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Understanding the supply chain resilience: a Dynamic Capabilities approach

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Abstract

This paper proposes to view the resilience of supply chains in a dynamic capabilities perspective. Both concepts are defined and their characteristics are analyzed in order to better understand their significations and to establish a link between them. We define supply resilience as the ability to bounce back from disruptions and to permanently deal with and respond to the changing environment. The link between the two literature reviews is made by adopting a process view of both concepts, namely the process of adaptation, absorption and innovation to create and sustain competitive advantage. We then build two propositions that will be used for future empirical testing.

Keywords: Supply Chain Risk Management, Supply Chain Resilience, Resource-Based View (RBV), Dynamic Capabilities (DC)

1. INTRODUCTION

Since the end of 20th century, managing risk has become an important topic in supply chain management. This concern was stimulated by various kinds of risks, in particular by certain severe attacks which may have led to supply chain disruptions in the global context, for instance the natural hazards (e.g. earthquakes, tsunamis, inundations, and etc), man-made disasters (e.g. strikes, terrorists, hacker attacks, and etc) and fluctuations in economic markets (e.g. financial crises, resource wars, and etc).

As the supply chain disruption risks have been proven to cause significant impacts on a firm's short-term performance (Tang 2006a, Shukla et al 2011), managers and researchers have been devoted to design a new type of supply chain capable to survive disruptions and to efficiently recover after ruptures. The concept of resilience reflects this capacity, implying the ability to bounce back from disruptions and return to its original state after being disturbed (Christopher and Peck, 2004; Sheffi 2005). Supply chain resilience has injected new vigour into the research in the field of supply chain risk management. Nevertheless, the conceptualization of supply chain resilience remains ambiguous and the process of implementing resilience in supply chain remains unexplored.

In Resource-Based view (RBV), organizational capabilities have been identified as one major source for generation and development of sustainable competitive advantages (Schreyogg and Kliesch-Eberl, 2007). These capabilities are dynamic and focus on rapidly creating situation-specific new knowledge according to the degree of environmental dynamism (Eisenhardt and Martin 2000). As a key organizational capability of risk-concern, supply chain resilience has often been studied on its strategies, practices or mechanisms (Tang 2006b, Sheffi 2007, Waters 2008). So we propose and will prove that the RBV could offer a theoretical framework to better understand the supply chain resilience. Furthermore, the concept of dynamic capabilities helps us learn the changing patterns of organizations in the supply chain and the development of

resilient capabilities to match the changing environment and sustain competitive advantages from risks.

In this paper, we first review the research literature to obtain a thorough understanding of supply chain resilience. Then we analyze this notion in the context of resource-based view of the firm, relating to a dynamic capabilities view. At last, we look for the similarity between the characteristics of supply chain resilience and the factors of the dynamic capabilities development process.

2. WHAT IS SUPPLY CHAIN RESILIENCE?

2.1 Managing risks and vulnerabilities requires supply chains to be resilient

Supply chain risks and vulnerabilities have recently received significant attention. Supply chain risk refers to the variation in the distribution of possible supply chain outcomes, their likelihood, and their subjective values, comprising “any risks for the information, material and product flows from original supplier to the delivery of the final product for the end user” (Juttner et al, 2003). Supply chain vulnerability is the result of risk, as an exposure to serious disturbance arising from the risk inside or outside of the supply chain (Christopher and Peck 2004, Briguglio et al 2009).

The changing environment with diverse uncertainties make the occurrences and consequences of risk unpredictable, especially for the extreme events with rare occurrences but severe impacts, such as fire, earthquake, terrorism etc (Zsidisin et al. 2000, 2004, Hasuser, 2003). In particular, researchers found the greatest weakness of daily risk management, which is its inability to adequately characterize low-probability, high-consequence events (Chopra and Sodhi 2004, Sheffi and Rice 2005, Kunreuther 2006). Disruptions often occur in the supply chain by following these events, of supply, demand or logistics. At the same time, the vulnerability of the supply chain, as an other threat to the operation, is the manifestation of the inherent state of the system (e.g., physical, technical, organizational, cultural) that can be exploited to cause harm or damage to the system (Haimes, 2006).

