

Open Research Online

The Open University's repository of research publications and other research outputs

Key Organisational Factors to Building Supply Chain Resilience: a Multiple Case Study of Buyers and Suppliers

Journal Item

How to cite:

Pereira, Carla Roberta and Da Silva, Andrea Lago (2015). Key Organisational Factors to Building Supply Chain Resilience: a Multiple Case Study of Buyers and Suppliers. *Journal of Operations and Supply Chain Management*, 8(2) p. 77.

For guidance on citations see [FAQs](#).

© 2017 FGV/EAESP



<https://creativecommons.org/licenses/by/4.0/>

Version: Version of Record

Link(s) to article on publisher's website:

<http://dx.doi.org/doi:10.12660/joscmv8n2p77-95>

Copyright and Moral Rights for the articles on this site are retained by the individual authors and/or other copyright owners. For more information on Open Research Online's data [policy](#) on reuse of materials please consult the policies page.

SPECIAL ISSUE

Article invited

DOI: <http://dx.doi/10.12660/joscmv8n2p77-95>

Key Organisational Factors For Building Supply Chain Resilience: A Multiple Case Study Of Buyers And Suppliers

Carla Roberta Pereira

PUC-Campinas
pereiracz@gmail.com

Andrea Lago da Silva

UFSCar
deialago@hotmail.com

ABSTRACT: Achieving resiliency along the supply chain requires internal and external effort from all members of the chain. The purpose of this paper to identify key organisational factors for building resiliency in the supply chain, and to understand how these factors can influence the development or enhancement of supply chain resilience. To do so, a multiple case study was performed on different supply chains to validate organisational factors identified in the literature. As a result, ten organisational factors (six internal and four external) were highlighted and propositions were developed after a cross-case discussion to affirm the influence of them in building or enhancing supply chain resilience.

Keywords: Supply Chain Resilience, Organisational Factors, Case Study.

1. INTRODUCTION

Recognising the increasing number of events that have been hampering thousands of supply networks, recent studies have emphasized the great importance of identifying sources of risk that might threaten business, in order to create effective actions to mitigate them. Extensive examples are easily found in the literature along with historical cases of tsunamis, epidemics, and terrorist attacks. The World Economic Forum (2015) has published a report about the most likely and severe risks that might occur globally, and it is clear how risks from different categories (economic, environmental, geopolitical, societal and technological) are connected and may influence each other. Consequently, they are very likely to cause supply disruptions, which potentially end up having great impacts for small to large businesses throughout the complex global network. Furthermore, this report highlights political and environmental instability as a high societal risk, and Brazil has been highlighted in it due to the many protests against corruption, and urban issues due to climate change.

The percentage of global companies reporting a loss of income due to a supply chain disruption increased from 28% in 2011 to 42% in 2013 (Sáenz and Revilla, 2014). In this context of increasing numbers of natural and man-made disasters, businesses from every sector have vividly demonstrated the recent need for changes to traditional strategies, especially companies that depend on timely delivery of materials. The concept of supply chain resilience brings forward the idea of developing effective actions in preparing, responding and recovering from any disruptive event by means of resource management (Ponomarov and Holcomb, 2009). Creating resilient actions along the supply chain to respond to the most recent likely risks and disasters is therefore a way to assure competitive advantage and survival.

In this regard, scholars have seen this topic as a great opportunity to be explored and thus helping practitioners with business continuity and competitive advantage (Sáenz and Revilla, 2014; Pereira et al., 2014; Ambulkar et al., 2015). Although several researchers (e.g. Sheffi, 2001; Christopher and Peck, 2004; Brandon-Jones et al., 2014; Fiksel et al., 2015) have explored ways to better cope with unexpected events and the consequent unplanned outages, scant attention has been paid to investigating the main internal and external organisational factors for building resiliency in the supply chain. The purpose of this pa-

per is twofold: to identify key organisational factors to building resilience in supply chains, and to understand how these factors can influence the development or enhancement of supply chain resilience.

This paper is structured as follows. Section 2 reviews the literature on supply chain resilience, and the internal and external organisational factors identified that help to create supply chain resilience. Section 3 reveals the research methodology, followed by section 4 which discuss details from each case regarding internal and external organisational factors. Section 5 presents the framework for building resiliency, and develops propositions for each of the organisational factors after the cross-case analysis. Finally, section 6 draws the final conclusions and points out further research opportunities.

2. LITERATURE REVIEW

2.1 Supply Chain Resilience

The term 'resilience' was not well-known in business in the past and, to some extent, its meaning nowadays is still limited to a minority of researchers within the supply chain management field. From Latin *origem* (*resilire*), resilience means to leap back or to rebound. Thus, this concept can be explained as "the ability of an entity or a system to 'recover form and position elastically' following a disturbance or disruption of some kind" (Simmie and Martin, 2010, p.28). Ergo, the concept of resilience has also been applied to different subjects such as ecology, psychology, economy, social, and organisational approaches to demonstrate the capacity of any system to return to the equilibrium state after a temporary disturbance. Because of this overarching view, resilience has become a multi-dimensional and multidisciplinary phenomenon in the last forty years (Ponomarov and Holcomb, 2009; Pereira et al., 2014).

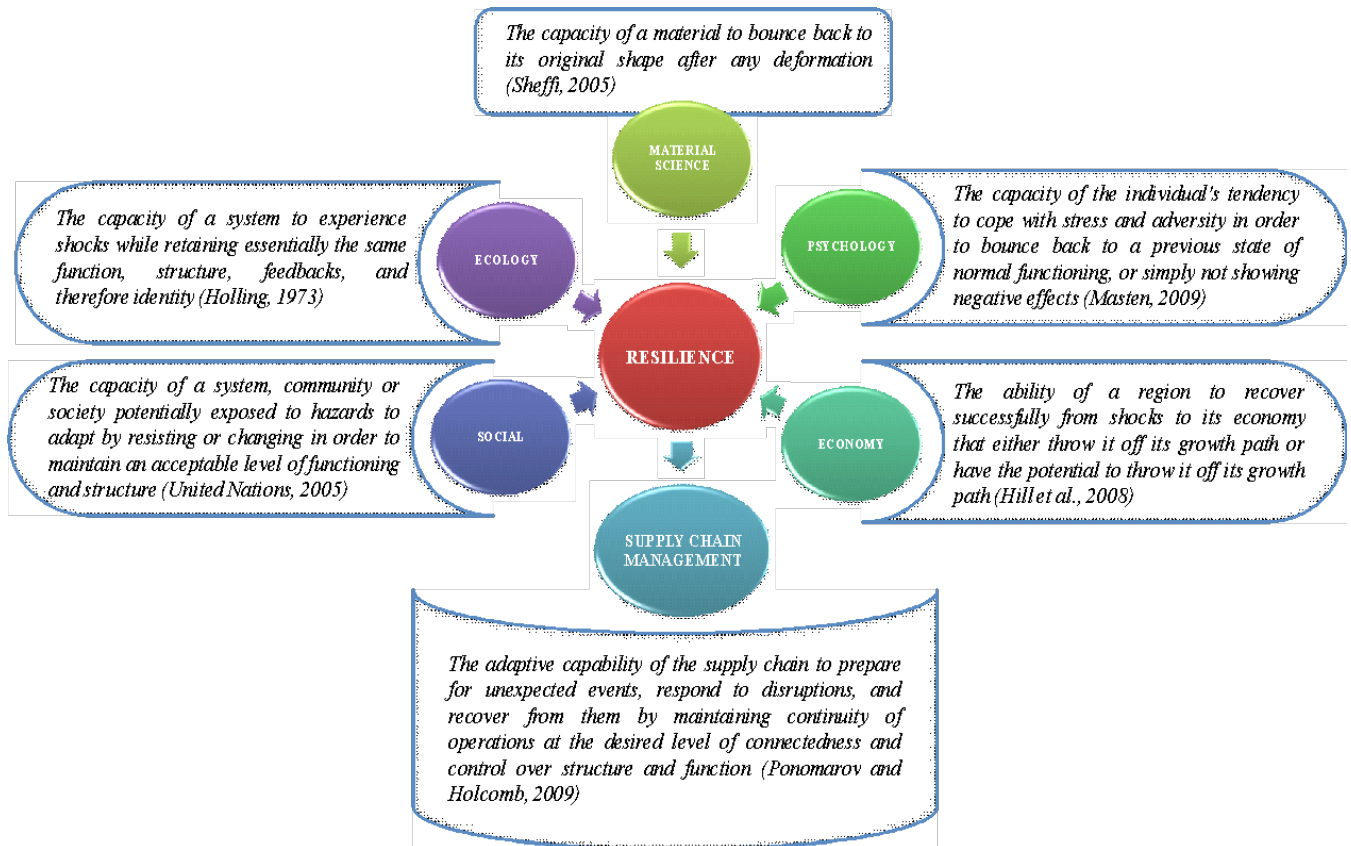
In accordance with this, Figure 1 illustrates the definitions of the resilience concept in different research areas, with noted similarities. Today there are many definitions of supply chain resilience proposed by different authors in the operational management area. Hohenstein et al. (2015) listed 46 definitions from 2003 to 2013. Nevertheless, it is noteworthy that the general idea is consistent. Thus, the definition of supply chain resilience followed in this study is the capability of supply chains to prepare for unexpected events so as to be able to respond to and recover from them in a way to restore operations to

the previous performance level, or even to a new and higher level.

