7
Discussions

This section offers additional analysis and preliminary conclusions regarding the empirical findings presented in chapters 5 and 6, respectively.

7.1.
Discussions on Supply Chain Flexibility

SC A was exposed to uncertainty both upstream and downstream from the vehicle assembly plant. From the perspective of the usage aspect of flexibility, it can be said to be reactive with a low level of responsiveness. Despite managing part of the unexpected demand increase with internal labor flexibility at the engine plant, it lacked other internal flexibility types for success. The lack of flexibility relationship increases the possibility of a restriction at the engine block and crankshaft supplier because there is no collaboration between this second-tier supplier and other members of the SC (for instance, by sharing investments and/or risks related to an idle production capacity), which is in keeping with the empirical findings of Stevenson & Spring (2009). The cases where there was a lack of sourcing flexibility regarding second-tier suppliers for the electronic injection for the 1.0 engine and the components for the diesel engine cases is also notable; it was impossible to find new suppliers in the short term. While the former was caused by the demand increase, the latter resulted from a supply process breakdown. Here, capacity constraints resulted in a lack of volume-mix flexibility to end-customers. Both cases were exacerbated by a single sourcing operation, consequence of the supplier base rationalization trend within the automotive industry's SC. On the one hand, this rationalization seeks the benefits of a close relationship that can provide flexibility with a greater willingness on the part of the supplier to cope with change, but on the other hand, such relationships can make SC re-configuration more difficult, as seen in both cases. This

reinforces the concerns in the literature regarding this type of relationship in an environment of uncertainty (Lee et al., 2009) resulting in trade-offs with risk and flexibility in the SC (Stevenson & Spring, 2009).

In turn, SC B was also exposed to uncertainty as the demand increased unexpectedly. From the perspective of the usage aspect of flexibility, it was also reactive, but its response varied depending on the limitation and on the analyzed product (vehicle model). Considering the air conditioning and power steering components for the low-cost subcompact model, the chain's ability to provide flexibility to its end-customers can be considered satisfactory, although there was a mix restriction delivered to end-customers. The SC managed the demand increase by using different internal flexibility types such as labor, relationships, postponement and sourcing. Both postponement and sourcing flexibilities can be considered examples of allowing re-configuration flexibility. The same SC did not react as successfully with the highly valued compact model because the postponement flexibility was not successful, resulting in a different flexibility level provided by the chain to end-customers. Considering the supply of alloy wheels, the lack of sourcing flexibility limited the SC's ability to provide flexibility to its end-customers and impacted them differently (mix for the low-cost subcompact model and volume for the highly valued compact model).

Postponement flexibility is present in SCs A and B. This flexibility type is used to deal with uncertainties in customers' variety preference (mix) resulting from the long order lead-time of the vehicle assembly plants' delivery strategies. Dealers use late configuration as a means to accommodate specific customer preferences within considerably shorter lead-times. Although postponement increases the range number of the mix offered to end-customers, it also has limitations because dealers can add only peripheral variants to the vehicles, resulting in low range heterogeneity.

Like SCs A and B, SC C was exposed to uncertainty regarding end-customers' demand. However, this chain had a decrease in its forecasted demand, and its lack of flexibility in dealing with existing inventories and purchased orders in the pipeline limited the mix range-number offered to end-customers. As the product variety offered was considered important in its vehicle's market segment, this mix restriction not only resulted in lost sales but also forced discounts at dealers and ended with some damage to the OEM's brand in the market. It is

possible to examine the limited chain's ability to deal with this decrease in demand. In this case, however, the restrictions in the SC had a strong influence on other SC members, especially those hosted in the OEM's supplier park near the plant. This supplier park was established to offer logistic flexibility to the OEM in a greenfield area. However, the vehicle model demand was lower than forecasted, resulting in the transference of the seat supplier assembly line from the OEM's supplier park to another existing facility and a huge overcapacity of the other suppliers' installations in the supplier park, as they could not use their capacity to meet demand in other plants. Because this thesis focuses on the SCs' ability to provide flexibility to their end-customers, this supplier perspective will not be analyzed here. Hence, it represents a possible subject for future research.

A summary of the similarities and discrepancies among the three supply chains is presented in Table 16, offering a synthesis of the cross case analysis.

Characteristics	**Supply Chains**		
	A	**B**	**C**
Time in the market	Well established	Well established	New comer
Market segment	Low cost subcompact	Low cost subcompact and highly valued compact	Premium compact
Market dynamics	Expansion/growing	Expansion/growing	Retraction/decrease
Main Restrictions			
OEM	None	None	None
1st tier supplier	Engine plant limited capacity production	Limited capacity production: air conditioning, power steering, and alloy wheels.	Overstocked components: doors, seat trims
2nd tier supplier	Engine blocks and crankshafts limited capacity production; 1.0 liter electronic injection volume supply; diesel components supply disruption		
Flexibility observed			
Dealers	Postponement: order decisions of trivial configurations / low heterogeneity	Postponement: late configuration of air conditioning and power steering	
OEM		Air conditioning: sourcing (new supplier)	Logistics (supplier park nearby)
1st tier supplier	Engine plant: labor force journeys and contracts	Power steering: flexible labor Alloy wheels: relationships (negotiated an increase in production capacity)	
2nd tier supplier	Electronic injection and diesel components: sourcing (new supplier)		
Order-to-delivery strategies	Forecast based; Built to stock; Long order lead times	Forecast based; Built to stock; Long order lead times	Forecast based; Built to stock; Long order lead times
Flexibility use	Mainly reactive, dealers proactive (trivial postponement)	Mainly reactive, dealers proactive (trivial postponement)	Mainly reactive, OEM proactive (supplier park)
Limitation to end-customers	Volume and mix	Volume and mix	Mix

