

# Supply chain risk management and competitiveness in Latin America: preliminary findings

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## Abstract

This paper presents preliminary findings of a comprehensive study on Latin American companies' current supply chain risk management, highlighting its effect on competitiveness. It includes results of an online survey based on ISO 31000:2009 principles and guidelines, including the most prominent supply chain risks and strategies employed by respondents' companies. The study shows that SCRM is positively correlated with supply chain objectives, which in turn are positively correlated with business performance.

**Keywords:** Supply Chain Risk Management, ISO 31000:2009, Competitiveness

## INTRODUCTION

In the last decade, supply chain risk management (SCRM) has been a crucial strategy for competitive and thriving organizations. SCRM has gravitated from conventional, constrained approaches towards a holistic, organization-wide paradigm, fostering intertwined frameworks for coping with risk and enhancing organizations' resilience. According to the International Organization for Standardization (ISO), the term "risk" refers to any "effect of uncertainty on objectives, which could have an enduring effect in the organization's competitiveness..." (Leitch, 2010). A rising supply chain disruption incidence triggered by natural disasters, oversights, oil price increase, terrorist attacks, breach of contracts, consumer demand ambiguity, and SARS or Ebola outbreaks have exposed vulnerability across supply chains (Fischer *et al.* 2014; Monroe *et al.* 2014; Tang 2006). Implementing strategies such as outsourcing or near-sourcing could make supply chains more vulnerable to disruptions rooted in uncertain supply chain elements (e.g. chain configuration and information system.) Latin American organizations have faced these realities (da Silva *et al.* 2013; Revilla and Sáenz, 2013; Cardona 2005), as intense competition forces businesses to confront diverse risks and turn to risk management (Murphy *et al.* 2012).

For this reason, we must assess whether SCRM supports formal strategic decisions and effectively manages supply chain uncertainties from unpredictable, and dynamic sources in the region. Studies have shown that SCRM is crucial in reducing vulnerability and deviation from strategic objectives (Avelar-Sosa *et al.* 2014; Jereb *et al.* 2012). However, while recent research has focused on other geographical regions, only a few studies have focused on Latin America.

This research’s objective is twofold: (1) to uncover current SCRM practices in Latin America, and (2) empirically test whether these approaches have increased supply chains’ responsiveness, reduced costs and enhanced organizations’ competitiveness. Grounded on ISO 3100:2009 principles and guidelines, the study assesses whether SCRM supports business performance (i.e. competitiveness), and highlights areas for future research.

## LITERATURE REVIEW

Mastering SCRM allows businesses to seize opportunity and sustain a competitive edge (Avanzi, Bicer *et al.* 2013; Zhao *et al.* 2013). SCRM frameworks help gain insight into their business processes and nurtures transparency throughout enterprises to assess and control risks. These frameworks are crucial to organizations’ planning and control systems, where timely risk identification, assessment and response are linked to pertinent processes

Researchers have established numerous rating mechanisms, and approaches regarding supplier risks (Cousins *et al.* 2004; Hallikas *et al.* 2004). Some use descriptive criteria and other holistic approaches based on system thinking (Roussakis and Lizarzaburu, 2013; Manuj and Mentzer, 2008; Kleindorfer and Saad, 2005; Chopra and Sodhi, 2004). Nevertheless, companies must understand how to strategically respond to those risks (Ritchie and Brindley, 2007).

Most researchers agree on the following SCRM processes: risk assessment (identifying potential losses or gains), establishing the impact or extent of those losses or gains, understanding the risk likelihood (probability), and risk response strategies. Most focus on determining the magnitude of potential losses and appraising overall risk. Recently, researchers assess risky events in terms of opportunities presented and risk thresholds. Within the organizational context, such assessments are considered important activities for supply chain personnel and companies.

In 2004, the Committee of Sponsoring Organization of the Treadway Commission (“COSO”) published the Enterprise Risk Management (ERM) framework, one of the first successful efforts to implement a company-wide risk management framework (Ballou and Heitger, 2005). Since then, several guidelines have been developed based on COSO framework’s principles, including ISO 31000:2009.