Admitting that almost every supply chain faces supply disruptions of varying severity and types (Wieland, 2013; Golgeci and Ponomarov, 2013, Treiblmainer, 2014), Christopher and Peck (2004) classified those disruptions into: internal, external and environmental. Being prepared for any future

disruptive event enables companies to create efficient and effective responses, and therefore are less vulnerable to disturbances (Ponomarov and Holcomb, 2009; Pettit et al., 2010; Azevedo et al, 2013b; Scholten et al., 2014). For this reason, resilience is recognised as a responsive capability for firm performance as well as a key factor of a firm’s survival (Golgeci and Ponomarov, 2013).

Figure 1. Definitions of resilience in different areas



Source: created by the author

2.2 Internal and external organisational factors that challenge the building of supply chain resilience

In a general way, it is known that every buyer seeks to ensure that all orders are placed with the right amount, at the right time, at the right place and for the right quality, while suppliers are responsible for fulfilling that buyer’s requirements. However, satisfying all of these “rights” has never been an easy task for supply managers. Lately, these objectives have been a challenge for those that wish to enhance

the value of the products/service as well as satisfying customers.

The challenge is therefore to help organisations to develop efficient capabilities through their own resources to cope with rapid-onset events. Based on that, agility in threat detection and response, collaboration and information sharing among supply chain members, besides assertive decision making to overcome different kinds of disruptions are crucial to enabling to companies continue their busi-

ness without significant impacts (Pereira et al., 2014; Sholten et al., 2014; Ambulkar et al., 2015; Van der Vegt et al., 2015). How to better prepare for an efficient response and recovery from such unforeseen disruptions is considered an important capability, which is called here as resilience.

To achieve supply chain resilience through the actions of buyers and suppliers, internal and external organisational factors were identified in the literature as ways of building this capability. Table 1 exposes the internal and external organisational factors and the corresponding references.

Recognising that the knowledge built up by managers and employees from their experiences throughout the years makes them more prepared and competitive in general, the backup of any information

from a company’s development should be an important dataset to be kept safe. In this regard, developing and updating this kind of database can help professionals to manage and monitor risk from previous experiences and hence be more capable of mitigating future risks and creating resilience. All information recorded (knowledge acquired and backup) by the company can be used to train employees, conduct effective post-disruption analysis, understand the total cost of supply chain management (Blackhurst et al., 2011), and closely monitor the contingencies from various risk resources (Jüttner and Maklan, 2011). Therefore “the capacity to learn from past disruptions to develop better preparedness for future events is a principal property of resilience” (Ponomarov and Holcomb, 2009, p.137).

Table 1. Internal and external organisational factors

Internal organisational factors	References	External organisational factors	References
Knowledge Acquired and backup	Sheffi (2001); Christopher and Peck (2004); Svahn and Westerlund (2009); Blackhurst et al. (2011); Jüttner and Maklan (2011); Azevedo et al. (2013b)	Strategic Sourcing	Zsidisin et al. (2000); Sheffi (2001); Zsidisin (2003); Blackhurst et al. (2005); Sheffi and Rice (2005); Tang (2006a); Svahn and Westerlund (2009); Zsidisin and Wagner (2010); Yang and Yang (2010); Blackhurst et al. (2011); Christopher et al. (2011); Stecke and Kumar (2009); Carvalho et al. (2012a); Simangunsong et al. (2012); Azevedo et al. (2013b)
Inventory	Sheffi (2001); Christopher and Peck (2004); Stecke and Kumar (2009); Zsidisin and Wagner (2010); Carvalho et al. (2012); Azevedo et al. (2013b)	Design of the Supply Chain	Christopher and Peck (2004); Blackhurst et al. (2005); Tang (2006a); Christopher et al. (2011); Blackhurst et al. (2011); Carvalho et al. (2012b); Spiegler et al. (2012).
Product Flexibility	Tang (2006a,b); Sheffi and Rice (2005); Stecke and Kumar (2009); Yang and Yang (2010); Blackhurst et al. (2011)		
Technology to communication and early detection of disruptions	Sheffi (2001); Christopher and Lee (2004); Blackhurst et al. (2005); Sheffi and Rice (2005); Tang (2006b); Tachizawa and Gimenez (2010); Christopher and Holweg (2011); Carvalho et al. (2012b)	Transportation	Sheffi and Rice (2005); Tang (2006a); Stecke and Kumar (2009); Azevedo et al. (2013b)
Risk Management	Christopher and Peck (2004); Zsidisin (2003); Colicchia et al. (2010); Christopher et al. (2011); Azevedo et al. (2013b)		

It is asserted by Christopher and Peck (2004) that safety stock or a “slack” in the inventory can also be a fundamental way to create supply chain resilience. If any unexpected incident happens, the company can easily overcome that situation by holding inventory (Zsidisin and Wagner, 2010), especially of critical items. Although redundancy may be considered a good strategy to create re-

sponsiveness, it is important to remind that it only affords the company with extra time to think about next actions (Zsidisin et al., 2000).

The way products are designed and assembled may be a strategic manner to cope with unpredictability by increasing flexibility and responsiveness of the processes. The success of Dell after the earthquake

in Taiwan is a good example of product flexibility. As product designs and supply chain processes are demand-based, Dell was able to change the configuration of their computers and keep the manufacturing and sales without huge losses (Sheffi and Rice, 2005; Tang, 2006b). Consequently, the more complex the products' configuration becomes, the more difficult is the recovery from any supply chain disruption (Blackhurst et al., 2011).

Technology is considered a powerful tool to share and spread information nowadays. Tachizawa and Gimenez (2010) affirm that the adoption of technology tools, such as EDI (Electronic Data Interchange), can help to integrate organisational processes. In this sense, having tools to facilitate communication is a good way to improve responsiveness in times of disruption. Sheffi and Rice (2005) report the case of UPS after the shutdown of the United Parcel Service of America's air hub due to a severe blizzard in Louisville (January, 1996). After the UPS recovery, which was successful because of its flexible processes, UPS developed its own weather service in order to avoid future disruptions. In fact, it is reported by the same authors that this software can work much better than National Weather Service in forecast accuracy.

Colicchia et al. (2010) assert that a better understanding of the risk sources for specific supply chain settings can enable the design of a more resilient supply chain. Additionally, Zsidisin et al. (2005) describe four processes to prevent discontinuities: risk identification (enumerating the causes/sources of potential supply chain disruptions); risk assessment (evaluation of the probability of occurrence and the impact an event will have on the business); risk treatment (strategies development for reducing their probability and/or mitigating their impact on the business); and risk monitoring (looking at developments in the supply chain that may increase or decrease risks on an on-going basis). Therefore, by managing risk and their effects on business, companies become a more prepared function to manage, and hence deal with, disruptive situations.

Decisions regarding supplier base, supplier relationship and development, and criteria for supplier are essential to develop valuable sourcing strategies. Thus, determining the supplier base (sole or multiple for each item) is one of the key elements of supplier management (Christopher et al., 2011; Azevedo et al., 2013b), and it is therefore one of the key ways to build resilience. How to relate to sole,

dual or multiple suppliers is also a prominent decision. Christopher et al. (2011) assert that in terms of single supplier, a close relationship is advised, while for a number of different suppliers, a less close relationship is appropriate in order to spread risks. Not only Christopher et al. (2011) but also, Svahn and Westerlund (2009) and Zsidisin and Wagner (2010) discuss and claim the same point. Furthermore, enhancing the relationship between buyers and suppliers may increase collaboration, alignment and visibility. Regarding supplier selection, many criteria are to be considered: supplier locations (e.g. Sheffi, 2001; Christopher et al., 2011); processes, practices and culture (Sheffi, 2001); common platforms for products (Zsidisin et al., 2000; Stecke and Kumar, 2009); capacity constraints (Christopher et al., 2011); financial stability (Zsidisin et al., 2000); and effectiveness of the supplier's management team (Zsidisin and Wagner, 2010). Moreover, developing members of the supply chain to be as responsive as possible in times of disturbance is a valuable factor to overcome resilience. If the company helps the suppliers to develop their processes, they become aligned and more responsive to changes (Zsidisin et al., 2000). Furthermore, it can help to improve information sharing, integration and also flexibility (Yi et al., 2011).

Although the design of the supply chain can be the result of companies' choices regarding strategic sourcing, there are also cases in which redesign will be needed to mitigate risk and create a more responsive supply chain. In this context, Tang (2006a) shows that Liz Claiborne moved all its textile supply chains to China, which caused a reduction from 10-50 weeks to fewer than 60 days in the lead time of the company's products. Therefore, how to design the supply chain is also highlighted here as an important factor, considering that rearrangements of it may enable an easily recovery.

Having more than one option for delivery is a wise strategy to help companies avoid large and small problems regarding flow disruptions. These options can be divided into transportation modes or routes (Tang, 2006a). The Brazilian post office (Correios) has recently used this strategy to deal with protests against the government that blocked hundreds of roads, which hampered Correios' service. However, Correios had the advantage of working with other modes of transportation, such as by plane. Hence, it was able to overcome the situation by delivering urgent loads on time by plane (ILOS, 2013).

