Supply chain risk management under environmental turbulences

Priscila Laczynski de Souza Miguel (priscila.miguel@fgv.br)
EAESP-FGV

Virginia Spiegler
Kent Business School

Vanessa Barreto
EAESP-FGV

Vanessa Scaciotta
EAESP-FGV

Abstract

This study aims to investigate how Brazilian supply chains (SCs) were affected by the economic and political crisis (2014 to 2016) and if and how supply chain risk management were used by these organizations to mitigate its consequences. To accomplish with our goals, a qualitative research was conducted within three supply chains. Our findings indicated a lack or risk perception and revealed that organizations mainly adopt contingency rather than mitigation strategies, showing a more reactive manner to deal with risks. The impacts to the supply chains were demand volatility, suppliers' financial health issues and material cost increase.

Keywords: Supply chain risk management, environmental turbulence, developing countries

Introduction

Supply chain risk management (SCRM) is the process of accounting for different sources of risk and defining action plans to prevent, reduce or contain vulnerability (Jüttner, Peck, & Christopher, 2003). By reducing the exposure to risk, organizations can increase their resilience, recovering from disruptive events (Sheffi, & Rice Jr, 2005)

SCs are exposed to different sources of risks: internal to the organization; internal to the supply chain and external risks related to the environment. Environmental turbulences are examples of these external risks and may include socio-political instability and economic crisis that affect interest and exchange rates; inflation, salaries, labor availability, and changes in regulatory and tax regime (Christopher, Mena, Khan, & Yurt, 2011; Ghoshal, 1987; Trent, & Monczka, 2005; Wagner, & Bode, 2008).

Understanding the importance of political and economic context is key for organizations to create strategies that may reduce the negative impact of environmental turbulences (Sheffi, 2001; Christopher, & Peck, 2004; Economist Intelligence Unit, 2010; Juttner, & Macklan, 2011; Punniyamoorthy, Thamaraiselvan, & Manikandan, 2013).

Despite of this, this source of risk has not been broadly investigated in the supply chain risk literature. One exception includes the work of Wagner and Bode (2008) who found, despite prior literature, that there is no significant relationship between regulatory, legal and bureaucratic risks and supply chain performance. However, their work was undertaken in Germany, a country economically reliant and whose overall institutional setting is characterised by stability and robustness (Organisation for Economic Co-operation and Development [OECD], 2010).

Developing countries are more vulnerable to exchange rate volatility and politico-economic uncertainty, which negatively affect companies' performance. (David, & Stewart, 2013; Dornier, Ernst, Fender, & Kouvelis, 1998). For example, Brazil's current political crisis has thrown its economy into recession. As a country's economy slips into recession, supply chain disruptions are reported given the reduced customer demand, price volatility, suppliers with financial problems, etc. According to a previous research conducted in the country, the main source of risk identified by supply chain managers in Brazil is the so called "country risk", that encompasses political, economic and regulatory issues (Miguel et al., 2015).

Given the importance of understanding the impact of political and economic pressures on supply chain resilience, this research aimed to understand how the economic and political crisis (2014-2016) affected the supply chain operations and how organizations dealt with it.

Literature review

Supply chain risks and management

Supply chain risk can be defined as the probability and impact of singular or several events that may cause supply-demand mismatch. (Jüttner et al., 2003; Jüttner, & Maklan, 2011; Zsidisin, Melnyk, & Ragatz, 2005; Spiegler, Naim. & Wikner, 2012).

Supply chain risk management (SCRM) emerges as an attempt to ensure the profitability and the continuity of the business avoiding or managing the impacts of the disruptions in the different nodes of the supply chain. This can be achieved through coordination and collaboration between the supply chain partners with the objective of: identifying and monitor risk sources and vulnerabilities, analyzing the consequences of the disruption and creating and applying possible mitigation strategies (Jüttner et al., 2003; Christopher, & Peck, 2004, Tang, 2006; Wagner, & Bode, 2007; Manuj, & Mentzer, 2008a; Manuj, & Mentzer, 2008b, Ghadge, Dani, & Kalawsky, 2012).

