise in 'near misses' is that some accidents and catastrophes could have been foreseen and avoided if the organizations have the capacity to detect and react to the early warning signs. Furthermore, in many cases where these signs were detected, they were either ignored or not shared.

Employee empowerment, involvement and commitment

One of the most detailed studies on understanding the human element of organizational resilience is that by Lengnick et al. (2011), which suggest that "an organization's capacity for resilience is developed through strategically managing human resources to create competencies among core employees, that when aggregated at the organizational level, make it possible for organizations to achieve the ability to respond in a resilient manner when they experience severe shocks". This is achieved through a carefully planned training program as well as work system (Righi et al., 2015; Lengnick et al, 2011). Rice and Caniato (2003) emphasized education and training for security and resilience as the most common practices. The results of an empirical study by Blackhurst et al. (2011) also showed that education and training of supply chain employees was identified as a major factor in enhancing their firm's capabilities in supply chain resilience.

Work systems determine whether employees will take initiative when needed during times of disruptions without the fear of being penalized (Ojha et al., 2013). The role of work systems and training in developing dynamic capabilities has been acknowledged in several studies (Easterby-Smith and Prieto, 2008), particularly empirical studies (e.g. Montealegre, 2002; Ojha et al., 2013). While work systems ensure that employees' contribution to building dynamic capabilities is established by clear roles and rewarded in career development, training prepares them for the decision-making authority and responsibility taking (Anand et al., 2009).

An important tenets of resilience is empowering front-line employees to take initiative and actions quickly on the basis of the facts on the ground" (Sheffi and Rice, 2005; page 47) "Organizations that distribute decision-making power and are successful in getting their employees to be passionate about the company's mission are fundamentally resilient." (Sheffi and Rice 2005; page 48). The expansion of decision-making boundaries is a key resilience construct. Empowered employees will engage in decision-making processes and be able to generate creative solutions with enhanced authority and ability. (p. 767). Employee involvement and empowerment is crucial in order for the employee to exhibit appropriate behaviors when faced with adversity or a chaotic environment (Kantur and Iseri Say, 2012; p. 767).

In addition, an effective training program can enhance resilience skills, which can be defined as "individual and team related skill of any type necessary to adjust performance, in order to maintain safe and efficient operations during both expected and unexpected situations" (Saurin et al., 2014 p. 30). These skills need to be developed with a focus on dealing with unexpected situations (Righi et al., 2015) and can involve both technical and social skills (Ojha et al., 2013). Training can be discussed at the level of the individual, but when considered within the context of resilience, the unit of analysis should be at the organizational level or in other words, "the joint cognitive system" (Hollnagel and Woods, 2005).

Training for resilience is challenging as it requires employees to achieve a fine balance at a time of turbulence and uncertainty. The needed balance is that between finding new and innovative solutions based on systematic thinking and expertise and to still be careful, critical and come up with a feasible solution. Lengnick et al. (2011) assert that the balance can be achieved when the organization supports three sets of factors, namely, cognitive, behavioural and contextual factors. With respect to cognitive factors, a strong sense of organizational purpose, common core values, a genuine vision, a deliberate use of language; constructive sense making and shared mind-set can create the environment where employees explore alternative solutions while still feeling grounded by the common organizational themes that bind them together. On the other hand, learned resourcefulness, ingenuity, bricolage, ability to follow a dramatically different course of action from that which is the norm; development of useful, practical habits especially repetitive, over-learned routines that provide the first response to any unexpected threat and behavioural preparedness establish the behavioural norms to achieve the fine balance between exploring creatively the solution space while at the same time following a still relatively systematic process. Last, the contextual factors including the perception of psychological safety; deep social capital; diffused power and accountability and broad resource networks prepare the environment that induces employees to take ownership problems and act.