3. RESEARCH METHODOLOGY

This research started with an extensive literature review to identify the organisational factors listed in Table 1. After that, empirical data was gathered through a multiple case study in order to validate the factors found in the literature. To guide this study, two research questions were addressed:

- *What are the key organisational factors for building supply chain resilience?*
- *How do internal and external organisational factors influence the development or enhancement of the supply chain resiliency?*

Among many qualitative techniques for collecting the data, the case study approach was considered an appropriate method that fitted these research requirements by investigating the phenomenon in a current real-life context without interfering on the phenomenon (Yin, 2009). Following on from these research questions, a case study protocol was developed through the specification of all details and requirements.

Four focal companies (buyers) including two of their key suppliers were selected to be part of this empirical study. The reason for choosing a multiple case study is that it is considered less vulnerable than using a single case study in which all efforts are invested in only one “shot” (Stuart et al., 2002). The companies were selected based on different criteria, such as:

- *size of the focal company: medium to large-size companies which are naturally more complex in terms of structure, processes and human capital (Massey and Dawes, 2001; Paiva, 2010);*
- *type of company: manufacturing companies to limit the scope of the study, since interesting cases of resilient solutions are related to this type of companies (e.g. Christopher and Peck, 2004; Carvalho et al., 2012a; Brandon-Jones et al., 2014);*
- *location: Brazilian companies were chosen due to the lack of studies about supply chain resil-*

ency in this particular country, and considering the emergent need of this capability to local practitioners;

- *sectors: a variety of sectors (beverage, household appliance, food, and agribusiness) provide a rich view of extreme situations, and helps to clarify common issues among companies, as well as identify existing differences (Christopher et al., 2007);*

After identifying companies that fit into these criteria, contact was made by e-mail and telephone to present the aim of the study, the methods of data collection and contributions. In addition, a formal letter was attached to the e-mail, providing all the details of the research including the confidentiality of the data shared by them. Table 2 shows the main information about companies included in each case (one focal company and two suppliers from each one).

Regarding data gathering, semi-structured interviews and secondary data (archival data provided by suppliers and focal companies as well as information from their websites) were conducted with individuals from the focal companies as well as from their key suppliers. As a result, six to nine individuals from each of the four supply chains (buyers and suppliers) were interviewed. Most of the interviews were conducted by Skype due to the distance between one company and another. Deakin and Wakefield (2013) argue that synchronous online interviewing is a useful supplement or replacement for face-to-face interviews.

In total, 30 individuals from buyers and suppliers were interviewed. The interviews lasted around 45 minutes each, and were conducted between January and May of 2014. All interviews were recorded and transcribed for further analysis. Additional notes, impressions and ideas that occurred during the data collection were also recorded and added to the case study database (Yin, 2009). Furthermore, to increase the reliability of the data gathered, a follow up by e-mail was made in case details were missed during the analysis (Voss et al., 2008).

Table 2. General information of the cases

Case	Companies	Annual Prod. Volume	Interviewees	Main characteristics of the companies in each case
BEV	BEV-FC: carbonated / non carbonated drinks	180 million liters	Strategic Procurement Manager (Mproc1), Plant Manager (Mplan1), Purchasing Manager (Mpurc1), Commodity Manager (Mcom1), Production and Material Planning Manager (Mmpm1)	BEV-FC (focal company) is one of the 40 Brazilian plants of the multinational organisation, but it has thousands of other plants in over 200 countries. BEV-S1 and BEV-S2 are both large companies (suppliers). BEV-S1 supplies BEV-FC weekly with one of the main input to produce several final products. Thus, BEV-S1 is considered one of the largest companies in the plastic segment. BEV-S2 is also a large company which has additional plants abroad. Recognising them as two large suppliers, BEV-FC is not their main customer; however they do provide critical items to BEV-FC, which means that any problem with these suppliers might cause a supply disruption to BEV-FC.
	BEV-S1: Plastic packaging	110 tons	Market Intelligence (Mmint1s1), Sales Manager (Msale1s1)	
	BEV-S2: Plastic film	80 tons	Sales Person (Psale1s2), SAC Manager (Msac1s2)	
KAPPL	KAPPL-FC: Household appliance	Disclosure not allowed	Inbound Logistics Manager (Minlog2), Production and Planning Control Manager (Mppc2), Transport Manager (Mtransp2), Purchasing Manager (Mpurc2)	KAPPL-FC (focal company) is a well-known multinational company, which has been ranked as the world's second-largest appliance maker by units sold. Currently, it has sold more than 5 million products from 8 strong brands in around 150 countries, however the highest sales have been in US and Brazil. In Brazil, it holds 5 plants in three different cities. Both suppliers in this case are responsible for supplying the focal company with specific raw materials to manufacturer three important products. KAPPL-S1 and KAPPL-S2 are both small national companies, but important suppliers to KAPPL-FC.
	KAPPL-S1: Metallurgical	960 thousand components	Head of the company (Hcomp2s1), Admin assistant (Aasm2s1)	
	KAPPL-S2: Wood structure	360 thousand items	Sales Person (Psale2s2)	
FOOD	FOOD-FC: Food	1.4 million tons	Metal Commodity Buyer (Bmet3), Coffee Commodity Buyer (Bcof3), Logistics Buyer (Blog3), Nuts Commodity Buyer (Bnut3)	FOOD-FC is a multinational organisation that operates in more than 86 countries, and holds 30 plants in Brazil with more than 220.000 employees. In Brazil, it is responsible for 141 brands, and a gross sales of 16 billion reais. Both suppliers work in the same agribusiness sector, and they are responsible for supplying the focal company demand with a specific raw material in "nuts" segment. The FOOD-S1 plays a strategic role by intermediating the second tier supplier (FOOD-S2) and the focal company (FOOD-FC).
	FOOD-S1: Juices & concentrates	N/A	Sales Manager (Msales3s1)	
	FOOD-S2: Nuts	90 thousand tons	Sales Manager (Msales3s2), Procurement Manager (Mproc3s2)	
AGRO	AGRO-FC: Agribusiness	N/A	Procurement Manager (Mproc4), Commodity Manager (Mcom4), Materials Analyst (Amat4)	AGRO-FC is a multinational company that operates in more than 90 countries, and holds around 15 plants in Brazil with about 1800 employees along a complex and diverse supply chain; it has suppliers with different profiles - from chemical industry to independent producers and farmers. In Brazil, this focal company works with two business divisions - seeds and crop protection. Both suppliers (AGRO-S1 and AGRO-S2) are responsible for supplying the focal company with a specific pigment. They are large companies and operate in the chemical sector; because of that, they considered each other competitors.
	AGRO-S1: Pigments	Disclosure not allowed	Supply Chain Manager (Mscm4s1), Sales Person (Psale4s1)	
	AGRO-S2: Surfactants & special chemicals	2 million tons	Sales Manager (Msale4s2)	

After all the interviews had been transcribed, the data was analysed qualitatively by means of the content analysis method (Bardin, 2008; Gibbs, 2009; Voss, 2008). The aim of this technique is to help the researcher extract useful information in order to provide understanding of the phenomenon in study and, consequently, to build knowledge (Bardin, 2008). To support this analysis, a qualitative software named QDA Miner was used to codify the interviews (data fragmenting and re-assembling), which made it easier to interpret them by enabling the visualisation of the outcomes in different ways.

4. WITHIN-CASE ANALYSIS

The main results from each case are shown in this section, which details the unique characteristics of each case regarding the constructs of the analysis. These individual results will then be consolidated for the cross-case assessment in the next section, which is the basis for the development of the propositions.

4.1 Case 1

Following the construct of analysis presented in the literature review (section 2), this case explores how

the focal company act to deal with each of the internal and external organisational factors. Regarding knowledge acquired and backup, all interviewees from the buyers, as well as from their suppliers, have emphasized the great importance of knowledge acquired to prepare the company to deal with critical supply disruptions, especially when the knowledge comes from lessons learned. Furthermore, in dealing with different types of disruptions over the years, managers become capable of better managing internal and external companies' resources to re-establish the normal operating performance. It was found that DRINK-S2 has a formal way to register problems and solutions through customer service registrations in DRINK-S2, while DRINK-FC and DRINK-S1 do not have any way of recording lessons learned.

Interviewees have also affirmed the importance of holding additional inventory to mitigate the variability of the raw materials along the supply chain. Although all interviewees have asserted the need of a reliable safety stock, DRINK-FC seems to work with low volume of stock, aiming to reduce cost. This is technically and theoretically sound to some extent; however, interviewees from both suppliers have asserted that DRINK-FC requires a high-

er stock from its suppliers so that they are able to promptly supply it in case of any emergency. This can be observed even through Mpmp1's statement: "[...] We depend on them; so their stocks have to handle the changes in demand in order to keep us supplied. Otherwise we can't do anything. This is our limitation". However, Mproc1 from the DRINK-Corporation has stated that in times of high demand, they do increase the internal stock volume (raw material as final product). Furthermore, interviewees from DRINK-S1 and DRINK-S2 have affirmed that stock is therefore their main tool to deal with supply disruptions, however the challenge is to solve the problem of high stock when there may be changes in product specification. "My customer might change their product specification and this will impact on my stock. Basically it's wasted money" (Msac1s2).