Facing the extrinsic risks and inherent vulnerabilities that contribute to potential supply chain disruptions, the firms are driven to seek ways to anticipate, absorb, and finally overcome these threats. In such circumstances, the concept of resilience was emerged, implying the ability of an organization to confront the unforeseen (Sheffi, 2005). The supply chain should not only continue functioning with risk tolerance, but also continue to satisfy their customers when the risks are recognized by containing the damage occurred (Gaonkar and Viswanadham 2004, Tang 2006a). The resilient supply chain has therefore been proposed, as an important complementary perspective in High Reliability Theory, aiming at developing a high degree of organizational reliability for specific supply chain at risk, which focuses on the processes that a firm can implement to ensure continued organizational reliability and reduce or even eliminate the possibility of accidents (Roberts 1990a, b, Perrow 1994). By Waters (2008), a resilient supply chain is no longer vulnerable facing the risk attacks. Moreover, this resilience ability makes firm better positioned than competitors, hence gaining a competitive advantage from disruptions (Sheffi 2005).

2.2 Resilience, a multidimensional concept

The concept of resilience has been studied in different disciplines of science. From the physical origin such as metallurgy, the resilience implies the ratio of necessary kinetic energy absorbed to induce rupture of a metal, to the acreage of surface of the broken section (Lighezzolo and De Tychey, 2004). In the eyes of psychologists and sociologists, the resilience is more like a characteristic trait, as a personal ability to withstand the trauma and to rebuild oneself after the trauma (Tisseron 2007) or “*a dynamic capacity to modify his or her model level of ego-control, in either direction, as a function of the demand characteristics of the environmental context*” (Block and Block, 1980, p. 48).

Transferred into management science, the resilience emerged in the crisis management and the theory of High-Reliability Organizations (HROs) (e.g., nuclear power plants, nuclear aircraft carriers, and air traffic control) which are considered as “a

source of valuable lessons for how all organizations can minimize error and handle peak demands” (Weick and Sutcliffe, 2001). The term resilience in management field is defined as capability or quality:

“the ability of an individual or organisation to expeditiously design and implement positive adaptive behaviors matched to the immediate situation, while enduring minimal stress”

or

“a fundamental quality of individuals, groups, organizations, and systems as a whole to respond productively to significant change that disrupts the expected pattern of events without engaging in an extended period of regressive behavior” (Kendra and Wachtendorf, 2003).

In the supply chain field, the concept of resilience is related with risk and vulnerability in the way that not all the risk could be completely avoided, controlled, or eliminated (Christopher and Peck, 2004; Peck, 2006). Supply chain resilience is often considered as a capability, as the ability to bounce back from a disruption (Sheffi and Rice, 2005), or the ability of the system to return to its original state or an optimal state after the disruption (Christopher and Peck, 2004), or *“the intrinsic ability of an organisation (system) to maintain or regain a dynamically stable state, which allows it to continue operations after a major mishap and / or in the presence of a continuous stress”* (Hollnagel et al, 2006).

As the external environment of supply chain is changing radically, organizations in the supply chain focus more on keeping a dynamic equilibrium than returning to its initial state after a perturbation. Supply chain resilience is rather the aptitude of system to regain its equilibrium state after a disturbance (Dauphiné and Provitolo, 2007). Different from the robustness, resilience is the ability to adjust to harmful influences rather than resist them. A resilient supply chain can absorb the effect of disturbances and regain normative or characteristic structural or functional attributes following a perturbation.

3. SUPPLY CHAIN RESILIENCE FROM A DYNAMIC CAPABILITIES PERSPECTIVE

3.1 Supply chain resilience: a strategic tool for firms' competitive advantage in dynamic environments

In the last section, we have learned that the supply chain resilience is a capability of organizations. The supply chain resilience no longer implies merely the ability to manage risk. More important, this ability enables a company to be in a better position than competitors to deal with, and even gain advantage from disruptions (Sheffi, 2005). The development of resilience encourages the optimization of actors, relations, activities and functions of supply chain which is formed by connected and interdependent organizations (Peck, 2006). To gain this aptitude, a series of strategies are proposed to integrate, to reconfigure resources, to renew and to recreate the advantages, for example, multiple suppliers, safety inventory storage, responsive price strategy, postponement strategy (Tang 2006a, b, Sheffi 2007). This emphasis on capability and strategy can be found similarly in Resource-Based View (RBV) which focuses on the thinking that resources and capabilities as the genesis of competitive advantage.