Table 1- Cross case comparisons

7.2.
Discussions on Supply Chain Risk Management

Although all of the interviewed executives agreed that it is important to act and to take risk into account in SC decisions as an instrument that will sustain SC performance, the analyzes of the manifested risks in three different SCs demonstrates a lack of formal instruments for SCRM along the different tiers. It is not surprising that this result agrees with Blos et al. (2009) because the researchers also studied the automotive industry in Brazil. However, these findings should not be regarded as specific only to the automotive industry of Brazil, as Thun & Hoenig (2011) found similar results in the German automotive industry. It should also not be regarded as being a unique characteristic of the automotive industry because these findings are aligned with the results from studies that have addressed other industries (e.g., Jüttner, 2005; Lavastre et al., 2012). The similarities of findings from different empirical studies indicate that, although SCRM has become a relevant topic, SCRM practices are still far from being widely implemented. Therefore, a risk identification analysis should be considered as the first phase of an SCRM process, as recommended in Kern et al. (2012). The analysis conducted in this research provides the main risks drivers, risk sources, and risk events to which Brazilian automotive SCs are exposed, based on real-life manifested risks, and is the basis for a proposed risk profile for this industry.

The risk sources associated with the demand uncertainty of the end customers for new cars played important roles in SCs A and B. These risk sources are also highlighted in other empirical studies (e.g., Thun & Hoenig, 2011; Sofyalıoğlu & Kartal, 2012). Inertia network-related and supply risks were also observed in the upstream tiers of the SCs. For instance, the production capacity limitations for some auto parts of the first- and second-tier suppliers for the VMs' assembly plants caused the shortage of some components, which restricted the supply volumes for some vehicle models and for the mix of their versions at the dealer level. The use of postponement as a mitigation strategy to react to demand volatility is also observed in other empirical studies (e.g., Sofyalıoğlu & Kartal, 2012). Although it was quite successful for the low-cost vehicle models, it did not succeed for highly valued models. Government policy and macroeconomic

uncertainties were also revealed. As increasingly more SCs operate in a global environment, these risk sources will occur more frequently. Within this context, Cohen & Huchzermeier (1999) and Novaes & Souza (2005) mention that global enterprises can use different generic types of real options that can aid in the mitigation of the impact of uncertainty, as for instance the abandoning option. This option has been adopted in the Brazilian automotive industry with the displacement of entire assembly lines across the borders, for instance, when Daimler-Chrysler phased out the production of the Dodge Dakota in Brazil, resulting in a volume mismatch between end customers' demand and dealers' supply. Where, the local currency devaluation and changes in government regulation impacted the company, causing the exit option (Lazzaroto et al., 2009).

Among the observed risk drivers, concentration and dependence on a reduced supplier base were also identified in the German automotive industry (Thun & Hoenig, 2011), which is not surprising because such drivers are associated with well-known trends in the automotive industry's SCM. This phenomenon was also observed in other industries, such as retail (Khan et al., 2008).

Table 17 presents a summary of the findings, offering a risk profile that should be assessed by the Brazilian automotive industry. It is important to highlight that this table is not intended to be exhaustive but aims to provide an initial risk profile as a way to start a SCRM process. Once the SC reaches a higher maturity level, the members can use other approaches to identify new risks and improve the provided risk profile and follow other SCRM process steps, such as assessment, treatment, and control.

Risk Drivers	**Risk Sources**	**Risk Events**
Supplier Concentration; Supplier Dependence; Global Sourcing	Environmental Source: macroeconomic uncertainties	Economics crises and local currency devaluation
	Environmental Source: government policy uncertainties	Economic reforms, changes in government regulations and trade restrictions
	Industry Source: product market uncertainties	Demand change for new cars (Brazilian automotive market)
	Industry Source: input market uncertainty	Limited supplier capacity availability offered to the industry
	Industry Source: product market uncertainty	Demand change for auto parts
	Industry Source: competitive uncertainty	Additional supplier production capacity given to a rival VM taking part in another supply chain
	Network-related risk source: demand risk	Demand change for a specific supply chain product (vehicle model)
	Network-related risk source: supply risk	Limited supplier capacity availability offered to a specific supply chain and supply interruption from a single-source supplier
	Network-related risk source: inertia	Long time to select / develop a new supplier and long time to adequate suppliers' capacity to demand change

Table 2- Risk Profile