Figure 1 depicts the ISO 31000:2009 risk management process, which became an archetype for risk management systems. For instance, Scannell *et al.* (2013) published an SCRM framework using ISO 31000:2009 processes. The authors established that ISO 31000 is more comprehensive than other SCRM frameworks. In light of this lack of consensus, as aforementioned, most survey questions (excluding those used for profiling respondents) were geared towards determining how companies conduct these processes.

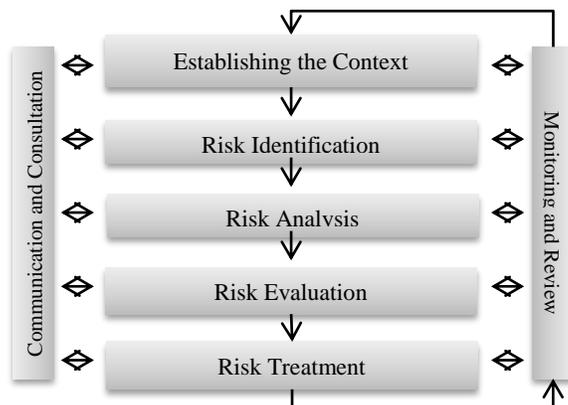


Figure 1 - ISO 31000:2009 Risk Management Processes

Source: ISO 31000:2009 Risk Management Principles and Guidelines

Table 1 shows a sample of studies that incorporate these processes into proposed SCRM frameworks. As demonstrated, three studies incorporated all processes recommended by the guideline. Notwithstanding a lack of consensus regarding what processes constitute an SCRM framework; most descriptions are similar to those suggested in ISO 31000:2009 guidelines.

Table 1 - ISO 31000:2009 Processes and SCRM Frameworks

Studies Sample	ISO 31000:2009 Processes					Monitoring and Review
	Communication and Consultation	Establishing the context	Risk identification	Risk analysis	Risk treatment	
Hallikas et al. (2004)			X	X	X	X
de Souza, Goh & Meng (2009)	X	X	X	X	X	X
Moeinzadeh & Hajfathaliha (2009)	X	X	X	X	X	X
Cagliano et al. (2012)	X		X	X	X	X
Tummala & Schoenherr (2011)			X	X	X	X
Kouvelis et al (2011)		X	X	X	X	
Aloini et al. (2012)			X	X	X	X
Vilko et al. (2012)	X	X	X	X	X	X

## RESEARCH METHODOLOGY

Based on the ISO 31000:2009 risk management principles and guidelines, we generated an exploratory online survey as the primary data collection method. We added profiling questions to understand respondents' nature. Overall, the survey aims to answer the following questions:

- 1) What is the current SCRM state in Latin America?
- 2) Do the extant SCRM practices increase businesses' competitiveness?

Since only a few empirical researchers specialize on the subject, this study is based on ISO 31000:2009, and, to some extent, on Sheffi's (2005) vulnerability framework. Furthermore, survey responses adduce information on supply chain disruptions, identified potential risks' probability (likelihood) and impact, a prioritization scheme (a probability and impact matrix), and their response strategies. For SCRM's impact on respondents' strategies, we assessed two supply chain objectives: supply chain responsiveness and costs. Respondents chose these two objectives as the main determinants of competitiveness. The Supply Chain Council (SCC) defines the term "cost" as the aggregate of all operating expenses, including "labor costs, material costs, and transportation costs..." and the term "responsiveness" as "...the velocity at which a supply chain provides products to the customer..." (Ntabe *et al.*, 2014.)

To understand SCRM activities and performance at the macro level, we collected data from various industries, including Manufacturing/Electronics, Construction, and Distribution/Transportation. We conducted an online survey from August 2013 through April 2014 in seven countries: Colombia, Costa Rica, Dominican Republic, Honduras, Mexico,

Panama, and Puerto Rico. We sent survey invitations to 237 companies of various sizes and from diverse industries, with different supply chain management positions and ownership structures (public, semi-public and private). These companies were members of the Association of Operations Management (APICS) and the SCC. We contacted other companies directly and included them in the study. Overall, we gathered 117 responses, 16 of which were removed because of insufficient information, for a final 47 percent response rate (the “Respondents” or the “Sample,” which is comprised of 101 companies). We tested late-response bias by comparing the means of all scale items via *t*-tests between the first responses and those received after December 15<sup>th</sup>, finding no significant differences ( $p \geq 0.05$ ). We found no indication of a non-response bias.