Interviewees from DRINK-FC admitted to have a sort of flexibility in product manufacturing by having substitutable items. In fact, they affirmed that substitutable products and communication are critical factors to be managed. "We try to work with substitutable products, whether it is final product or raw material, or even communication. I think these are critical factors" (Mpmp1). Regarding DRINK-S1 and DRINK-S2, interviewees have reported that they do not have such flexibility to customer's product due to their product's standardization, but they have a simple process to manufacture the raw material required by DRINK-FC.

Regarding communication, it was emphasized not only within the organisations, but also along the suppliers (between DRINK-FC and DRINK-S1/DRINK-S2). "The better the communication, the faster the problem gets solved, both internally and externally. Remember those barriers that I told you about - I believe that a greater proximity can help with them" (Msale1s1). The technological ways used to improve communication were e-mail, Skype and an internal system similar to the ERP (Enterprise Resource Planning). On the other hand, DRINK-FC has a system that integrates all information about the consequences and results of a problem, and then helps develop an action plan to cope with that particular problem. To do so, it makes use of quality tools, such as PDCA and Ishikawa graph, and involves internal business functions as well as the corresponding suppliers. Regarding suppliers, only Mmint1s1 from DRINK-S1 has confirmed the existence of a similar system to the DRINK-FC, however he also states that it is not well used on a daily basis.

By observing the business environment and market behaviour, managers usually apply their knowledge to manage risks likely to happen. In this regard, DRINK-FC as well as DRINK-S1 and DRINK-S2 showed to be aware of incidents that might happen even though they continuously execute practices to mitigate them. "Can incidents happen? Yes. Could [a plant] catch fire? Yes. But this is the responsibility of this committee, to analyse and deal with these incidents that may occur" (Mplan1). Additionally, Mplan1 reported the existence of a corporation's group of incidents management that is located in the headquarters of DRINK (in the United States). Thus, when a very critical incident occurs, it is reported to this group, which decides what kind of action is going to take place in order to diminish the economical losses as well as the consequences for the company's image. Although both suppliers presented well-established risk management practices, it is interesting to highlight that they take all these risk mitigation actions without having them as a formal procedure.

Looking at outside of the focal company (DRINK-S1), there are some strategic sourcing factors that have to be considered to create supply chain resilience. Not surprisingly, the supply base is definitely a key factor to DRINK-FC. However, DRINK-S1 and DRINK-S2 are also aware of the benefits of not depending on a single supplier. "In the past, we have had problems like this, so today we don't have any kind of exclusivity with any suppliers. [...] I never give a purchase order to just one supplier. I go even further than two suppliers; today we work with 3 or 4 suppliers" (Mmint1s1). Therefore, they prefer having more than one supplier for a critical item in order to not risk any shortages in supply to their customers (in this case, DRINK-FC). What is particularly interesting from DRINK-FC's and also from DRINK-S2's perspective is the support from their franchises in acting as suppliers when a disruption happens. Although the company may depend on a single supplier when there is no substitutable suppliers in the market, they can normally exchange between franchises. The results from both sides of the focal company have shown a good relationship between DRINK-FC and its suppliers DRINK-S1 and DRINK-S. In this context, Mplan1 have asserted that "[...] disruption is something we mitigate through partnership". Thus, DRINK-FC promotes coaching and workshops to their suppliers as a way to get all of them together and make the relationship stronger. Interviewees from the focal company have emphasized that besides intensively sharing information,

they also share possible risks with suppliers and this increases the level of collaboration and trust. For this reason, they support each other in time of need.

In the case of taking strategic decisions to reconfigure the supply chain in order to mitigate risk, the focal company usually analyse the location of their suppliers and franchises to order urgent materials in case of shortages. If the closest supplier has a problem, they have other suppliers that will likely supply them. Regarding this issue, it is noteworthy that due to DRINK-FC's and DRINK-S2's work with franchises, they can use them to change routes in case any operation fails. Additionally, both suppliers in this case are responsible for delivering orders to DRINK-FC, which are made by road, although interviewees reported situations in which a plane was used as a way to make the delivery faster, and consequently mitigate the consequences of a failure to supply.

4.2 Case 2

Following the same rationale of the case above, constructs of analysis presented in this case are here discussed. Interviewees from APPL-FC as well as APPL-S1 and APPL-S2 have strongly affirmed the importance of knowledge acquired to better deal with disruptions and, consequently, overcome them. "Internal, external and any other knowledge possible" (Mppc2). Considering that all interviewees in this case have worked in those companies for more than 20 years, except for one interviewee from APPL-S1 (4 years), the knowledge asset of the supply chain is valuable indeed. In this sense, they have affirmed that experience is achieved through daily work and information sharing with older employees from the company. Despite this, no way to record lessons learned was found in any of these three companies - "No, we don't have this. It's more of a daily routine" (Mtransp2).

APPL-FC does not hold much stock due to a just-in-time system. In this case, they have to be constantly in contact with suppliers to check if all the planned deliveries are going to arrive on time. However, to balance the demand as well as supply fluctuations, APPL-FC holds a very small safety stock of raw materials within the company. On the other hand, interviewees from APPL-S1 and APPL-S2 have asserted that the redundancy of some items (a high volume of safety stock) is their best strategy to manage daily changes in demand, and continuously monitor

APPL-FC requirements in case any trouble arrives upstream of their supply chain. However, when the raw material is scarce in the market or has a long lead time (imported items, for instance), APPL-FC must hold additional stock. To hold stock in suppliers' plants, APPL-FC makes use of an external inventory by holding it in a warehouse that is located near the plant. The responsibility for the level of inventory in the warehouse is the suppliers'. The focal company and its suppliers are connected through electronic data interchange (EDI) in order to operate the vendor-managed inventory (VMI) strategy. In this context, APPL-FC seems to make full use of EDI by using a specific system to connect the focal company and its suppliers. Information is shared in real time, hence suppliers are able to visualise any changes made in the company's inventory. Therefore, it improves the visibility along the supply chain as well as the response capacity if any unexpected event occurs.

Although interviewees have positively affirmed the benefits of product flexibility for supply chain resilience, APPL-FC seems to not make use of it. Most of the interviewees and especially those from the suppliers (APPL-S1 and APPL-S2) have stated that each product has particular characteristics, and because of that they need unique and specific components. Nevertheless, interviewees from APPL-FC mentioned the possibility of changing a product's configuration in the absence of a specific item, but there is always additional cost in changing components to fit another product. Unlike APPL-FC, interviewees from APPL-S1 have confirmed their capability to change their products if there is a need. In this respect, Hcomp2s1 reported that if they lose a customer for any reason, they are capable of changing their processes in order to produce another item.

Interviewees from APPL-FC reported well-developed procedures to mitigate risk by identifying possible risks from the suppliers and hence managing and reconfiguring internal and external resources to moderate them. These resources can be related to information sharing through internal communication, safety stock and location of inventories (internal or external), for example. Thus, risk analysis and risk management are constantly executed in daily activities. Even if there is no team or department dedicated to this task, standard procedures are executed in daily activities, such as the follow-up of items to identify critical ones (based on inventory and classification of the ABC-level items), contingency plans

for critical items, and daily meetings to discuss the current operation. Hence, interviewees have mentioned risk management as a way to prevent breaks of the flow. Furthermore, Minlog2 reported a new practice in which they record the problem, and explore it afterwards in order to find the cause. “Internally, the company is forced to have contingency plans. We have to think about mitigating. If this happens...what do you do? If that happens, what do you do? We have to have a strategy. Otherwise, when people talk about supply disruptions, we often talk about hours, but risk means months, or even years” (Minlog2).

Through the discussion about sourcing strategies, interviewees from APPL-FC have shown many ways to deal with suppliers so as to better cope with unexpected events. In this regard, APPL-S1 and APPL-S2 have confirmed the statements of APPL-FC interviewees about avoiding single sourcing and improving supplier relationships. Therefore, APPL-FC seeks to closely work with few suppliers but never depends on single sourcing. For this reason, these companies always have an extra supplier approved for each item.

“There was a time when APPL- FC existed as a global company which followed the Swedish train of thought that said: it is much better to have few suppliers and consolidate volumes and get a better cost. But we are in Brazil; it’s a bit tricky to do that, and fortunately the company realised that after a while. So now, for example, you have to have at least three approved suppliers - two of them for daily supplying and one as a backup, a stand-by” (Mpurc2).

However, there are some occasions in which it happens, due to the lack of capable suppliers available in the market. When this happens, APPL-FC seeks to develop new suppliers. In this regard, the head of the APPL-S1 has reported that APPL-FC helped to develop APPL-S1 due to a critical problem they had with an imported item. It turned out that having a national supplier would help them reduce the lead time, the level of stock, and consequently, have a faster response due to closer location. In terms of suppliers, APPL-FC did not show any preference for large suppliers. In fact, it keeps many small suppliers nearby, which helps them in terms of shorter lead time. Thus, the supplier criteria is the competitiveness of the supplier. It is through a close relationship between focal company and suppliers that these companies practice strong communication,

share information, and become familiar with the processes.

