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# Implementing Sustainability Strategies in Emerging Economies: Challenges and Opportunities for Supply Chain Management

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## Abstract

Although research on sustainable supply chain has made many valuable contributions, there is a dearth of empirical evidence and theoretical reflection on sustainability strategies adopted by supply chains operating in emerging economies. Consequently, the literature still lacks a framework that incorporates the context and dynamics encountered in such settings. The aim of this paper is to help to fill this gap by exploring a successful case of a focal company that was able to deal with the challenges and exploit the opportunities associated with such contexts towards the incorporation of cleaner production innovations and sustainability strategies into supply chains. Drawing from capability accumulation, innovation and sustainability literatures, this paper develops a theoretical framework that provides a more fine-grained understanding of the dynamics, challenges and opportunities associated with the incorporation and management of sustainability within supply chains in emerging economies. This research employs case study method in the oil and gas supply chain in Brazil based on 52 interviews with key informants between 2004 and 2012. Our findings suggest that incorporating cleaner production innovations and sustainability strategies into supply chains in emerging economies presents additional barriers and higher levels of uncertainty when compared to supply chainsoperating elsewhere. This research contributes to the literature by identifying and discussing those salient barriers and arguing that in emerging economies, due to unique institutional idiosyncrasies, focal companies play an even more important role to endorse cleaner production innovations and promote sustainability strategies than in other countries. Also, it contributes to the research by asserting that sustainable supply chains can only be successfully pursued and implemented through innovation, which is a critical driver for supply chain enhanced sustainability performance.

***Keywords:*** *Sustainable supply chains, barriers to sustainability strategies, emerging economies, innovation, oil and gas, Brazil.*

## 1. Introduction

Over the past two decades, supply chain management has become an enduring research theme in the business literature. A key research stream that has raised a lot of attention in the industry, academic and policy circles is the one exploring why and how supply chains incorporate sustainability into their operations. This important body of the literature argues that supply chains must be managed taking into consideration the impact of its activities on the natural environment, which is a term often referred to as green supply chains or environmental supply chains (Beamon, 1999; Carter and Dresner, 2001). For example, Hall (2000) argues that it is crucial that suppliers make obvious that they are capable and reliable, and that disregard for the environmental dimension can increase significantly external (consumer and media) pressure and become a risk for the survival of the whole supply chain.

However, in this paper I argue that the modern concept of sustainability must be linked not only to the economic and environmental dimensions of supply chains, but also to the social impacts of supply chain operations. This is what the literature defines as the compliance with the triple bottom line (Elkington, 1997). Several studies claim that the social aspect of sustainability has been often neglected in existing research and practice (Beske et al., 2008; Pagell and Wu, 2009; Beske, 2012). Thus, based on the triple bottom line framework and theitsthree intrinsically related dimensions (social, environmental and economic), the concept of sustainable supply chain has emerged (Linton et al., 2007; Markley and Davis, 2007; Seuring and Muller, 2008). More recently, Pagell and Wu (2009) argue that economic goals can be compatible with environmental and social goals and propose that innovation capability is essential to build sustainable supply chains. Research has also explored the dynamics, implementation issues and success factors of sustainable supply chains. For example, Zailani et al (2012) examine the implementation of sustainable supply chain management practices and the outcomes of these initiatives on supply chain performance, based on a survey with 400 firms in Malaysia. Results show evidences that sustainable supply chain management practices lead to commercial success and should not be seen by firms as a moral obligation (Zailani et al, 2012).