Proper SCRM implementation is essential to competitiveness. For instance, even if companies reach their development and/or innovation objectives, their offerings’ commercialization will highly likely be hindered if risks are not properly managed. Unfavorable risk consequences can manifest in any performance measure. As aforementioned, to measure SCRM’s impact on competitiveness, Respondents chose two supply chain objectives: responsiveness (76%) and cost (67%). We used business performance as proxy for competitiveness, covering different areas, including market share and financial standing.

In a study on SCRM’s impact on competitiveness, Wieland and Wallenburg (2012) proposed a methodology to understand this relationship. Anchored on their methodology, in this study we tested the following four hypotheses:

- H<sub>1a</sub>: SCRM increases responsiveness.
- H<sub>1b</sub>: SCRM reduces cost.
- H<sub>2a</sub>: Responsiveness enhances business performance.
- H<sub>2b</sub>: Cost reduction enhances business performance.

We used a structural equation model (“SEM”) to test these hypotheses (see Figure 2). Model fit was good (i.e.  $\chi^2/df = 1.69$  and CFI=0.82). The responsiveness and cost links coefficients were 0.43 and 0.57, respectively, and in both cases  $p < 0.01$ , supporting both H<sub>1a</sub> and H<sub>1b</sub>. We found similar results in the paths from the supply chain objectives to business performance.

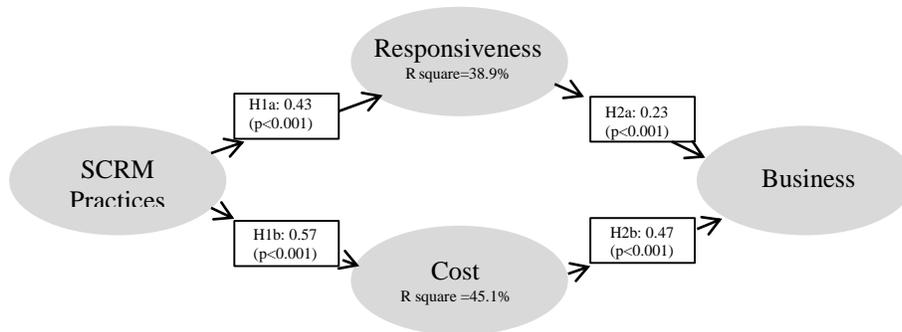


Figure 2 - Structural Equation Model

## DISCUSSION

ISO 31000:2009 recommends that businesses establish their risk management support systems, including responsibilities and scope, prior to planning or executing any action. Nevertheless, we found that 58 percent of Respondents have not institutionalized an SCRM support system, and that this process is limited to ad-hoc rather than systematic approaches, in many cases embedded in other strategic or tactical initiatives. We observed similar behavior

regarding communication and consultation processes. In the latter, although detailed operations information, including logistics schedules, quality, warehouse dispatching, and inventory control levels, were comprehensible, data centralization seemed lacking, causing visibility and accuracy problems, and hampering the SCRM support system.

## Respondents' Profile

Fifty-eight percent of Respondents belong to the “tangible” production industries, such as manufacturing, electronics, and construction. As to the “intangible” cluster, most Respondents form part of the logistics, information technology (“IT”) and consultancy, and retail/wholesale industries. Table 2 shows the Sample’s demographic statistics. As stated in this table, 53 percent have sales exceeding \$100M, 54 percent have at least 1,000 employees, 77 percent are Tier 1 suppliers, and 89 percent are privately owned.