As with APPL-FC, both suppliers in this case make use of strategies related to set up of the supply chain configuration in order to prepare themselves to be capable of responding and recovering from untimely events. It is worth emphasizing that APPL-S1 and APPL-S2 are both located near to APPL-FC, 90 Km away. Additionally, the warehouse recently set up by them is only 12 Km away from the focal company. It therefore enables APPL-FC to have a quick response supply, and it can sometimes reduce the total cost when considering the transportation tax. Taking into account the distance among suppliers and the focal company (APPL-FC), road transportation is used to collect and deliver raw materials at the first tiers of the APPL-FC supply chain, and shipping for imported items. Mpurc2 added to this by saying that “such transportation is by ship. So perhaps the flexibility to streamline is infrequent air freight”.

4.3 Case 3

As well as in the other cases, interviewees in this case were very positive in affirming the importance of managers’ experience and their knowledge to manage risk and to deal with disruptions. In this regard, interviewees from the three companies in this case have affirmed that the more knowledge acquired in how to manage and control internal and external resources, the more capable managers become with coping with disruptions. Nevertheless knowledge acquired is normally restricted to those who were part of a critical situation, since none of the companies in this case has a way to register lessons learned from a critical event in order to pass it on to new employees.

Strategies to manage stock are a key point to mitigate the impact of a disruption in the first place. This kind of decision sought to be part of COMES-FC, but it was also reported by the suppliers (COMES-S1 and COMES-S2) as an important way to overcome supply drawbacks in a short time. “So it’s clear that a big inventory doesn’t make your crisis disappear. It gives you more time, but depending on the size of the crisis, just having stock doesn’t help you, you know?” (Bnut3). On the other hand, inventory has to be very well managed in this particular supply chain, considering that COMES has a short shelf life. Therefore, keeping high volumes of stock is a risk to the company, in case the market does not per-

form to expectations - millions of dollars might be lost in stocking products for a long period. In the past, COMES-S2 used to hold a high volume of inventory to deal with the off-season. Currently, this practice has changed due to the short time in getting products from Africa (only seven days). Nevertheless, this supplier still keeps 60 days stock of non-processed raw material.

The development of new products was highlighted by interviewees from COMES-S1 and COMES-FC as an important factor to deal with extreme situations. In doing so, those companies were able to mitigate problems in supplying Production with specific raw material. In terms of product flexibility, COMES-S2 cannot support this strategy due to the wide range of the products' particularities for different customers.

Regarding tools to improve buyer-supplier communication, only Msales3s1 has reported the use of technology to exchange information between buyer and supplier. They confirm that COMES-S2 has an online system to place purchasing orders - "But COMES-S2 has a system. Every purchase order I make here, I add to the system and they can see it in Fortaleza, you know" (Msales3). Nevertheless, it is not a system that shares real time information between companies. Moreover, interviewees from COMES-FC have not reported any system that is used to place orders to COMES-S1 or COMES-S2. Otherwise, they do often contact by e-mail, Skype and telephone. To identify possible risk and disruptions, the only tool mentioned was the reports from government institutions that provide the medium term forecast about weather and crop development, but they are not accurate and reliable enough for companies to rely on them.

Identifying sources of risk and mitigating them is an important action that competitive companies are aware about, however, no formal procedure was reported by the interviewees. Interviewees have affirmed that risk management is normally embedded into daily activities, and there is no exclusive function or team to take care of this particular subject. In this case, contingency plans are specially drawn for items that are considered critical. In addition, they assert that the contingency plan is a costly strategy; however they are aware that it is safer for the business than maintaining the low price strategy in extreme risk occasions.

Strategic sourcing is definitely the most discussed and emphasised factor by the interviewees, with

regards to being more resilient. All three companies showed that they are aware of the risk in depending on a single supplier, especially when the supplier is not a large company and is responsible for a critical item for the final product. In this sense, they have this strategy well developed, in terms of holding at least three approved suppliers for any critical items. They also assert that having a big supplier base is not the solution to mitigate risk and possible disruptions. There is a need to have qualified suppliers to attend COMES-FC requirements, and COMES-FC qualifies them, analysing if the suppliers have extra capacity and whether they work with large suppliers. They affirm that it helps to avoid problems related to the lack of supplier capacity or poor financial health of the supplier. If there is no supplier in the market for a specific item, or if suppliers seem to be a risk for the buyer, interviewees agreed that developing suppliers is a safe way to keep the company operating in the event of a supplier problem. For this reason Bmet3 alleges that "So, the challenge is external, but it's also internal. Externally we face a challenge to find a supplier who fits. Internally, we also face a challenge to ensure that we have a second or third option developed".

As important as having a good supply base is the relationship between the focal company and its suppliers. Interviewees from COMES-FC have affirmed that the continuous communication with supplier is a key way to keep updated and to develop a trustful and committed relationship. If any risk is about to arise or something has just happened, suppliers automatically contact the buyer in order to discuss the problem, and come up with good solutions for both parties. The companies in this case clearly demonstrate the importance of this relationship to develop resilience through communication, commitment and collaboration between internal and external parts of the company.

In this case, companies use shipping for imported items and road transport to make the majority of the deliveries. Only one interviewee mentioned the airplane mode to deliver an urgent parcel to other country. However this mode of transportation is very restrictive with regards to the type of product that can be sent. For some of COMES-FC's raw material, for instance nuts, it would not be possible use airplane for transportation.

4.4 Case 4

Increasing the knowledge of managers enables them to become more capable of dealing with further disruptions; even though these disruptions might arise from different causes. All interviewees have affirmed the importance of this issue for creating resilience within the company, and consequently along the supply chain. In spite of this positive affirmation, only CHEM-S1 records the problems and the actions taken to overcome them. Thus, much information can be lost over time, and new members might have not the opportunity to learn from others' experience. "Yeah, this is really important. Each season is different, but a material may behave the same for different seasons. So really, knowledge is a facilitator" (Mcom4).

As well as emphasizing creating supply chain resilience, redundancy of critical components is another factor well-discussed and well-applied to companies' activities for coping with supply risk. Internal safety stock was shown to be a common business strategy of these companies to avoid production breaks and supply disruptions along the supply chain, especially when the raw material comes from a single source. Moreover, CHEM-FC makes use of this factor to cover another possible factor - product flexibility. Neither CHEM-FC nor CHEM-S1 or CHEM-S2 have product flexibility due to the product's specification. It is possible, but is not welcomed by the companies, as can be seen in one of the examples above. "let's say that the most critical case is the product that is single sourcing, highest volume. If this product has any shortage, the gross profit that I'm going to lose is high. [In this case] it's just the stock; Even if we make an agreement with the supplier to keep stock as well, CHEM-FC also keeps a safety stock" (Mproc4). Nevertheless, this agribusiness supply chain has a unique element to deal with for safety stock. Some raw materials/products have a short shelf life; thus, there is a limitation regarding the size of the internal safety stock. The higher the stock, the lower the quality of the product over time. Therefore, redundancy of critical components is just a partial strategy to creating supply chain resilience. CHEM-FC has extra time to implement other strategies to cope with supply disruptions, knowing that additional stock is kept externally - at their suppliers - which are strategically located nearby.

Having technology that supports internal and external information sharing appears to be a good tool to keep members updated throughout the business,

and hence knowing as soon as possible about possible changes that may turn into disruptions. Thus, technology to improve communication is another factor mentioned by the interviewees in this case. It has shown to be valuable for creating resilience, by sharing information with important members within the focal company (CHEM-FC) or along the supply chain (CHEM-S1 and CHEM-S2 in this case). However, no technology that shares real time information was found between the focal company and its supplier. Apart from telephone, e-mails and Skype, interviewees from CHEM-FC and CHEM-S1 have mentioned SAP (System Application Products) and Team Space as technologies. Nonetheless, according to their statement both systems seem to be internally-focused.

Interviewees from CHEM-FC mentioned the existence of a department responsible for identifying and analysing risk that might affect different types of commodities. Thus, information provided from this department is rather important for managers to make decisions and guarantee preparedness and response to rapid onset events that might come from CHEM-S1, CHEM-S2 or any other suppliers. Procurement interviewees from CHEM-FC were shown to have well-developed risk management practices in which they observe possible risks from their suppliers, and hence manage and reconfigure internal and external resources to avoid them. These resources can be related to internal communication, safety stock, location of the inventories (internal or external), size and number of suppliers or even supplier relationship. Furthermore, risk analysis and management is executed as part of daily activities, so that it is a common practice.

Interviewees from CHEM-FC reported the complex situation of having more than one supplier approved for every component. The issue given was the lack of substitutable suppliers in market, the lack of product quality from other suppliers, the long distance between buyer and supplier, or even because the company could not approve any extra suppliers due to excessive bureaucracy. In line with this, the criteria applied to select and approve suppliers in this case are related to the size of the suppliers. Thus, CHEM-FC seeks to work with global companies, so that it does not become vulnerable to suppliers regarding their financial health or a lack of commitment. Additionally, the location of the supplier is relevant to reduce lead time. In this sense, Mproc4 affirms "CHEM-FC has few contracts or

purchases from small suppliers. Most of the suppliers are global. The reason is to mitigate risk". In terms of supplier development, as CHEM-FC prefers working with global suppliers, it does not look to develop new suppliers; however, for special circumstances the company is trying to develop new ones so as not to depend on one critical supplier. Although the interviewees have positively affirmed the need of good supplier relationship, CHEM-FC works closely with strategic suppliers only, and not with all of them. "If I have a supplier that I define as strategic, I will work in partnership with them. I'll talk to them about innovation projects, I will focus all my efforts to improve the supplier, I will work with them every month to see what the opportunities are, what volume I'll need... this is a strategic partnership"(Mproc4).