Although the prior research on sustainable supply chains has made many valuable contributions, there are several important issues that still require research attention. The literature suggests that there is little empirical evidence and theoretical reflection on the supply chain dynamics encountered in emerging economies (e.g., China, India and Brazil) especially regarding the issues related to the implementation and management of sustainability strategies (Zhu et al., 2005; McCormack et al., 2008; Cerra et al., 2008). This research builds on capability accumulation, innovation and sustainability literatures and offers at least four theoretical contributions. First, I assert that supply chains in emerging economies face additional barriers to sustainability strategies when compared to supply chains elsewhere. More specifically, I argue that the lack of regulatory framework for sustainability, high level of bureaucracy and corruption, strong presence of informal economy and lack of trust in the government reduce the incentives for cleaner production innovations and hinder the implementation of sustainability strategies by supply chains. Second, based on the field work, I reason that sustainable supply chain management in emerging economies is permeated by additional levels of uncertainty. This is because pressing social issues are encountered in these countries, and they must be considered by supply chains for successful operation. Third, I argue that focal companies play an even more important role in emerging economies to overcome these barriers. They are thus fundamental to endorse the adoption of innovations, which allow supply chain to implementsustainability strategies. More specifically, I argue that in emerging economies the contribution of entrepreneurial and focused focal companies working for building supplier capabilities and driving the supply chains toward their strategic objectives is fundamental to enhance sustainability performance of supply chains. Finally, I argue that sustainable supply chains can only be successfully pursued and implemented through innovation. Innovation is critical for sustainable supply chain implementation because the sustainability concept has influenced supply chains to change and adopt new practices (innovations) that allow them to integrate the environmental and social dimensions into their business models, without losing market competitiveness.

In the remainder of the paper, the theoretical framework is discussed through the lenses of capability accumulation, innovation and sustainability literatures as well as how the issues associated with these research streams may or may not be applied to the adoption of cleaner production innovations and sustainability strategies by supply chains in emerging economies. The methodology employed in this study is then detailed. The in-depth case study of the successful trajectory and challenges faced by the oil and gas supply chain in Brazil is the discussed, followed by the implications, theoretical contributions of this paper and avenues for future research.

## 2. Capability Building and Innovation: challenges for sustainable supply chains

In the literature, supply chains are defined as vertical sequences of interdependent transactions that add value to the final consumer and require a systemic approach to allocate resources and share information in order to perform properly (Christopher, 2005; Lazzarini et al., 2001). According to Pagell and Wu (2009:38), "a sustainable supply chain is then one that performs well on both traditional measures of profit and loss as well as on an expanded conceptualization of performance that includes social and natural dimensions". For that to happen, supply chain members need to be capable to

identify, acquire, understand and employ new capabilities and incorporate key innovations for sustainable operations. In this sense, supply chains are similar to firms: they are initially immature, but they learn, absorb and accumulate knowledge and capabilities overtime and consequently evolve (Nelson and Winter, 1982; Silvestre and Dalcol, 2009; Hall et al., 2012a).

Recent literature on strategy and innovation has also stressed the importance of accumulating new capabilities for firms and supply chains to achieve enhanced sustainability performance (Cohen and Levinthal, 1990; Caloghirou et al., 2004; Teece, 2007). According to Kim (1997), technological capabilities are referred to the ability to use technological knowledge efficiently, adapt and create new technologies. Technological capabilities can be classified as routine and innovative capabilities (Bell and Pavitt 1992; Figueiredo, 2002; Silvestre and Dalcol, 2009). The first is associated with production and operational skills or the abilities needed to use technology, and the latter is related to innovation or the abilities to creating, modifying or improving products and processes. Other studies also highlight the importance of organizational capabilities. For example, the dynamic capabilities approach has primarily addressed the role of organizational capabilities (Chandler 1990; Teece and Pisano 1994; Zander and Kogut, 1995), which involve the ability to utilize business-related and administrative knowledge, including the ability to learn and creatively seek solutions for managerial problems.

The accumulation of organizational and technological capabilities by supply chain firms is thus a crucial process for supply chains to achieve superior sustainability performance. According to Nelson and Winter (1982), firms are technologically immature, but they gradually learn over time, accumulating knowledge and capabilities so that they can become able to progressively perform new activities, innovate and absorb new capabilities. I argue that the same cycle is associated with supply chains and that collaboration is crucial: as members of a supply chain collaborate, learn and build new technological and organizational capabilities, the supply chain as a whole tends to have its performance improved through innovation. However, the existing models for sustainable supply chains are the ones developed based on conditions encountered in developed countries (e.g., North America and Europe), which rarely can be applied to supply chains operating in emerging economies. For example, the literature explicitly claims that there is a need for the establishment of stronger relationship ties among supply chain members in emerging economies, as well as a better integration regarding processes such as demand management, information management and order synchronization (Hilsdorf et al, 2009; Power, 2005). Also, the lack of supply chain integration in emerging economies strongly affects the sustainability performance of supply chains. These issues are not so salient in developed countries.