The RBV has enriched the knowledge of differential firm performance and elevates the understanding of strategic management, which gives equivalent attention to firms' strengths and weakness versus external opportunities and threats (Wang and Ahmed, 2007). In theory of RBV, the VRIN (valuable, rare, inimitable and non-substitutable) resources of a firm are essential to enable or limit the choice of markets the firm may enter, and the level of profit it may expect (Wernerfelt, 1984). But in a volatile, unpredictable environment, when firms cannot perceive advantages from resources, distinctive capabilities are essential to a firm to make better use of its resources (Wang and Ahmed, 2007), and these capabilities need to be dynamic (Shrejogg and Kliesh-Eberl, 2007). Distinctive capabilities need to be developed to deal with periods of high turbulence (Hamel and Välikangas, 2003), in high velocity markets (Eisenhardt and Martin, 2000) and in rapidly changing environments (Teece et al, 1997). Firms should be

able to achieve dynamic fit with these types of environments (Rindova and Kotha, 2001). Teece et al. (1997) describes these dynamic capabilities as “the key role of strategic management in appropriately adapting, integrating, and reconfiguring internal and external organizational skills, resources, and functional competencies to match the requirements of a changing environment”.

3.2 The dynamic capabilities view

Like the Resource-Based view, the Dynamic Capabilities (DC) based view focuses on core issues such as the competencies and the firm's performance but in a dynamic perspective (Esterby-Smith et al. 2009). The DC based view answers the limitations of the resource based view while addressing issues concerning varying environmental dynamism and sustainable competitive advantage. Even though there exists a “dynamic resource-based view” (Helfat and Peteraf, 2003), the concept of DC deals with change (Leoncini and Montresor, 2007). According to Romme et al (2010, p. 1271), the DC concept “*lies at the heart of the organizational ability to enact change in a systematic and fruitful way*”. It questions how resources and capabilities of the firm can be adapted, integrated or modified constantly to deal permanently with change in the environmental context.

Similar with the emergence of resilience, the environmental context is considered as a key factor in the deployment of DC. Several authors underline the role of environmental dynamism and the way DC can be developed. For example, Eisenhardt and Martin (2000) analyse the role of DC in moderately dynamic and highly dynamic environments. They explain the way DCs are deployed in these kinds of environments is different. DC for the first issue consist in simple routines with stable, detailed and analytic processes and in highly dynamic markets, they consist in highly experiential processes with unpredictable outcomes (Eisenhardt and Martin, 2000, p. 1105). Moreover, several studies have proven the role of networks in capability development. For example, Dyer and Singh (1998) propose a relational approach to explain firm's competitive

advantage. Lavie (2006) extended their work and to explain the link between different network configurations and the appropriation of the relational rent. We can thus consider that firms in networks benefit from a relational capability that enables them to collaborate and benefit from these exchanges.

Teece (2007) define DC as the ability to sense opportunities and threats in the environment, to shape these opportunities and threats and the different resources and capabilities needed to respond to them and then, to seize the opportunities. In fact, resilience capacity influences an organization's response to environmental change in two important ways. First, resilience capacity encourages a company to develop a broad and varied repertoire of routines for responding to uncertainty and complexity. Second, resilience capacity encourages a company to think about its environment in ways that improves its ability to determine both the content and the duration of the change (Lengnick-Hall and Beck, 2005). And resilience capability enables the firm to improve its responses to crises and capitalize on past experiences to better respond to crises that can occur in the future.

However, resilience can be a source of competitive disadvantages if it does not enable the reconfiguration or replacement of core capabilities of the firm (Webb and Schlemmer, 2006)

We build our conception of DC on the definition given by Wang and Ahmed (2007) to better understand the capability of resilience. As many authors adopt a process based view of DC, and building on the several definitions presented, we propose that DC consist in organizational and managerial processes that enable the organization to adapt to changing configurations in its dynamic environment, through constant integration, recombination, alignment and reconfiguration of its resource base.

Therefore, we propose that:

Proposition 1, the dynamic environment, which is the antecedent to supply chain resilience, is also antecedent to dynamic capabilities

4. CHARACTERIZING RESILIENCE AS A DYNAMIC CAPABILITY

4.1 Characteristics of Supply Chain Resilience

It is known that organizations can thus deploy or develop specific dynamic capabilities such as idea generation capabilities, market disruptiveness capabilities, new product development capabilities, marketing capabilities or new process development capabilities (Esterby-Smith et al, 2009). Resilience capability seems to be in the last group of capabilities mentioned.