According to Jüttner et al. (2003), SCRM aims to identify possible sources of risks in supply chain and implement appropriate actions to avoid or contain the supply chain´s vulnerabilities. They classify the sources of risks in three groups: organizational, network and environmental risks. Christopher and Peck (2004) further suggest the following classification: 1) internal to the firm: includes risks inherent to the internal managerial and internal decisions, being sub-divided in "process" and "control"; 2) external to the firm but internal to the supply chain network: composed by risks emerged from the buy-sell relationships with customers and suppliers. They are sub-divided as "demand" and "supply"; and 3) external to the networks: composed by man-made or natural disasters (Sheffi, & Rice, 2005), political, social, economic and technological threats (Christopher, & Peck, 2004; Tang, & Tmlin, 2008; Punniyamoorthy et al., 2013).

The interest in geopolitical, economic and social risks has increased considerably due to the internationalization of firms and global outsourcing. These subjects have been broadly addressed in the strategic literature. Nevertheless, they have been less addressed in depth in the supply chain risk management literature which focuses on the internal supply chain network (Jüttner, & Maklan, 2011; Sodhi, Son, & Tang., 2011; Tomas, &

Alcantara, 2013) and more recently in natural and social disasters (Natarajarathinam Capar, & Narayanan, 2009; Ghadge et al., 2012).

The interdependence of global supply chains increases the exposure of firms to the vulnerability of the nations that they deal with. Consequently, political, social, regulatory and macro-economic turbulences may affect directly or indirectly on their product flows and their profitability (Christopher, & Lee, 2004; Jüttner et al., 2003; Vestring, Rouse, & Reinert, 2005; Punniyamoorthy, et al., 2013), emphasizing the relevance of the theme.

According to Manuj and Mentzer (2008a, 2008b), external or environmental risk sources manifest themselves disturbing a combination of other risk sources such as supply, demand, operational and security. Environmental turbulences may include social-political instability and economic crisis that affect the interest and exchange rates, (Ghoshal, 1987; Trent, & Monczka, 2005; Christopher et al., 2011); inflation, salaries (Ghoshal, 1987), labor availability (Blackhurst, Scheibe, & Johnson, 2008) and changes in regulatory and tax regime (Ghoshal,1987; Rice, & Caniato, 2003; Preston, 2004; Trend, & Monczka, 2005; Wagner, & Bode, 2008; Christopher et al., 2011).

Subsequently, these changes increase cost, reduce demand and potential economies of scale whilst increasing the instability and the insolvency of customers and suppliers, resulting in additional internal crisis into the supply chain (Natarajarathinam et al., 2009). Thus, this network structure may amplify the risk acting as a knock-on-effect triggered from the environmental risk sources (Jüttner et al., 2003) and threatening the whole supply chain (Jüttner, & Maklan, 2011; Pereira, Christopher, & Lago Da Silva, 2014).

In a supply chain strategy, suppliers in these regions under environmental turbulences would be avoided (Jüttner, & Maklan, 2011) as these turbulences may cause insolvency, opportunist behaviors or extras cost resulted from changes in the operational dynamics (Zsidisin, & Wagner, 2010). Furthermore, the effect of economic and political hazards increases the probability of governments to perform adverse changes in regulation, taxes and even expropriation, affecting business performance and reducing the investment level of multinational companies (Henisz, 2000; Xavier, & Bandeira de Mello, 2014; Oh, & Oetzel, 2011). These factors reinforce the economic and political turbulences contributing to worsen the current crisis as a cycle.

Building resilience strategies and caabilities

SCRM also encompasses risk mitigating and contingency strategies. Mitigation strategies aim to reduce the vulnerabilities and uncertainties along the supply chain through actions taken before the disruptive event happens (Miller, 1992), while contingency strategies involve actions taken after the disruptive event (Tomlin, 2006; Falasca, Zobel, & Cook, 2008; Spiegler et al., 2012). These strategies are well documented in the literature (Sodhi et al., 2012), as presented in Table 1.

The use of mitigation and contingency strategies is an essential part for firms to build supply chain resilience. As applied in other areas of science, such as physical, material science, ecology and psychology, the term resilience refers to the ability of certain elements or systems to return to their original shape after undergoing deformation or pass through adversities. (Sheffi, & Rice 2005; Ponomarov, & Holcomb, 2009; Hosseini, Barker, & Ramirez-Marquez, 2016). In the supply chain context, resilience has been defined as the ability of a system to return to steady state (Zsidisin et al., 2005) or move to an even more desirable state after a disruption (Christopher, & Peck, 2004; Pereira et al., 2014).