The core assumption of this research is that firms do not compete in isolation, but rather together with its supply chain partners to achieve sustainable operations. I thus argue that supply chains compete against other supply chains in the marketplace. Thus, it is critical that all stages of the supply chain operate efficiently, responsively and transparently so that the whole system can perform in a sustainable manner. If one stage of the supply chain is inefficient, presents low level of responsiveness, or is not sensitive to emerging environmental and social risks, the entire supply chain will suffer or definitely fail. Another critical element for supply chains to function well is the collaboration among its members. Collaboration in supply chain demands "aligned objectives, open communication, sharing of resources, risks and rewards" (Soosay et al., 2008:160). Since the literature clearly sustain that supply chain collaboration enhances innovation and sustainability performance (Corsten and Felde, 2005; Sahay, 2003; Swink, 2006), the main goal becomes thus to build the right capabilities to reduce overall costs and increase responsiveness (Bello et al., 2004; McCarthy et al., 2013) while at the same time minimizing its impact on the natural environment and communities (Carter and Rogers, 2008; Hall et al.; 2012a).

However, the adoption of innovation is a complex process that requires further attention in emerging economies (Silvestre and Silva Neto, 2012). Parente and Prescott (1994) argue that there are several barriers to innovation adoption, and that policy-makers should work to reduce such barriers in order to contribute to the economic development. Following the same reasoning, Attewell (1992) argues that even the knowledge and capabilities previously accumulated by firms and supply chains can function as barriers to the adoption of innovations, which is sometimes referred as path dependency (Coombs and Hull, 1998). Consequently, firms usually postpone innovation until they are comfortable and assured they will be able to implement and operate it successfully (Attewell, 1992).The concept of innovation is referred in this paper, in line with Schumpeter (1934), as the introduction of a new good, a new

method of production, a new organizational form, the opening of a new market, and the use of a new source of supply of raw material or semi-finished products. For Schumpeter (1934), innovations are primarily recombinations of existing knowledge that are economically more feasible or more efficient than the previous way of doing things. For the purpose of this study, innovations are seen as recombinations of existing knowledge expressed in one of the Schumpeterian categories above and applied by a particular organization pertaining to a supply chain. According to the OECD Oslo Manual (2005), innovation can be: new to the firm, new to the market or new to the world. OECD (2005) defines market as (p. 58) "the firm and its competitors and it can include a geographic region or product line. The geographical scope of new to the market is thus subject to the firm's own view of its operating market". In this paper, the working definition of innovation as new to the market is adopted.

In emerging economies, since uncertainty levels are higher, the rates of innovation in supply chains are strongly associated with the role and power of the focal companies. This is consistent with Rogers (1995), who highlights the importance of change agents, or in this case focal companies, to promote and diffuse innovations. I define focal companies as supply chain members that have the leadership and can specify supply chain policies to other members, can exercise certain levels of control over the chain's decisions and activities. Clearly, focal companies are likely to be the most powerful member in the supply chain, exercising influence over the other members and directing the actions toward a strategic direction (Cooper and Ellram, 1993). Innovation diffusion is referred as "the process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers, 1995, p. 5). Therefore, the innovation diffusion process is successful if several or most members of an industry, or in our case a supply chain, adopt the proposed innovation. This will certainly bring consistency to supply chains.

In Brazil, successful supply chains that have emerged through innovation are not rare. For example, research argues that the Brazilian energy industry was able to move from irrelevance to being recognized as a world leader, in part because supply chains were willing to absorb and adopt innovation and sustainable practices (Silvestre and Dalcol, 2009; Hall et al, 2011). According to Hall et al. (2012a), supply chains that only focus on financial performance are likely to remain irrelevant. However, in an empirical study in Brazilian supply chains, Brito and Berardi (2010) found that external pressures (from the regulations, market and/or society) are the most critical factors that motivate supply chains to engage in sustainable initiatives. The authors also highlight that in such regions there are difficulties to achieve a proper level of collaboration among chain members, but the reasons are not discussed. I argue that in these settings, supply chains may have more difficulties to identify and acquire the right capabilities. This argument is consistent with Brito and Berardi (2010), who assert that collaboration attenuates the effects of these faulty knowledge systems. Consistent with Rogers (1995), I argue that focal companies are even more fundamental to accumulating knowledge, building capabilities, promoting cleaner production innovationsand implementing sustainability strategies in emerging economies, playing the role of change agents.