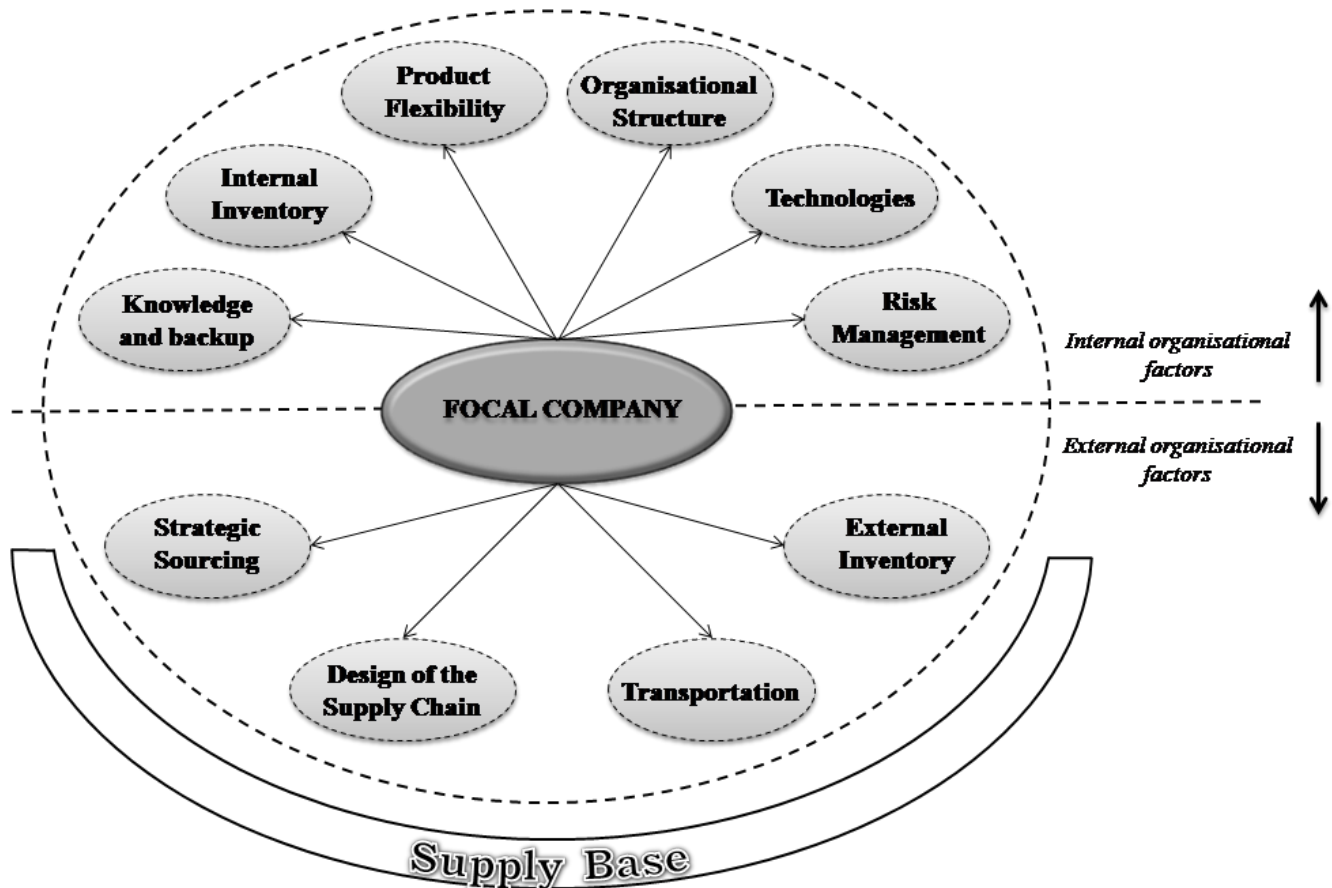
Supply chain configuration and transportation modes were also considered relevant factors in this case due to actions taken by members from CHEM-

FC as well as CHEM-S1 and CHEM-S2 to reconfigure routes and/or to change modes in order to reach the goal, and not fall into breaks. "Products can't be more than 300 Km from my processing plant. It's a perishable material, so as soon as I take it from the field, I have to take it for processing" (Mcom4).

5. FRAMEWORK AND PROPOSITIONS

This section presents the general results of the cross-case analysis. Figure 2 summarizes the main internal and external organisational factors purposed to help companies to enhance resiliency in the supply chain. Considering all eight factors identified through the literature review, two additional factors were identified through the empirical data: organisational structure, and external inventory. Through the discussion of the results, propositions were developed to reaffirm how the identified internal and external organisational factors can help to enhance supply chain resiliency.

Figure 2. Framework of the main internal and external organisational factors for supply chain resilience



Knowledge acquired and backup from lessons learned from past critical events is a key factor for increasing a manager's experience in order to deal with future disruptions. It is through knowledge acquired that managers or employees from buyers and suppliers improve their abilities to manage available resources to prepare, respond and recover their business from any critical breaks. In this sense, Ponomarov and Holcomb (2009, p.137) affirmation says that "the capacity to learn from past disruptions to develop better preparedness for future events is a principal property of resilience". Furthermore, it means that they are able to deal with a wide range of disruptions through wisely managing and controlling other internal or external factors, and hence creating supply chain resilience. Although companies from the four cases are embedded in different supply chains, this factor was strongly highlighted by all of them as an important factor to improve their abilities to cope with future untoward events.

One characteristic that differentiated this factor from one case to another was the routine of recording problem situations (backup). Only DRINK-S1 (Case 1) and CHEM-S1 (Case 4) record problems and the subsequent actions taken to overcome them. This is therefore a critical finding of this analysis considering that Sheffi (2001, p.4) has stated that "companies cannot afford to maintain redundant employees around "just in case"; companies should ensure that their knowledge is backed up". Much information can be lost over time, and new members might not have the opportunity to learn from others' experience. It can undermine the resilient capability of companies along their supply chain, reminding them that knowledge management is part of the planning process to build supply chain resilience, and constant information exchange and learning from horizontal and vertical supply chain partners to keep skill levels up is therefore essential in a company.

P1: The practice of recording and making a backup of the lessons learned from past experiences increases supply chain resilience through shared knowledge.

Internal inventory was also a predominant factor found in the four cases. Although stock may be considered a good strategy to mitigate disruptive impacts in the first place and create responsiveness through redundancy, it only affords the company extra time to find other effective actions to cope with the consequences (Zsidisin et al., 2000). All companies within the cases are aware of the high cost of

maintaining inventory, especially APPL-FC which works with the kanban system; however they all hold a minimal safety stock of raw materials which is done in a strategic manner. DRINK-FC, for instance, holds additional stock in times of high demand, whereas APPL-FC holds higher volume of stock of imported items which demand long lead times. As well as APPL-FC, COMES-S2 used to hold high volumes of stock for imported items, however it has since changed this due to importations from Africa which now take only seven days to arrive at the Brazilian coast. Despite this, COMES-S2 still holds 60 days of stock to cover any unpredictable events that could stop it from serving its customers (COMES-FC, for instance). Thus, it seems that all companies hold different volumes of stock according to their needs. In Cases 3 and 4, for example, companies do hold high stock due to the short shelf life of their products - The higher the stock, the lower the quality of the product over time.

P2: Product characteristics, customer requirements and the company's strategy must be carefully considered to define the correct amount of internal inventory, in order to build supply chain resilience.

Developing interchangeable or substitutable items, which characterise product flexibility, is therefore a powerful alternative to companies to mitigate a possible lack of specific items due to a disaster in a supplier's plant, for example (Sheffi and Rice, 2005; Tang, 2006b). Despite this action being considered a great strategy for creating supply chain resilience, only in Cases 1 (DRINK) and 3 (COMES) has this strategy showed up. Furthermore, DRINK-FC only has this ability for B and C-level items (goods with medium or lowest consumption value). For this reason, interviewees from DRINK-S1 and DRINK-S2 have stated that they are unable to provide any substitutable item to DRINK-FC considering the uniqueness of its products. One of the APPL-FC managers has affirmed that this lack of flexibility is a limitation of the company; on the other hand, APPL-S1 has shown to be flexible in this regard. Lastly, no evidence of this factor was found in Case 4 (CHEM). The more complex the products' configuration becomes, the more difficult the recovery from any supply chain disruption is (Blackhurst et al., 2011). Moreover, depending on the type of product, product flexibility may require changes in the design and to the project, and it can be costly. This seems to be the reason why APPL-FC does not use this strategy. On the other hand, it may simplify manufacturing

processes and likely would increase the options of available suppliers, as well as reduce the base of suppliers. Although building supply chain resilience through product flexibility might be a costly factor at first glance, it may bring advantages that would certainly absorb the initial investment.

P3: Product flexibility promotes supply chain resilience through considerable investment, but can generate additional benefits to absorb this cost.