Table 1: Examples of mitigation and contingency strategies

Author	Mitigation and contingency strategies
Rice and Canito (2003)	Multiple/single source, flexible supply contracts, standard parts (product flexibility), modify inventory levels, multiple carrier and transportation modes, logistics providers, multiple facilities, rage of communication media, back up data and knowledge, use of mirrored IT system, multiskilled workers, process simplification,
Chopra and Sodhi (2004)	Add capacity, add inventory, redundant suppliers, increase responsiveness, flexibility, aggregate or pool demand, multiple customers
Tomlin (2006)	Re-routing shipments, transferring orders to new suppliers and demand management.
Tang and Tomlin (2008)	Multiple suppliers, flexible supply contracts, flexible manufacturing process or resources, postponement, responsive pricing
Spiegler et al. (2012)	Inventory and capacity management, multiple suppliers and locations, cultural change, vulnerability management, re-engineering/re-design, collaborative relationship, flexibility, re-routing shipments, transferring orders to new supplier, demand management, situation awareness / early sensing, agility

Ponomarov and Holcomb (2009) define resilience as "the adaptive capability of the supply chain to prepare for unexpected events, respond to disruption, and recover from them" (p. 131) and highlight that resilient supply chains are built proactively before the disruption.

The resilience level depends on the financial, technological and human resources available to be applied in the mitigation and contingency strategies chosen in accordance with their respective trade-offs and risk-drivers. In addition, these strategies should be incorporated into the supply chain and be supported by a supply chain risk management culture (Christopher, & Peck, 2004).

Despite several overlapping terms, the most frequent cited resilience capabilities in the literature are: flexibility, redundancy, velocity, visibility and collaboration (Rice, & Caniato, 2003; Ponomarov, & Holcomb, 2009; Sheffi, & Rice, 2005; Jüttner, & Maklan, 2011; Pereira et al., 2014). Other authors also apply the term agility to describe the ability of the supply chain to align and respond quickly to changes in the market (Sheffi, & Rice, 2005; Gligor, & Holcomb, 2012). Christopher and Peck (2004) argue that agility is a result from the velocity and visibility capabilities, while Jüttner and Maklan (2011) consider agility as a capability resulted from flexibility, velocity and visibility.

Flexibility refers to a variety of options in decision-making that implies responsiveness in critical times (Pereira et al., 2014; Ponomarov, & Holcomb, 2009). It can be built to tackle different sources of risk such as manufacturing, demand and supply (Tang, & Tomlin, 2008). Internally it can be obtained with multi-skilled work-forces and flexible manufacturing processes. In the supply chain network, flexibility can be achieved working via multiple suppliers or through flexible supply contracts. Scavarda, Ceryno, Pires, & Klingebiel (2015), add that this capability should be reinforced along the supply chain as the resilience in different tiers can impact the resilience of the focal firm.

Finally, the impact of demand risks can be reduced through responsive pricing or postponing products strategies. (Rice, & Caniato, 2003; Tang. & Tomlin, 2008; Blackhurst, Dunn, & Craighead, 2011). Thus, flexibility can be achieved even with a low

level of investment through the mitigation strategies (Tang, & Tomlin, 2008, Ghadge et al., 2012).

Redundancy requires investments in capital and capacity before any sign of disruption. It can be built through multiplying inventories (emergency stock) and sites of production, back up strategies for knowledge and processes and reinforcing relationships or contractual delivery clauses with long-terms suppliers. (Sheffi, 2001; Rice, & Caniato, 2003; Ponomarov, & Holcomb, 2009). Both resilience initiatives, redundancy and flexibility, can reduce the impact of disruptions. Nevertheless, the duplication of resources and activities necessary for the redundancy strategy, results in a trade-off between resilience and cost. On the other hand, flexibility may bring about operational competitive advantages (Christopher, 2000; Gligor, & Holcomb, 2012).

Velocity is the capacity of responding quickly to a disruption and can be achieved through simplification of process, lead-time and non-value added time reduction (Christopher, & Peck, 2004; Jüttner, & Maklan, 2011). Consequently, besides improving the supply chain resilience, this simplification of process also can improve operational performance.

Visibility is the ability to see every node of the supply chain. It surges from the collaboration through shared information and knowledge and from the alignment between focal firm, suppliers and customers (Cranfield School of Management, 2003; Christopher, & Peck, 2004; Blackhurst et al., 2011). There are several challenges in aligning interests among partners and provide visibility of environment in long supply chains (Cranfield School of Management, 2003; Tang, & Tomlin, 2008) although it can reduce risks and provide more effective solutions in case of disruption. (Sheffi, 2001; Chopra, & Sodhi, 2004; Christopher, & Peck, 2004; Jüttner, & Maklan, 2011).