This paper also highlights that supply chain members operating in emerging economies need to overcome additional barriers to cleaner production innovations and sustainability in order to improve economic, environmental and social performances of supply chains. The field work carried out in the Brazilian oil and gas supply chain and previous literature suggest that supply chains in emerging economies present at least four additional barriers to innovation and sustainability. These are: the lack of an adequate regulatory framework, high level of bureaucracy and corruption, strong presence of informal economy, and lack of trust in the government.

The literature advocates that emerging economies still lack an adequate regulatory framework for innovation and sustainability (Bonilla et al, 2010a; Zapata and Nieuwenhuis, 2010). Sustainability policiesrequire compliance from firms and allow supply chains to operate in a more sustainable environment, where firms know the rules and are aware of what they need to do. Consequently, I argue that the lack of an adequate regulatory framework prevent focal companies and supply chains to promote cleaner production innovations and implement sustainability strategies into their operations.

The second barrier is associated with the high level of bureaucracy and corruption (Guasch and Straub, 2009; Zuvanic et al., 2010). According to Hopkins (2009:375), "after over 300 years of colonial rule and some 175 years of independent government, the enduring patterns of bureaucracy in Latin

America persist except for the few cases" while Blake and Morris (2009:2) argue that "substantial evidence suggests that in much of Latin America corruption permeates daily life". Bureaucracy also increases as a result of intricate tax systems. The literature suggests that the high level of taxation and the multiplicity of cumulative taxes generate complex tax systems that make it difficult for even the local entrepreneurs to understand (Ferretti and Funchal, 2011; Varsano et al., 1998). This complexity coupled with the low level of perceived benefits from public action make the level of taxation difficult to be justified by governments. Consequently, based on previous literature and our field work, this research argues that high levels of bureaucracy and corruption are consistently present in emerging economies' business environments, which increase supply chain costs, discourage investments on cleaner production innovation and prevent the adoption of sustainability strategies.

The third barrier is informality (informal economy). In line with Castells and Portes (1989), I define informal as unregulated economic activities of otherwise licit goods and services. The absence of institutional regulation in the informal economy may impact on the labor in terms of wages and benefits, work environment such as health, hygiene and safety conditions (Castells and Portes, 1989). Loayza (1996: 129) argues that the "informal economy arises when excessive taxes and regulations are imposed by governments that lack the capability to enforce compliance", and there are strong evidences that poor countries, including emerging economies, tend to have higher levels of informality than developed countries (Schneider, 2002). The high level of informality in emerging economies hinders the adoption of cleaner production innovations as well as pulverizes the supply chain efforts for addressing the environmental and social dimensions of sustainability.

The fourth barrier is the lack of trust in the governments. In line with Matos and Silvestre (2012), I argue that entrepreneurs lack trust in the government because of a recent history of miscommunication and bad politicians that promised during election time and never return to deliver their promises, especially in Latin America, Asia and Africa. In addition, the authoritarian military regimes that spread in Latin America in the 60's, 70's and 80's have also a fundamental impact on the current distrust of the population in the governments (Carvalho, 2005). For example, Hall et al. (2011) assert that farmers tend to not trust in the government because of bad past experiences. Additionally, I argue that this lack of trust creates a business environment of uncertainty, rumors and doubts (which obviously sometimes do not represent reality), that is inconsistent with flourishing cleaner production innovations, long-term investments and supply chain enhanced sustainability performance.

Our field studies in Brazil suggest that additional complexity and uncertainty emerge from such environments where the lack of regulatory framework for sustainability, high level of bureaucracy and corruption, strong presence of informal economy, and lack of trust in the government are still encountered. In such environments, especially when coupled with controversial social issues (e.g., social exclusion, wealth concentration, crime/violence, etc), focal companies and supply chains need to employ extra effort to understand and manage uncertainty as well as overcoming these existing additional barriers to innovation and sustainability. Consequently, I assert that the role played by focal companies in directing the supply chain toward its strategic goals is even more fundamental than in developed countries. In the case study presented in this paper, Petrobras was able to implement the innovation and sustainability culture in the Brazilian oil and gas supply chain. With a massive effort, this focal company was able to adopt innovations and integrate its supply chain, and achieve what is known nowadays as the leading operation in offshore oil and gas exploration and development in the world while still seriously addressing issues associated with the environmental and social dimensions.