The process by which training needs are identified and a training program has been developed has received particular attention in the disaster management literature. Lundberg and Rankin (2014) proposed, based on focus group discussions with crisis response teams, guidelines for the design of training for taking improvised roles. Saurin et al. (2014) discuss how to adapt scenario based training for the particular context of resilience. Wachs et al. (2012), using the case of an electric distributor discuss how to identify the non-technical skills needed and train employees on these skills. An interesting point they raise, is how interdependent the training is with the other organizational factors such as norms, rules and processes. Sometimes the question is not whether training is needed but whether these factors need to be changed.

Physical Capital Resources

With respect to supply chain resilience, there are several physical capital resources that are well established. They are flexibility, redundancy, velocity, visibility and supply chain risk management. This section is brief due to an abundance of research in these areas.

Flexibility, Redundancy and Velocity

Flexibility can be defined as "the ability to change or react with little penalty in time, cost or performance (Upton, 1994). Flexibility itself is a capability (Rice Jr and Caniato, 2003) although an operational rather than dynamic one and it is fundamental in helping organizations respond to emergencies and crises, particularly unexpected ones (Scholten and Schilder, 2015). It needs to be designed in the organizational strategies, systems and structures (Tang and Tomlin, 2008).

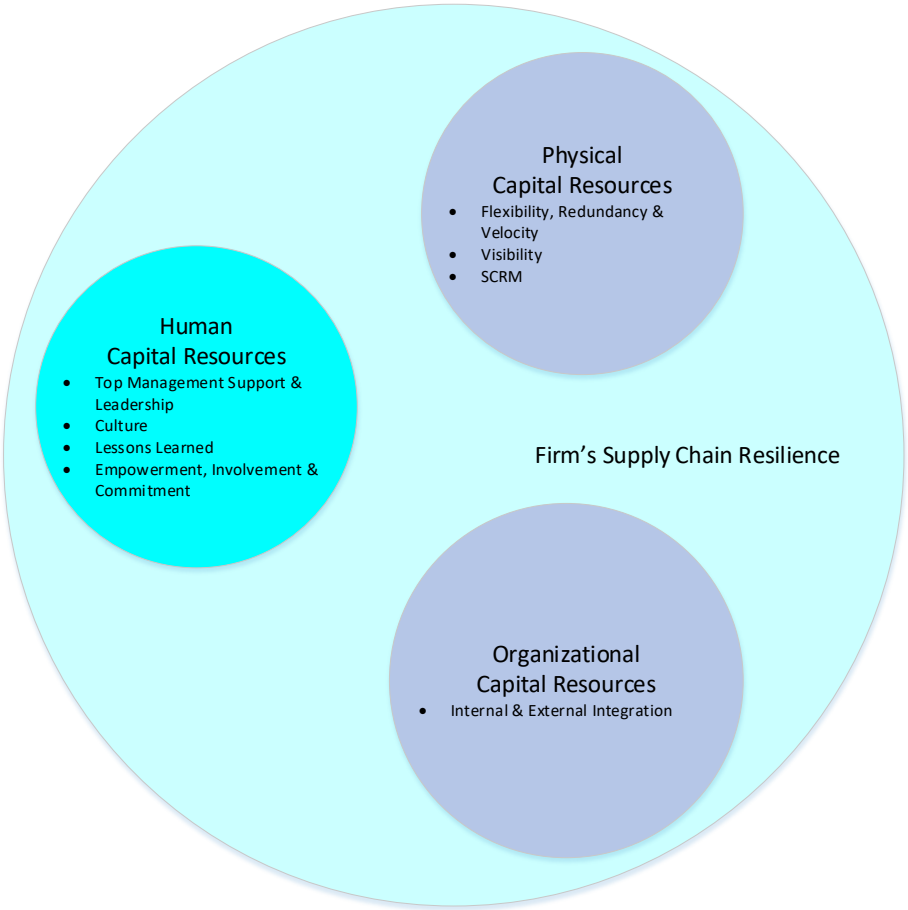

Figure 1 Composition of Construct

Velocity is another concept that is tightly linked to flexibility, either as a part of it (Johnson et al., 2013) or as a complement (Juttner and Maklan, 2011). Such discussions make it very clear that this stream is quite sensitive to concept definitions.