Collaboration includes not only the information exchange necessary to improve visibility reducing uncertainty and event readiness, but also exchange of knowledge and common efforts between trading partners with a common objective to achieve mutual benefits or gains. (Cranfield School of Management, 2003; Sheffi, 2001; Wieland, & Wallenburg, 2013). The quantitative research of Wieland and Wallenburg (2013) confirms the positive influence of communication and collaboration under agility and resilience.

Market turbulences requires changes and adaptation in the supply chain dynamics and structures (Trkman, & McCormack, 2009). A longitudinal multi-case study conducted by Jüttner and Maklan (2011) analyzed companies before and after the global financial crisis and confirms the relevance of all formative resilience capabilities mentioned to protect supply chains during economical turbulences. Flexibility provided the possibility of adapting product for the needs of the marketing and velocity assisted the access to new regions and clients. Furthermore, visibility prepared the focal firms for insolvency of main suppliers, substituting raw materials and partners. Finally, collaboration assist the supply chain to achieve targets and reduce costs.

As mentioned before, the political and economic turbulences can be a source of risk by directly or indirectly affecting other risk sources and the resilience can reduce the potential impact of the disruption in instable environments.

Methodology

The present study is characterized as exploratory and qualitative research, based on three case studies - steel, agribusiness (more specifically, coffee) and personal care & cosmetics. These sectors suffered significant decrease in production, sales, and export and were exposed to high exchange rate volatility and inflation during the Brazilian crisis. In each sector, only one focal firm was chosen, thus making each sector a case. In order

to take a SC view, as well as to triangulate the data, we also interviewed suppliers and customers of those companies.

Focal 1 is one of the largest steel and mining company in the world. Is a multinational company that is present in 60 countries and supplies to automotive, construction, household appliances and packaging. Focal 2 is part of a German group that supplies both coffee and tea and associated products. Focal 3 is part of a global health, cosmetics and nutrition organization. In the present study, we investigated their personal care and cosmetics business in Brazil.

Data was collected through semi-structured interviews using an interview protocol with questions about the perception of the crisis, sources of risk and vulnerabilities, risk management plan, mitigation strategies and resilience capabilities of the organizations. New questions were included in the protocol as new themes arose from data. Nine interviews (average of 50 minutes) were conducted between August and October 2016. Of these 9 interviews, 6 were recorded and transcribed according to the respondent's permission. Four respondents did not allow the record. In these cases, the researchers take notes of the answers. In addition to these interviews, for chains in which the final product is in retail, additional information was collected in a meeting with industry and retail participants.

Table 2: Sample

Sector	Description	ID
Steel	Focal 1	Steel Manufacturing
	Supplier 1	Service Provider
	Supplier 2	Boiler Manufacturer
	Customer	Automotive Industry
Agribusiness (Coffee)	Focal 2	Coffee Manufacturer
	Supplier 1	Coffee grains Manufacturer
	Supplier 2	Package Supplier
Personal care & cosmetics	Focal 3	Health & Care Manufacturer
	Supplier 1	Input Manufacturer

Data analysis was performed concomitantly to data collection, always confronting evidence and literature, which allowed the refinement of issues throughout the study. The analytical procedure (Collis, & Hussey, 2005, p. 247) consisted of the following steps: (i) general analysis of the interview, identifying main ideas; (ii) detailed analysis of the data, identifying the context, conditions, and their agents interactions; (iii) data coding according to previously defined constructs based on the literature and classified according to the power of the evidence provided (weak, moderate and strong); and (iv) analysis of the results to verify patterns, similarities and differences.

In the data analysis processes, we first evaluated the focal companies' interviews and then the suppliers' perspective. A discussion of data analysis is presented in the next section.

Data Analysis

Risk perception is the first stage in risk management and the trigger for managers to assess vulnerabilities and plan actions to mitigate and control the source of turbulence (Sodhi et al 2011). However, our results indicate a lack of risk perception and consequently of preparedness to tackle the environmental turbulences.

Two respondents cited that they did not perceive the crisis affecting their organisations. However, the examples provided by them demonstrated the negative impacts of the crisis along their supply chains. In other interviews, the managers recognized that the turbulence affected their results in different ways. Nevertheless, the analysis revealed that although they perceived it, organisations were not proactive to avoid these negative impacts. These findings corroborate with de Brito, Miguel and Pereira, (2016) which states that organisations in Brazil has a low risk perception even in scenarios of eminent disruption.