Technological ways to communicate are considered fundamental for sharing and spreading information from horizontal and vertical supply chain partners (Christopher and Lee, 2004; Tachizawa and Gimenez, 2010). This communication can be very useful for managing the increasing number of activities within and outside the company, and thus know as soon as possible about possible changes that could turn into disruptions. Regarding this factor, only APPL-FC has presented the Electronic Data Interchange (EDI) to exchange information between buyer (APPL-FC) and its suppliers (APPL-S1 and APPL-S2). Through this system, information is shared in real time and suppliers are able to visualise any changes made in the company's inventory (Tachizawa and Gimenez, 2010). Nevertheless, it is only achievable if there is trust and collaboration among supply chain members. Also, technology for early detection of disruptions highlights technologies related to risk identification, actions and solutions development, and supply chain rearrangements. No evidence of this kind of technology was found in any of the cases as it is presented in the literature (Sheffi, 2001; Sheffi and Rice, 2003; Blackhurst et al., 2005; Tang, 2006b; Carvalho et al., 2012b; Azevedo et al. 2013b); however this kind of tool was suggested as an improvement for creating resilience by interviewees from Case 4 (CHEM).

P4: Technological tools help to build supply chain resilience by increasing visibility along buyers and suppliers.

According to Colicchia et al. (2010) "a better understanding of the risk sources for specific supply chain settings can enable the design of a more resilient supply chain". Thus, recognising that resilience is a result of some companies' strategic actions and decisions, which aims to prepare the supply chain to effectively respond and recover from disruption, risk management is therefore an essential factor in this study. Differences among cases were also found related to this factor, as they are embedded in different

supply chains. In Case 1, DRINK-FC makes use of a strategic purchasing matrix (spending vs. product complexity) to purchase items and they have a corporation's management group for incidents to report serious cases. Regarding their suppliers (DRINK-S1 and DRINK-S2), it is observed that although they do have risk mitigation actions, they do not acknowledge them as formal procedures. Similarly, CHEM-FC also has a department responsible for identifying and analysing risks. Differently from Case 1 and 4, Case 2 and 3 do not have any group or department responsible for monitoring and identifying risks. Golgeci and Ponomarov (2013) affirm that through effective risk management and mitigation, it is possible to build supply chain resilience so that, supply chain resilience reaches beyond the purposes of risk management.

P5: The capacity for building supply chain resilience through risk management may be increased through the creation of a group responsible for exploring and identifying internal, external and environmental risk.

Interviewees from all cases have pointed out the hierarchical structure as a barrier to creating supply chain resilience due to the rigid hierarchy and delays or long processes to get internal approvals. It is known that if the company has a very rigid organisational structure where functions do not communicate with each other, it can limit the flow of information and hence become a barrier to visibility and resilience as well (Christopher and Peck, 2004). It's due to this that "the ability of different organisations or internal business departments to work together to develop a collective strategy often determines the success or failure of managing a disaster and/or supply chain disruption" (Scholten et al., 2014, p.219).

P6: Hierarchical structure is a barrier to creating supply chain resilience.

Regarding strategic sourcing, supply base is definitely the most discussed and emphasised factor in all cases. Dual sourcing or multiple sourcing for each item (or at least for critical items) was highly discussed as a way to avoid crashes, and consequently becoming resilient (Sheffi, 2001; Sheffi and Rice, 2005; Azevedo et al., 2013). Related to criteria for supplier selection, DRINK-FC did not mention anything about supplier selection as a way to create resilience, however it is observed through data that they choose large suppliers to provide A-level items, and they observe capacity and location for

B and C-level items. As well as Case 1, COMES-FC has reported capacity and supplier size. Therefore, they all fit into the criteria found in the literature (Blackhurst et al, 2005; Tang, 2006a; Carvalho et al., 2012a), knowing that large companies are considered by them as companies with financial stability. Aside from those, competitiveness was highlighted by APPL-FC as a criteria for their supplier selection, recognising that they also focus on capacity and location, but that they do not prioritize size of the suppliers. Supplier relationship was particularly noted in Case 4, in which CHEM-FC works closely with strategic suppliers only, and not with all of them. In the rest of the cases, they do not specify any difference regarding supplier relationship; in fact, they have strongly highlighted the close relationship with them. In terms of supplier development, all focal companies seek to have large suppliers in order to mitigate risk, however it was noticed that they all have developed a supplier (at least once) after a severe incident that they have faced. Overall, factors related to the upstream of the supply chain are definitely strategic issues to be explored and analysed in order to create supply chain resilience.

P7: Strategic sourcing related to the base of suppliers, criteria for supplier selection, supplier relationship and supplier development is a key factor to build supply chain resilience.

External inventory is a factor that came out from the empirical data analysis from Cases 2 and 4, since buyers made use of external inventory to guarantee their supply. To do so, they hold additional stock (raw material) in warehouses or even in supplier's plants - both located nearby them. For this reason, buyers always hold less stock than their suppliers (as was noted in all cases). Lastly, interviewees from Case 4 (CHEM) have stated that they hold inventories as a way of compensating for the lack of product flexibility. Therefore, as well as internal inventory, a "slack" in external inventory is considered a fundamental way to deliver material on time (Carvalho et al., 2012a) and consequently create supply chain resilience in the current unstable environment (Christopher and Peck, 2004; Zsidisin and Wagner, 2010; Scholten et al., 2014).

P8: Keeping external inventory located nearby the buyers' factories can enhance agility to respond to unexpected disruptions and consequently increase supply chain resilience.

Strategies related to design of the supply chain can definitely help develop alternatives in order to be resilient. Distance between buyers and suppliers was well-highlighted in all cases as an important factor. This is clearly seen in APPL-FC where the warehouse was strategically located only 12km away from the focal company, and other suppliers are also located nearby. Companies from Case 4 (CHEM) work with global suppliers, and although they do not have proximity in their favour, they do analyse the location of their suppliers in order to evaluate risks of political or climate instability. Toyota Motors has had many troubles in holding all strategic suppliers in the same area, because in the case of a local disaster (such as a tsunami) it loses all of them (Sheffi, 2005; Tang, 2006). In Case 1, for instance, the location of the franchises from DRINK-FC and DRINK-S2 are also strategic, and they make full use of it to avoid great disruptions.

P9: The network configuration considering location of the supply chain members is a factor that can promote supply chain resilience.

Having at least more than one option for delivery in terms of routes or modes will help companies to mitigate disruptions, as stated by Tang (2006b). Thus, if any route was damaged due to a strike or problems on the road, there are alternatives for maintaining the normal operation of the company. Regarding transportation modes, transportation by road was predominantly mentioned by interviewees in all cases, while shipping was reported for imported items, and a plane is an alternative used only in severe situations. APPL-FC and COMES-FC therefore have this flexibility, except CHEM-FC, who can make use of air transport but normally make their deliveries by road only. Moreover, in Case 3 (COMES) there is a restriction on airplane transportation due to the type of product. Examples of the route strategy were found in all cases, since buyers monitor the routes and take action to deal with unforeseen situations.

P10: Decisions about transportation can certainly increase supply chain resilience, through alternatives routes and transportation modes.

6. CONCLUSION

The concept of supply chain resilience is currently excellent compared to other approaches to supply chain management as it enables an organisation to prepare

for, respond to, and successfully recover from disruptions. For this reason, understanding the company's vulnerabilities and knowing how to effectively act to mitigate them is fundamental to survive in today's complex and dynamic business environment. This exploratory study sought to investigate what the key internal and external organisational factors are for building resiliency in the supply chain, and how these factors influence the development or enhancement of supply chain resilience. As a result, ten organisational factors (six internal and four external) were highlighted in the framework (Figure 2) and propositions were developed to confirm how each of them influence the building of, or enhancing of, supply chain resilience.

The findings of this study help to expand the understanding of supply chain resilience in how it can be developed through observing the identified organisational factors, and taking actions from both side of the supply chain, in order to face challenges and impacts of the current global market. Additionally, as supply chain resilience is a recent approach to supply chain management, very few managers have demonstrated knowledge of this concept. In this regard, a new approach has been introduced to the participants of this research by inciting them to demonstrate how their current practices and strategies efficiently cope with supply disruptions. Lastly, the findings are not limited to the companies' sectors explored in this study. Managers from other sectors can make use of the factors to build resilient capability for dealing with critical situations and effectively responding and recovering from them.

This study did not have the intention of exploring the costs involved in creating resilience in companies, however it has been made clear through the discussion that the investment to achieve resilience may be high, considering the importance of developing actions related to inventory and product flexibility, for example. Nevertheless, the cost to create resilience cannot be viewed as a barrier to companies to develop this capability. The great negative impacts of disruptions for companies' finance and image are noticeable (Christopher and Holweg, 2011), and it is widely known that the cost to recover a customer is much higher than to keep them (Ballou, 2010). Creating supply chain resilience will certainly generate benefits that will cover all expenditures, such as increasing the available suppliers in the market and reduce the base of suppliers through product flexibility. In this regard, it would be interesting to

develop studies that analyse how the costs of resilience can be beneficial to companies survival, as well as quality. Additionally, further research could test and validate the propositions developed in this study by expanding the research into each of the factors and identifying additional practices that could help practitioners to build or enhance the supply chain resiliency. Through a quantitative research in different sectors (manufacturing or service) it would be valuable not only to test these propositions, but also to find new ones.