## 3. Methodology

This paper is part of a broader research project, which has been developed in the offshore oil and gas supply chain in Brazil between 2004 and 2012. The aim of this research is to understand how the offshore oil and gas supply chain emerged in Brazil and how it has become a leading offshore oilfield supply chain through innovation, being recognized for its remarkable achievements regarding sustainability and allowing the country to become energy self-sufficient in 2006 (Silvestre and Dalcol, 2009; Dalla Costa and Souza-Santos, 2012). In 2008, Petrobras was ranked the world's most sustainable oil and gas company by Management & Excellence (Noria, 2008).

The research strategy employed in this paper was the case study because this method is useful and appropriate to investigate contemporary phenomena within a real-life context, especially when the boundaries between the phenomenon and the context are not clearly evident (Yin, 2003). An inductive theory building approach was used and the research planning was based on three distinct key phases: case selection, data gathering, and data analysis. In terms of case selection, it was decided to proceed with one key case study in order to augment the depth of analysis, gain experience with the issues related to the field context, and elaborate a more robust argumentation by connecting such issues to the existing literature. The offshore oil and gas supply chain in Brazil was selected for three main reasons. First, the literature argues that further research is needed on the characteristics, challenges and strategies that result in success or failure of supply chains in emerging economies, especially in Latin America (SacomanoNeto and Pires, 2007; Cerra et al., 2008). The oil and gas supply chain is a classic case of success in Brazil – an emerging market that has been facing significant economic success recently (Brainard and Martinez-Diaz, 2009; Aman, 2011), yet still struggling with pressing social disparities (Hall et al., 2012a; 2012b). Second, the literature claims that further research is needed on resource-based supply chains in Latin America (Altenburg and Meyer-Stamer, 1999), and offshore oil and gas is an extreme case of resource-based supply chain that has recently experienced an impressive growth and success in terms of number of firms, jobs and total production (Moura et al., 2010; Lima and Silva, 2012). Third, during the 80's and 90's, firms operating in the supply chain were scrutinized by activist groups and media because of the lack of sustainability policies (oil spills, environmental incidents, and work-related accidents) and inability to spread their economic success into benefits for social development (Seabra et al., 2011; Herculano, 2012). More recently, the supply chain has been recognized as one of the most sustainable among the oil and gas industry (Noria, 2008). These three characteristic caught my attention, and certainly make the Brazilian offshore oil and gas supply chain a unique case to understand the dynamics of a fast growing resource-based supply chain in an emerging economy, which was able to overcome uncertainty and the additional barriers to enhanced sustainability performance.

I gathered data from two different sources. First, I conducted 35 semi-structured in person interviews with entrepreneurs, directors, managers and key employees in firms operating in the different parts of the upstream oil and gas supply chain. Apart from the data collected directly from the supply chain firms, I also conducted 17 interviews with key informants from other stakeholder groups associated with the oil and gas supply chain in Brazil. In total, I conducted 52 interviews that were selected following the snowball technique (Goodman, 1961; Berg, 1988), meeting Eisenhardt's (1989) suggestions regarding data saturation. Each interview took approximately 1 hour. Opportunities for data triangulation (Stake, 1995; Johnson, 1997) were used through unstructured conversations with firms' entrepreneurs, employees, policy makers, academics and through direct observation during 10 site visits at the supply chain firms. Second, in order to obtain contextual understanding of the situation, I collected publicly available documents related to this particular supply chain. Thus, data were collected from secondary sources by researching firms' websites, documents, industry reports, academic publications, newspapers, and specialized technical journals. The Internet was a key tool for searching, identifying and collecting such data. In the case of ambiguity, I clarified the issues with the key informants through email, phone or in person conversation.