The resilience should be not only defensive: absorbing the negative impact of the realization of risk, or reacting to a perturbation; but also proactive: in the ways the organization anticipates threats through learning from past experiences of disruptions. For example, Weick and Sutcliffe (2007) argued that resilience holds three dimensions:

- 1) Absorption capacity, enabling the company not to encounter the unexpected collapse or shock;
- 2) Renewal capacity, by which it can invent new futures;
- 3) “Ownership” capacity, enabling the company becomes stronger from the experiences.

Lengnick-Hall and Beck (2009) also proposed that the resilience is the capacity to absorb, to respond and to capitalize the perturbations caused by environmental changes.

These characteristics are actually three types of abilities: absorbing the impacts to adapt changing environment, renewing and reconfiguring resources, and integrating the knowledge of experience into innovating. The absorption ability aims to absorb the disruption, to withstand the effect of the shock and therefore keep the supply chain robust. The responding ability focuses on an adequate and agile reaction to variations in the supply chain, such as demand and supply. These two former abilities are often built by measures that emphasis the agility, flexibility and redundancy, for instance, saving buffer for delivery time, holding safe stock, flexible logistics channels and multiple sourcing, etc. However, the capitalization ability is rather a process of learning, or a fulfillment of a

self-development. The concern on learning ability is generally enforced by building a complete quality system, such as utilization of standard operation process, updating the databases after perturbation, ensuring the continuous improvement of the system of the supply chain.

4.2 Component factors of Dynamic Capabilities

As the “firm’s ability to integrate, build and reconfigure internal and external competencies to address rapidly changing environments taking into account the role of path dependency and market positions” (Teece et al., 1997, P. 516), dynamic capabilities are either viewed as organizational processes, either as mechanisms active in processes or as strategic functions in the organization (Altintas, 2011).

Similarly, Ambrosini and Bowman (2009) highlight that DCs are related to organizational processes such as: reconfiguration, leveraging, learning and integration (Ambrosini et al, 2009, S11).

Dynamic capabilities are mostly related to the core processes of adaptation, integration and coordination and reconfiguration (Menon, 2008). Wang and Ahmed (2007) define DC as “*a firm’s behavioural orientation constantly to integrate, reconfigure, renew and recreate its resources and capabilities and, most importantly, upgrade and reconstruct its core capabilities in response to the changing environment to attain and sustain competitive advantage.*” The authors argue that DCs are not only processes but are embedded in the processes. They classify capabilities into three orders and the most important order is the third one which enables the firm to be in “*constant pursuit of renewal, reconfiguration and re-creation of resources, capabilities and core capabilities to address the environmental change*” (Wang and Ahmed, 2007, p. 36). They identify three component factors of DC, i.e, adaptive capability, absorptive capability and innovative capability.

Adaptation consists in the firm’s ability to align its strategy to changes in its environment and to capitalize on emerging markets opportunities (Wang and Ahmed,

2007). Adaptive capacity is the firm's ability to seize the opportunities present in its environment and is different from adaptation according to Chakravarthy (1982). While adaptation concerns a state, adaptive capability consists in the permanent ability to search new opportunities and explore new possibilities, for example, Rindova and Kotha (2001) through the case analysis of Yahoo. And Excite explain how the form; function and competitive advantage of firms co-evolved. DCs are expressed in these cases as the adaptiveness of the firm to its dynamic environment and imply strategic flexibility. The dynamic fit between the firm's resources, capabilities and processes and its changing environment thus reflects its adaptive capability. The changes experienced by the firm are considered as continuous morphing that includes significant changes and profound transformations of resources, capabilities and structures to deal with dynamism (Rindova and Kotha, 2001).

It has been underlined that firms with higher order supply chain integration capability experience sustainable performance (Rai et al., 2006). The "strategic fit" aspect of this DC (Teece, 2007) is fundamental in supply chains which are characterized by the necessary integration and adaptation of resources, information and activities for strategic ends.