*Table 2 - Sample Summary Statistics*

<i>Industry</i>	<i>Percentage of companies</i>
Agriculture	7%
Automobile and Aerospace	5%
Banking	3%
Construction	17%
IT & Consultancy	13%
Consumer Products	3%
Distribution and Transportation	14%
Manufacturing & Electronics	19%
Pharmaceutical & Medical Devices	7%
Retail/Wholesale	11%
<i>Companies size: sales (in million \$)</i> <i>(mean=129.04,sd=11.17)</i>	<i>Percentage of companies</i>
<15 (min. 9.3)	14%
15-75	12%
75-100	21%
100-150	24%
150-200	16%
200-400	9%
>400 (max.=523)	4%
<i>Companies size: number of employees</i> <i>(mean=2259.8 ,sd=419.6)</i>	<i>Percentage of companies</i>
<100 (min=23)	6%
100-250	7%
250-500	17%
500-1000	16%
1000-2500	21%
2500-5000	15%
>5000 (max=7,830)	18%
<i>Supply chain position and Ownership</i>	<i>Percentage of companies</i>
OEM	23%
Tier 1	77%

Private	89%
Public or Semi-Public	11%

## RISK IDENTIFICATION

Identifying supply chain risks requires comprehensive understanding of supply networks’ structure, flows, operational dynamics and complexities. To this end, most Respondents rely on mapping techniques or general purpose frameworks (e.g. the supply chain reference model), identifying and assessing risk.

Various process-based tools aid in identifying and assessing supply chain risks. Based on our experience, we studied the following six tools: document review, SWOT analysis, cause and effect analysis, scenario planning, process mapping, and brainstorming. Figure 3 states our results regarding these six tools. While Respondents could include and comment on other tools used for this purpose, they selected from among those presented in the survey. “Document review or any similar technique” was the preferred (32 percent) risk identification technique. Most Respondents employ a combination of these tools with brainstorming-type processes, accounting for the latter’s’ popularity. Our findings reveal an intentional preference towards less quantitative and structured tools, as supported by responses to open-ended questions regarding this issue.

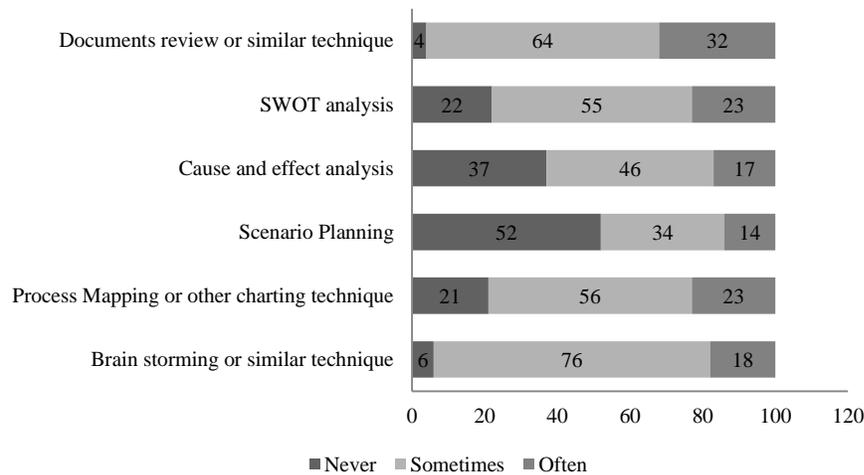


Figure 3 - Supply Chain Risk Assessment Techniques

## RISK ANALYSIS

A main risk analysis phase is selecting an adequate risk category framework. Risk categories help prioritize risks in risk planning. Generally, risk categories are developed on a case-by-case basis. The standard risk categories are internal versus external, or endogenous versus exogenous, but no other formal categories exist. Once organizations have developed risk categories, they usually develop risk breakdown structures (“RBS”) to organize the information. Most RBS are hierarchical, which better suits frameworks that define risk source and response strategies. Some companies have implemented database management systems to serve as these categories’ data-knowledge repositories. RBS must serve as a visual and analytical scheme, portraying the hierarchy of the overall risk pattern and related constructs and facilitating risk assignment, prioritization, detection, response, and control.

Following are the supply chain risks faced by Respondents. RBS is grounded on Blös *et al.* (2009) study on supply chain vulnerability in the Brazilian automotive and electronics industries, which categorized risks in the following four classes: external, financial, operational, and strategic. Under this categorization scheme, risk membership is mutually exclusive. Table 3 shows the percentage of Respondents that identified the corresponding risk as a concern. For instance, 97 percent of Respondents stated that “suppliers interruptions” are an operational concern. Surprisingly, only 3 percent identified “changes in industry regulations” as a concern.