## 5. The case of offshore oil and gas supply chain in Brazil

The emergence of the offshore oil and gas supply chain happened gradually, accompanying the discoveries of oil fields in Campos Basin and other parts of the country. Since the beginning, Petrobras (the National Oil Company and currently listed as the 14th biggest oil company by Forbes) positioned itself as the focal company and consequently managed its emergence and subsequent development. The first oil field, Garoupa, was discovered in 1974 (Petrobras, 2012), and Petrobras started building infrastructure and engineering support in the country. This was a gradual process, intensified with the economic feasibility due to a relatively constant discovery of new fields. Gradually, Brazil has emerged as an important point of interest for multinationals and domestic firms operating in the oil industry.

Due to Petrobras' efforts, direct suppliers soon were attracted to Brazil, the first being multinational suppliers of goods and services with high technological complexity and long-term contracts with the National oilfield operator. Numerous other firms later migrated from various Brazilian regions and from abroad attracted by the growing operational volume of Petrobras as well as the presence of other large

international suppliers, creating a virtuous cycle. Numerous local start-ups emerged from knowledge spillovers. This process resulted in an extensive supply network operating in the country. According to Silvestre and Dalcol (2009), the oil and gas upstream suppliers can be classified according to the levels of technology complexity used in their operations and degrees of responsibility. The role of Petrobras in the emergence of the offshore oil and gas supply chain in Brazil was thus crucial, and this leadership role continues until now, despite the presence of other large multinational operators. Petrobras was able to maintain its leadership position mostly because of the accumulated knowledge acquired over the last 30 years, providing the firm with substantial competitive advantage.

Petrobras is also a central entity for the oil and gas supply chain to building supplier capacity within the country. This leadership can also be observed when it comes to the sustainability standards and strategies adopted by this supply chain. According to Petrobras former CEO Gabrielli de Azevedo (2009), Petrobras' operations had been hindered by poor environmental performance in the past. For example, in 2000 the company was responsible for major oil spills, and lost a modern floating platform (P-36) after numerous explosions, killing 11 employees in 2001 (Bayardino, 2004). These events, along with public backlash, contributed towards the company's shift in its environmental and social stance, bymaking extensive efforts to sustain high environmental supply chain standards. The company is now seen as a model for corporate social responsibility within the oil and gas industry (Noria, 2008). The success of Petrobras and its supply chain, in terms of profitability and reputation, was based on the accumulation of sophisticated, world-leading technologies, supply chain management and a major emphasis on environmental protection and social responsibility.Because of its supply chain leadership, Petrobras has been pressuring suppliers to obtain quality and environmental certifications to compete in Petrobras' bids. The high-standards demanded by the major oil companies and their direct suppliers (usually large multinational companies) is the main limitation for micro and small enterprises (MSE) participation, which is further exacerbated by the scarcity of financial resources to implement the changes and obtain the required certification (FIEMG/IEL and SEBRAE, 2006). At one point in the past, these MSE end up excluded from the offshore oil and gas supply chain because of these difficulties. More recently, since MSE have the potential to provide a wide range of employment opportunities (Baldwin and Picot, 1995) and to work as mechanisms for poverty reduction (Tendler and Amorin, 1996), Petrobras and The Brazilian Service of Support for Micro and Small Enterprises (SEBRAE) have established programs to formalize these businesses, increase quality of their goods and services in order to achieve quality and environmental certification, provide management and technology training and encourage the emergence of cooperation networks among these economic agents (Campos and Figueiredo, 2007).

These initiatives represented an attempt to reverse this trend and help MSE to participate in the oil and gas supply chain again. A number of programs have been implemented to strengthen the Brazilian upstream oil and gas supply chain in partnership with organizations such as the Science and Technology Ministry's Funding Agency for Studies and Projects (FINEP), National Institute of Metrology, Standardization and Industrial Quality and the National Council for the Scientific and Technological Development (CNPq). Since 2003, the Federal Government has implemented a public policy to increase the participation of domestic MSE in the offshore oil and gas supply chain called PROMINP – i.e., Mobilization Program of the National Oil and Gas Industry (PROMINP, 2012). SEBRAE, an industry sponsored agency for capability development, also offers support to MSE such as capability building in total quality management, productivity management, environmental management, corporate social responsability and financing to innovative projects. Other programs have been carried out by National Association of Advanced Technologies Entrepreneurship (ANPROTEC) along with other initiatives from the financing institutions and state-owned banks such as the Brazilian Development Bank (BNDES), Bank of Brazil (BB), and Regional Development Banks. According to Milani and Canongia (1999), Brazil is creating a robust support infrastructure to develop its MSE and allowing them to participate in the oil and gas and other sophisticated supply chains.