Absorptive capacity is the second type of DC underlined by Wang and Ahmed (2007). It reflects the firm's ability to identify *"the value of new, external information, assimilate it, and apply it to commercial ends"* (Cohen and Levinthal, 1990). Learning plays a great role in the process of absorption. It is considered as the ability of the firm to acquire, assimilate, transform and exploit knowledge that already exist and create new knowledge (Zahra and George, 2002). The learning process thus enables the firm to modify its resource base. Learning is possible through the absorptive capacity of the firm, which consists in the firm's ability to generate new knowledge and capabilities by deploying the resources and knowledge already present inside and outside the firm.

These capabilities are highly developed in supply chains since the latters are built on

partnering, both vertical and horizontal. Dyadic relationships have been proved to enable access to external sources of resources and competences and to favor the creation of specific rents (Dyer and Singh, 1998). More complex network relationships are also known to facilitate or inhibit the appropriation of the rent created by the interactions of complementary and competitive actors in a network (Lavie, 2006). Since absorptive capacity deals with the upgrading of internal knowledge through external sources, it is hence facilitated by the web of heterogeneous relationships that are enabled in supply chains.

Innovative capability consists in the aptitude of the firm to develop new products and markets (Wang and Ahmed, 2007, Eisenhardt and Martin, 2000). For example, Shamsie et al. (2009) characterize the development of new films as a DC to deal with the highly dynamic environment of film-making.

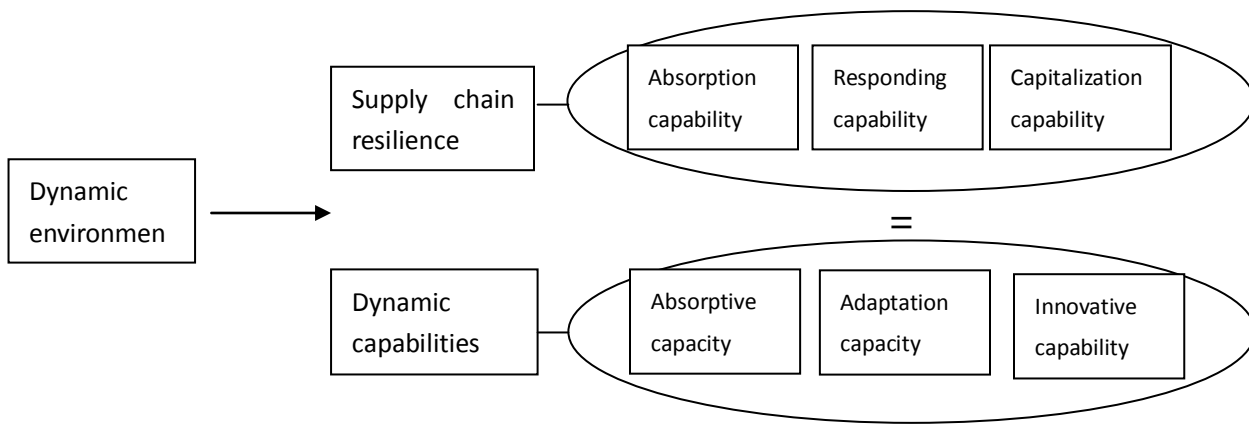
Mitchell et al. (2007) analyze the acquisition dynamic capability as the aptitude of the firm to realize new acquisitions modifying its resource base through implementing new resources in the organization. This DC consists in the selection, the identification and reconfiguration of resources.

In supply chains, innovative capability enhances competitive advantage because relationships are strategically built and assembled by several firms to benefit from different and complementary resources and capabilities for innovative outcomes.

Hence, we argue that:

Proposition 2, the factors of supply chain resilience: absorption capability, responding capability, and capitalization capability match the factors of dynamic capabilities: absorptive capacity, adaptive capacity and innovative capability.

The diagram below illustrates the process of supply chain resilience and dynamic capabilities and the important role of the environmental context:



5. CONCLUSION

The purpose of this paper is to establish the link between supply chain resilience and dynamic capabilities. As we have mentioned, several characteristics in both literatures are common. First of all, dynamic capabilities are known to be efficient when deployed in dynamic environments. This is also the case for resilience which is a capability that enables firms to absorb shocks and deal with turbulences. Secondly, both literatures highlight the process aspect of both concepts.

The result of our research suggests that supply chains that possess resilience capability are better suited to respond to crises. They are also better in capitalizing on past experiences to respond to future turbulences. We propose that resilience is a dynamic capability that enables firms to perform in a dynamic and turbulent environment, and constantly reconfigure its resources and capabilities.

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