References

- Ambulkar, S.; Blackhurst, J., and Grawe, S. (2015), "Firm's resilience to supply chain disruptions: scale development and empirical examination", *Journal of Operations Management*, Vol.33, No.34, pp.111-122.
- Azevedo, S, Govindan, K, Carvalho, H, and Cruz-Machado, V. (2013), "Ecosilient Index to assess the greenness and resilience of the upstream automotive supply chain", *Journal Of Cleaner Production*, Vol.56, pp.131-146.
- Ballou, R.H. *Gerenciamento da cadeia de suprimentos: planejamento, organização e logística empresarial*. Porto Alegre: Bookmann, 2010.
- Bardin, L. (2008), "Análise de conteúdo", Lisboa: Edições 70. (Original book published in 1977).
- Blackhurst, J., Craighead, C. W., Elkins, D. and Handfield, R. B. (2005), "An empirically derived agenda of critical research issues for managing supply-chain disruptions", *International Journal of Production Research*, Vol.43, No.19, pp.4067-4081.
- Blackhurst, J., 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.
- Brandon-Jones, E., Squire, B., Autry, C. W. and Petersen, K. J., (2014), "A contingent resource-based perspective of supply chain resilience and robustness", *Journal of Supply Chain Management*, Vol.50, No. 3, pp. 55-73.
- Carvalho, H., Azevedo, S.G. and Cruz-Machado, V. (2012a), "Agile and resilient approaches to supply chain management: influence on performance and competitiveness", *Logistics Research*, Vol.4, No.1-2, pp.49-62.
- Carvalho, H., Barroso, A. P., Machado, V. H., Azevedo, S. and Cruz-Machado, V. (2012b), "Supply chain redesign for resilience using simulation", *Computers & Industrial Engineering*, Vol.62, No.1, pp.329-341.
- Christopher, M. and Peck, H. (2004), "Building the resilient supply chain", *International Journal of Logistics Management*, Vol.15, No.2, pp.1-14.
- Christopher, M., Jia, F., Khan, O., Mena, C., Palmer, A., Sandberg, E. (2007), "Global Sourcing and Logistics - Logistics Policy project number - LP 0507", Report produced at the Centre for Logistics and Supply Chain Management at Cranfield School of Management on behalf of the Department for Transport (DfT), pp.1-141.

- Christopher, M., Holweg, M., (2011), "Supply Chain 2.0: managing supply chains in the era of turbulence", *International Journal of Physical Distribution & Logistics Management*, Vol.41, No.1, pp.63-82.
- Christopher, M., Mena, C., Khan, O. and Yurt, O. (2011), "Approaches to managing global sourcing risk", *Supply Chain Management*, Vol.16, No.2, pp.67-81.
- Colicchia, C., Dallari, F. and Melacini, M. (2010), "Increasing supply chain resilience in a global sourcing context", *Production Planning & Control*, Vol.21, No.7, pp.680-694.
- Deakin, H., and Wakefield, K. (2013), "Skype interviewing: reflections of two PhD researchers", *Qualitative Research*, Vol.0, No.0, pp.1-14.
- Fiskel, J., Polyviou, M., Croxton, K.L., and Pettit, T.J. (2015), "From risk to resilience: learning to deal with disruption", *Risk Management*, Vol.56, No.2, pp.79-86.
- Gibbs, G. (2009), "Análise de dados qualitativos", Porto Alegre: Artmed.
- Golgeci, I. and Ponomarov, S. Y., (2013), "Does firm innovativeness enable effective responses to supply chain disruptions? An empirical study", *Supply Chain Management: An International Journal*, Vol.18, No.6, pp. 604– 617.
- Hohenstein, N.; Feisel, E. and Hartmann, E. (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.
- Instituto de Logística e Supply Chain - ILOS (2013), "Manifestação afeta logística e já para fábricas pelo país", available at: www.ilos.com.br/clipping/index.php?option=com_content&task=view&id=7009&Itemid=27(accessed 02 September 2013).
- Jüttner, U. and Maklan, S. (2011), "Supply chain resilience in the global financial crisis: an empirical study", *Supply Chain Management*, Vol.16, No.4, pp.246-259.
- Massey, G. and Dawes, P.L. (2001), "Integrating Marketing and Sales: the frequency and effectiveness of methods used in Australia and the United Kingdom". In: ANZMAC Conference, 2001, Auckland, Proceedings.... Auckland, New Zealand.: ANZMAC, 2001.
- Paiva, E.L. (2010), "Manufacturing and marketing integration from a cumulative capabilities perspective" , *International Journal of Production Economics*, Vol.126, No.2, pp.379-386.
- Pereira, C.R.; Christopher, M., and Silva, A.L. (2014), "Achieving supply chain resilience: the role of procurement", *Supply Chain Management: an international journal*, Vol.19, No.5-6, pp.626-642.
- Pettit, T.J., Fiskel, 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.
- 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.
- Sáenz, M. J. and Revilla, E., (2014), "Creating more resilient supply chains", *MIT Sloan Management Review*, June, 2014.
- Scholten, K., Scott, P. S. 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, J. (2005), *The resilient enterprise: overcoming vulnerability for competitive advantage*, MIT Press, Massachusetts, Cambridge.
- Sheffi, Y. (2001), "Supply chain management under the threat of international terrorism", *International Journal of Logistics Management*, Vol.12, No.2, pp.1-11.
- Sheffi, Y. and Rice Jr., J.B. (2005), "A supply chain view of the resilient enterprise", *MIT Sloan Management Review*, Vol.47, No.1, pp.41-48.
- Simmie, J. and Martin, R. (2010), "The economic resilience of regions: towards an evolutionary approach", *Cambridge Journal of Regions, Economy and Society*, Vol.3, pp.27–43.
- Stecke, K.E. and Kumar, S. (2009), "Sources of supply chain disruptions, factors that breed vulnerability, and mitigating strategies", *Journal of Marketing Channels*, Vol.16, No.3, pp.193-226.
- Stuart, F. I., McCutcheon, D. M., Handfield, R. B., McLachlin, R., & Samson, D. (2002), "Effective case research in operations management: a process perspective", *Journal of Operations Management*, Vol.20, No.5, pp.419-433.
- Svahn, S. and Westerlund, M. (2009), "Purchasing strategies in supply relationships", *Journal of Business & Industrial Marketing*, Vol.24, No.3, pp.173-181.
- Tachizawa, E.M. and Gimenez, C. (2010), "Supply flexibility strategies in Spanish firms: Results from a survey", *International Journal of Production Economics*, Vol.124, No.1, pp.214-224.
- Tang, C.S. (2006a), "Perspectives in supply chain risk management", *International Journal of Production Economics*, Vol.103, No.2, pp.451-488.
- Tang, C.S. (2006b), "Robust strategies for mitigating supply chain disruptions", *International Journal of Logistics Research and Applications: A Leading Journal of Supply Chain Management*, Vol.9, No.1, pp. 33-45.
- Treiblmaier, H., (2014), "The next step in supply chain resilience research: From an assessment tool toward theoretical integration", 21th Annual IPSERA Conference, Palermo, Italy.
- Van der Vegt, G.S.; Essens, P.; Wahlstrom, M. and George, G., (2015), "Managing Risk and Resilience", *Academy of Management Journal*, Vol.58, No.4, pp.971-980.
- Voss, C. (2008), "Case Research in operations management". In: *Researching Operations Management*, edited by Karlsson, C. (2009), London: Routledge.
- Wieland, A., (2013), "Selecting the right supply chain based on risks", *Journal of Manufacturing Technology Management*, Vol. 24 No. 5, pp. 652-668.
- World Economic Forum (2015), "Global Risks 2015, tenth edition", *Insight Report*, Geneva, pp.1-65.

- Yi, C.Y., Ngai, E.W.T. and Moon, K-L (2011), "Supply chain flexibility in an uncertain environment: exploratory findings from five case studies", *Supply Chain Management*, Vol.16, No.4, pp.271-283.
- Yin, R., (2009), "Case study", 4 Edition. R. Yin, ed., United States of America: SAGE Publications.
- Zsidisin, G.A., Panelli, A. and Upton, R. (2000), "Purchasing organization involvement in risk assessments, contingency plans, and risk management: an exploratory study", *Supply Chain Management*, Vol.5, No.4, pp.187-197.
- Zsidisin, G.A., Melnyk, S.A. and Ragatz, G.L. (2005), "An institutional theory perspective of business continuity planning for purchasing and supply management", *International Journal of Production Research*, Vol.43, No.16, pp.3401-3420.
- Zsidisin, G.A. and Wagner, S.M. (2010), "Do perceptions become reality? the moderating role of supply chain resiliency on disruption occurrence", *Journal of Business Logistics*, Vol.31, No.2, pp.1-20.

Author's Biography:

Carla Roberta Pereira: holds a bachelor degree in Production Engineering in State University of Maringa (2008), masters (2011) and PhD (2014) in Industrial Engineering in Federal University of São Carlos. Nowadays she is a lecturer at PUC-Campinas, where teaches courses about Logistics and Supply Chain Management, Planning and Production Control, and Project Management for Engineering and Business students.

Andrea Lago da Silva: Professor at Department of Production Engineering (UFSCar) since 1994. She has a PhD in Business (FEA/USP,1999) and Msc in Production Engineering (UFSC, 1993). She teaches Marketing, Services Operations. Her areas of research are SCM and Services Operations. She had published in a number of Brazilian/International outlets like RAE/FGV, *Gestão & Produção*, *Sloan Management Review* and *SCM:int journal*.