*Table 3 - Responses of Risks by Category*

<i>Strategic vulnerability</i>		<i>Financial vulnerability</i>		<i>Operations vulnerability</i>	
Supplier interruptions	97%	Financial market instability	95%	HR accidents and risks	87%
Competitors	87%	Liquidity/cash	87%	Loss of key personnel	83%
Political risk	54%	Economic recession	71%	Compromise of IT	76%
Union regulations	52%	Currency and foreign exchange rate fluctuations	64%	Unacceptable quality	67%
<i>External vulnerability</i>		Fuel and other commodities prices	54%	Utilities failures	64%
Loss of key facility	92%	Changes in industry regulation	3%	Logistics disruptions	62%
Weather causes (hurricanes, flooding, and drought)	81%				
Cargo losses	61%				
Sabotage or unshedule process shutdowns	19%				

Strategic vulnerability surfaces in unfamiliar situations such as product launches, business model implementations or joint ventures commencements. As expected, supplier interruptions (97 percent) are Respondents’ main concern, as this risk greatly impacts companies’ inertia and competitiveness. Furthermore, as stated by some Respondents, when the competitive environment does not support companies’ essential strategic actions, often the problem is rooted in competitors’ actions combined with high political risk. In most cases, the competitor has special government support.

In this context, external vulnerabilities are uncertain, unintentional (non-man-made) events that could disrupt supply chains. Financial vulnerability refers to a high risk financial state, including debt and equity financing, and a crumbling financial market. Given the global market’s complexity, several disruption sources complicate financial flows and cash management in Latin America. Operational vulnerability manifests in different supply chain stages, and is traditionally associated with distribution network failures or other issues, such as container accidents due to operator error.

## RISK EVALUATION

We asked Respondents to identify each risk’s probability and impact. For probability and impact characterization, we only considered observations of Respondents that identified a specific risk as probable. We requested Respondents to provide probabilities and impact estimates for each risk based on available information, including quantitative methods results. We assessed and ranked all probability and impact results. For instance, a typical question in the survey is “...based on any relevant information available, what are the probabilities and impacts that characterized the risk of Loss-of-a-key-facility?” Based on these results, average probability and impact ranges were established, as shown in Table 4, used to prioritize risks.

*Table 4 - Probability and Impact Definition*

<b>Probability</b>	Very Low	Low	Medium	High	Very High
	2% < target	2% < target < 8%	8% < target < 12%	12% < target < 20%	> 20% above target
<b>Impact</b>	Very Low	Low	Medium	High	Very High
	5% < target	5% < target < 10%	10% < target < 20%	20% < target < 50%	> 50% above target

We employed these ranges to construct our probability and impact matrix (a common risk management scoring method), which rates each risk on an ordinal scale. Figure 4 shows these results.