As stated by Manuj and Mentzer (2008a, 2008b), external or environmental risk sources manifest themselves affecting other risk sources. In terms of effects of the crisis, three main impacts were identified: impact on the demand, impact on the suppliers' financial health and impact on the financial results of the companies. The crisis in Brazil affected the purchasing power of Brazilian consumers resulting in demand volatility and reduction. In both personal care & cosmetics and coffee supply chain, the focal company mentioned that they perceived a demand reduction of their products and the migration of consumers to less expensive competitors. In the steel supply chain, the focal company experienced more volatility in its demand and it challenged their way to operate. Demand risk resulted also in issues to plan operations and to manage capacity.

According to our respondents, the crisis also resulted in sales order cancellation to all players in the supply chain. With total demand reduction, suppliers had to decide what to do with their idle capacity and reduce their workforce and the number of production shifts. Therefore, companies didn´t know exactly how much suppliers could deliver and this could result in more vulnerability to disruptions in the near future. For some of our respondents, mainly suppliers, the crisis did not represent a volume reduction, but a change in their customer base. As an alternative for the usual market, seven of nine companies looked for new opportunities outside their regular supply chains, such as new customers inside the country and abroad, and developing of products for new markets (Tang & Tomlin, 2008; Chopra and Sodhi, 2004). However, only in four companies, these strategies were developed before the disruption.

Environmental turbulence also affected suppliers' financial health. In all three-supply chain investigated, focal companies reported that at least one supplier did not survive due to the crisis. Suppliers could not deliver products or services and the focal company was vulnerable to disruptions in their own operations. Only focal 3 reported the excess of inventory as a mitigation strategy against supplier risk.

Companies (focal 1 and 2) had to negotiate prices with suppliers. According to our respondents, at the first signal of inflation increase, suppliers asked for new negotiations and price increase. The buyers mentioned that, although they could not accept cost increase (that could not be transferred to consumer), they recognized that some of their suppliers would struggle to survive if this conflict was not solved. Therefore, in some cases, focal companies had to reduce their exercise of power. Despite this could be an evidence of collaboration, the respondents didn´t emphasize that they were willing to spontaneously join efforts with their partners.

Companies also faced problems with their profitability. The first impact of the economic crisis was on the exchange rate, devaluing the Real in relation to the US Dollar. Multinational organizations are usually dependent on imports; therefore, new exchange rate had a direct impact on the costs of raw material. To prevent new demand decrease, they had to reduce their own margins to maintain at least part of their market share. We summarize the impacts of the economic turbulence in Figure 1.

Figure 1 proposes that the environmental turbulence affects demand volatility increasing the risks associated with demand. It also increases the risk related to supplier,

therefore, supply risk. Both demand and supply risks may result in possible disruptions and consequently impact the financial performance of the company. Environmental turbulence also had a direct impact on profitability due to cost increase.

Regarding mitigation strategies, in terms of supply risk, companies adopted close controlling and monitoring of quality, processes and SC intelligence by frequently assessing financial information about each partner and the industry. They also preferred to adopt multi-suppliers' strategy. Focal 2 also reported a contingency strategy to deal with their insolvent supplier. They accessed their legal department to work with the official agency in order to expedite the warehouse license being able to return operations after a few days.

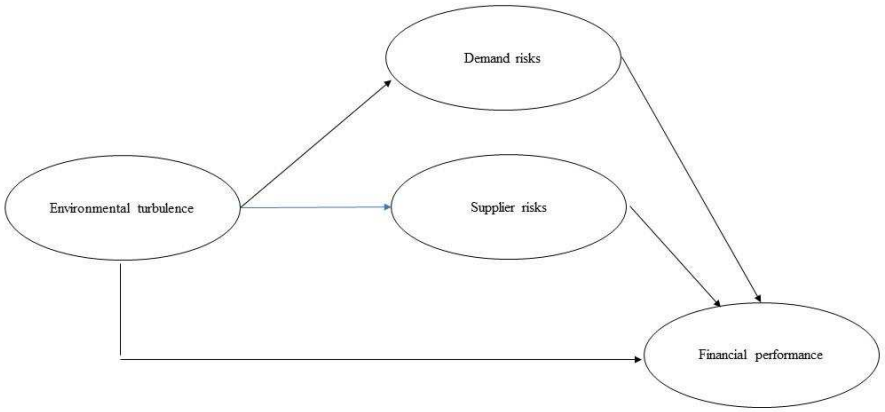

Figure 1- Proposed framework of the impact of environmental turbulence on risks sources and performance

Three strategies were identified in terms of demand risk. For focal companies, the preferred strategy was to maintain prices to avoid competition with low quality and less expensive products. On the other hand, suppliers maintained volumes by diversifying customer base and entering new markets. In the cases studied, interviewers mentioned that they had to look for new markets/industries to maintain volumes and mentioned that the entrance in new markets is also dependent on information availability (i.e. supply chain intelligence). The third strategy was adopted only in the steel SC and referred to export part of production.