Visibility

Authors have emphasized the need for high levels of visibility in the supply chain (Purvis et al. 2016). Visibility can be defined as the "knowledge of the status of operating assets and the environment" (Fiksel, 2015). Visibility in a supply chain is the extent to which members of a supply chain are able to access or share information which they consider as key or useful to their operations. Visibility emerges through information sharing in collaborative relationships (Brandon-Jones et al. 2014; Christopher Scholten et al. 2014). Given that it is the relationships that support visibility, social capital plays an important role in nurturing relationships where information is shared (Johnson et al., 2013).

Supply Chain Risk Management

Supply chain risk management is a well-developed area in its own right but the various academic perspectives makes it rather difficult to understand where supply chain risk management ends and supply chain resilience begins or even if they are one and the same thing. Juttner et al. (2003)

define supply chain risk management as "the identification of potential sources of risk and implementation of appropriate strategies through a coordinated approach among supply chain risk members, to reduce supply chain0 vulnerability". If we consider the phases of supply chain management including risk identification, risk assessment and risk mitigation, particularly with respect to avoidance or reduction options, this field seems to indeed focus on reducing the vulnerability of the supply chain towards various risks. Yet, others have argued that SCRM is fundamentally about increasing the resilience of the supply chain or that they are one and the same (Chopra and Sodhi, 2014). Perhaps a more nuanced approach is needed to understand their very inter-connected and inter-dependent nature. When one considers different risk mitigation options such as increasing flexibility, it can be seen that they are designed to increase resilience by reducing vulnerability (Christopher and Peck, 2004). As a matter of fact, concepts such as flexibility, redundancy, and visibility are as integral to risk literature as they are to resilience literature. But, there is still the question of how do organizations recover from disruption, particularly the unexpected disruption. All those above-mentioned capabilities should help (Scholten et al., 2014). Yet, even when most of them are not in place, the company may be able to recover by creative thinking or recombining previous capabilities in very novel ways. Alternatively, all those practices do not ensure that the company will recover from a disruption (Scholten and Schilder, 2015).

Organizational Capital Resources

Internal and External Integration

In the work of Blackhurst et al. (2011) it was identified that organizational and inter-organizational capital resources, defined as intangible assets of the firm that include the coordinating of systems or the relationships between the focal firm and firms within the supply chain are supply chain resiliency enhancers. Pettit et al. (2010; 2013) identified collaboration, defined as the ability to work effectively with others for mutual benefit, as a capability factor to be considered in SC resilience. Christopher and Peck (2004) included supply chain collaboration (planning and intelligence) as one of the four principles of creating a resilient supply chain.

Conclusion

The topic of supply chain resilience has become increasingly important as supply chains have become leaner and customers more demanding of consistent execution. Supply chain resilience is the ability to prepare for unexpected events, respond to disruption, and recover while maintaining control over supply chain function (Scholten et al., 2014). Resilience is also the ability to be adaptive and capable of sustained response to sudden shifts in output. In this article we have proposed a model of supply chain resilience, building on prior research, that emphasizes "soft" intangible factors over the tangible factors. Intangible factors include: leadership and top management commitment, culture, lessons learned, empowerment, involvement, and commitment.

The contribution to theory of this paper is to explicate a more complete model of supply chain resilience than has been published to date as far as the authors can identify. The contribution to practice is a greater awareness of all that is required to create resilient supply chains, and the importance of top management support in this or it will never be completed.

For future research we propose empirical test of the model is a logical next step to this stream of research. Empirical testing should establish the overall validity of the model, the relative importance of human capital, organizational capital resources, human factors in creating supply

chain resilience. Secondly, empirical research will serve to quantify the relative importance of each construct. The contribution to practice is

Limitations.: The model is bounded to the manufacturing and retail sectors implicitly since the nature of transactions and strategic importance of suppliers.

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