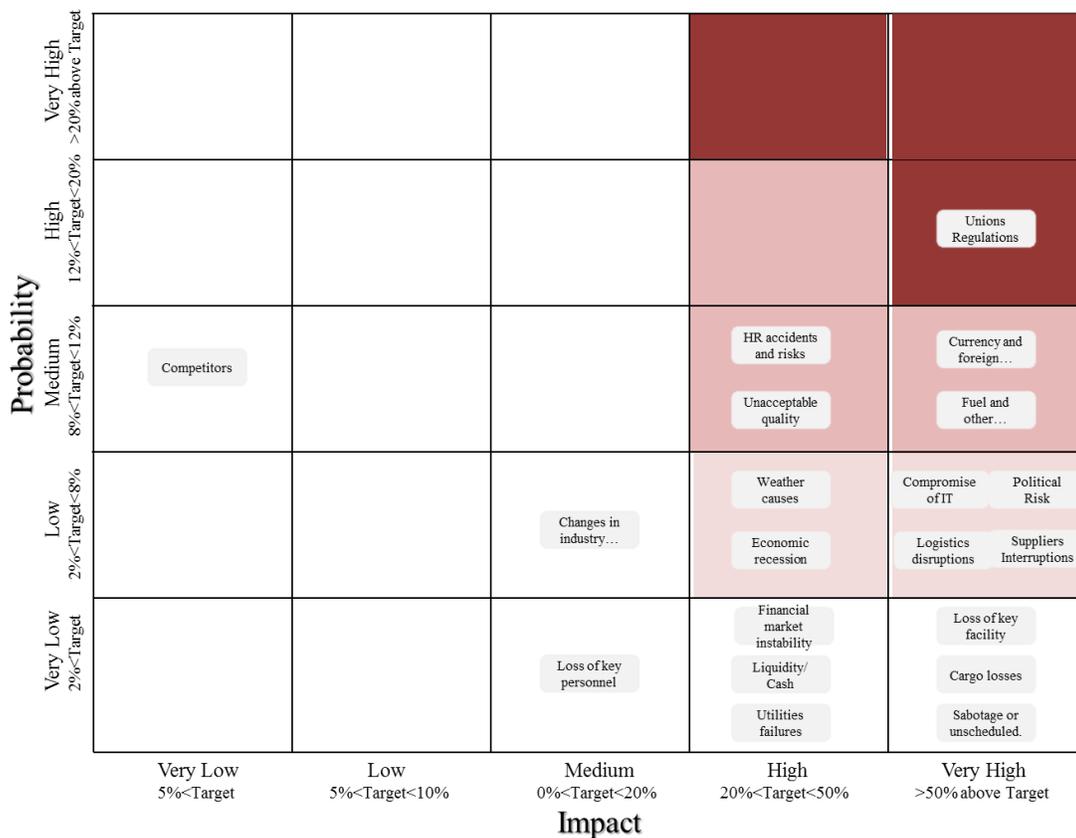


Figure 4 - Supply Chain Risk Probability and Impact Matrix

Respondents rated 85 percent of risks as having a high or very high impact. According to Respondents, the most likely risk was “union regulations,” which may generate disputes, negotiations and strikes. Although competitors’ actions, such as introducing new product lines and concentric diversification, are of concern, Respondents stated that on average they have very few consequences on their operations.

## RISK RESPONSE STRATEGIES

Risk response strategies are based on the probability and risk matrix, economic tradeoffs (response cost versus impact) and other considerations. Most response strategies fall into one of the following categories: avoiding, accepting, mitigating (also known as reducing) or sharing. Respondents stated that generally risk categorized under external vulnerability was not actively managed, and instead dealt with via contingency plans. Table 5 summarizes Respondents’ main response strategies. An important finding [not shown in the table] is that, although Respondents agreed that SCRM should be a joint effort, only 16 percent of Respondents implemented adequate administrative infrastructures to this end. Respondents agreed that these joint efforts could induce a rippling effect either with their suppliers or customers, especially those in Tier 1 positions.

Table 5 - Risk Responses

Avoiding	Percentage	Mitigation	Mean	Sharing	Mean
In-sourcing and near-sourcing	47%	Using Third Party Logistics (3PL)	74%	Insurance	87%
Six sigma and earned value management	35%	Redundant systems or processes	51%	Speculation or hedging strategies	47%
Process dismissal	12%	Delay differentiation (or Postponement)	43%	Joint product development initiatives	12%
Process displacement	9%	Multiple sourcing (rather than sole sourcing)	21%		
		Suppliers' training program or certification	16%		

## CONCLUSION

This study highlights SCRM's status in Latin America, based on ISO 31000:2009 recommended processes, and SCRM's relationship with competitiveness, showing the need for more proactive risk management. The study shows the most prevalent risk and response strategies according to Respondents' experience and perception. We found that SCRM (mainly response strategies) is positively correlated with supply chain objectives, which in turn are positively correlated with business performance. We determined that Respondents believe that openness to share risk-related information and accept supply chain risks as a joint effort, as well as trust, and better communication and administrative infrastructure are necessary for successful SCRM approaches. We confirmed Respondents' hypotheses that SCRM is imperative for both responsiveness and cost, and therefore for business performance. An area for further study is modeling risk interdependency, a critical challenge in complex supply chains.

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