In terms of resilience capabilities, we identified flexibility, redundancy, redundancy, velocity, visibility and collaboration. The mitigation and contingency strategies of multiple suppliers, diversification of customer base, excess of inventory increased the flexibility and redundancy of these organizations to respond to environmental turbulences as proposed by Tang and Tomlin (2008). The suppliers' financial health monitoring resulted in a greater visibility of focal firms for insolvency of main suppliers. These two aspects corroborate with Jütter and Maklan, (2011). In terms of velocity, just Focal 2 company provided evidence to how they reacted in a specific problem with one supplier. They were able to recover from the event in a few days.

There were three different evidences of collaboration: 1) Two firms of the coffee supply chain provided finance support to maintain some key suppliers. 2) According to

the respondent of focal company in the beauty SC, the collaboration with suppliers through information exchange increased the supply chain visibility. 3) Two respondents reinforced the importance of the internal collaboration (between departments) through information exchange about suppliers.

Finally, companies demonstrated different resilience levels along the supply chain. Whilst some companies presented basic mitigation strategies and formative resilience capabilities, other were unprepared to face the environment turbulences increasing the supply chain risk levels. This result illustrates the importance of resilience be reinforced in different tiers as suggested by Scavarda et al. (2015)

Conclusions

According to our literature review, environmental turbulence such as political and economic crisis are not broadly explored in the supply chain risk and resilience. In addition, the few studies addressing this theme are mainly conducted in developed economies where the so-called "country risk" is not an issue. The present research investigated the impact of the environmental risk in Brazil in three supply chains. Our analysis provided evidence of risk perception, impacts, mitigation strategies and resilience capabilities.

The main contributions of the study are twofold: First, using a qualitative interview, we found empirical evidences of the main impacts of environmental turbulence in supply chain and proposed a new model to be tested where environmental turbulence affects both supply chain operations, increasing the vulnerabilities of them to demand and supply risk source. Additionally, the variability in the exchange rate also affects the profitability by increasing costs that could not be transferred to final consumers. Secondly, the results suggest that respondents of the investigated supply chains did not anticipate and access their vulnerabilities to this event but respond to it by adopting flexibility, velocity, visibility and collaboration during the response phase. Our results suggest that those supply chains mainly adopt contingency strategies rather than mitigation strategies.

Our study has some limitations. The first limitation refers to the sample. The present study was focused on few respondents within each supply. Moreover, we could not interview respondents of all echelons of the studied supply chains. This research must continue to increase the number of interviews and also collect data from more steps of the supply chain.

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Interview Protocol

1. In your opinion, what are the main risks that affect your company's operations?
2. Does the company have any departments for risk management? Who is responsible for managing the risks related to operations and its supply chain?
3. Did you have a risk management plan? What did he propose? What risk factors were covered? Were there strategies for political or economic crises? How are risks?
4. How did you perceive the impact of the Brazilian political and economic crisis on your company's operations? And in the supply chain? Could you give us an example of events that affected your relationship with suppliers or customers and resulted in uncertainty or disruptions?
5. What are the main risk factors that have emerged in the supply chain leveraged by this crisis?
6. How did this crisis affect your company's supply chain? Did any risky situation actually occur? What did happen? What were the impacts?
7. In practice, how have you faced these problems? Which strategies the organization used to deal with these events that impacted the supply chain?
8. Do you think that your organization responded more quickly than the competitors? Can you give us some evidence, an example?
9. In your opinion, what are the most importante professionals and organizationals skills to be developed to deal with these problems and their impacts? Why?
10. What were the main challenges or difficulties encountered to respond to the problem and mitigate its impacts?
11. What could be done otherwise?
12. What are the perspectives for the future? Is the supply chain stable? Has the supply chain returned to normal operating levels? Are there perspectives for improvement?
13. Could you indicate a customer or supplier in order to deepen our research?