More recently, Petrobras has re-positioned itself as an energy company (not only an oil company) and strongly engaged in the biofuels supply chain (Hall et al., 2011). Matos and Silvestre (2012) highlight that the Biodiesel Program, led by Petrobras, was implemented to address in a greater extent the environmental (i.e., renewable energy is now the next strategic target) and social dimensions (i.e., social component of the Biodiesel Program through Social Stamp rebates). In line with the literature,

this strategic action reflects the urgency for the maturity ofrenewable fuels and other innovative ways to incorporate sustainability into production systems (Bonilla et al., 2010b; Mancini, et al., 2010).

## 5. Discussion

The literature claims that there are several barriers to sustainable supply chain. For example, Ageron et al (2012: 177) argue that some of the major barriers to sustainable supply chains include "financing the greening of supply management, return on investment, supplier production capabilities, supplier's human resources, green induced changes, supplier culture, nature of the product, company production capacity, supply chain network and top management support". Other researches highlight that firms have difficulties to appraise the financial gains of sustainable initiatives (Carter and Dresner, 2001; Bowen et al., 2001; Zhu and Sarkis, 2004). Ageron et al (2012: 177) suggest that this difficulty is a result of entrepreneurial short-term mindset. However, based on the theoretical framework used in this research and the presented case study, I argue that supply chains operating in Brazil, and more broadly in emerging economies, face additional barriers to adopt cleaner production innovations and sustainability strategies. That means that supply chains and focal companies are required to make extra efforts to overcome these barriers and improve supply chain sustainability performance. More specifically, based on an in-depth case study, in this paper I argue that supply chains operating in these settings face at least four additional barriers to innovation and sustainability. These are: the lack of adequate regulatory framework, high level of bureaucracy and corruption, strong presence of informal economy, and lack of trust in the governments.

In line with previous literature (Bonilla et al, 2010a; Zapata and Nieuwenhuis, 2010), our case study suggests that Brazil and emerging economies still lack adequate regulatory framework for sustainability. In practice, sustainability regulations have the power to educate, guide and allow supply chains topursue business profits while still reducing the harm on the natural environment and surrounding communities. Regulatory framework also democratizesthe expected sustainability standards businesses and supply chains must comply. In line with Guasch and Straub (2009) andZuvanic et al. (2010), our field studies also suggest that high levels of bureaucracy, corruption and multifaceted tax systems prevent supply chains to improve sustainability performance. Consistent with Hopkins (2009), Blake and Morris (2009) and Ferretti and Funchal, 2011), I argue that in Latin America bureaucracy, corruption and intricate tax systems permeate daily life of firms and supply chains. These elements reduce transparency and add uncertainty. Our field studies also clarified that the high level of informality also impacts supply chain performance in Brazil and Latin America. The absence of institutional regulation in the informal economy impacts on supply chain operations (Castells and Portes, 1989). During our fieldwork, the informal economy was often classified as an important barrier to the implementation of sustainability strategies by supply chains. Consistent with Hall et al. (2011), I argue that such an environment coupled with the lack of trust in the government because of past miscommunication and bad experiences prevent supply chains to invest in cleaner production innovations and sustainability strategies to enhance sustainability performance.

This paper proposes that additional uncertainty emerge from business environments where pressing social issues such as social exclusion, wealth concentration and crime/violence are the reality. In such environments, supply chains must consider and address such pressing social issues accordingly (Hoskisson et al., 2000; Hall et al., 2011). Examples of supply chains in emerging market facing unforeseen uncertainty and struggling to achieve sustainability performance are not rare (Sahay et al., 2003; Downie, 2007; Dale et al., 2010; Jiang, 2012; Silvestre and Silva Neto, 2012). However, with focused effort toward the desired direction, these barriers can be overcome. This paper presents an extreme case of success of a supply chain that was able to overcome these barriers through innovation and collaboration in order to promote the sustainability culture and achieve what is now one of the most impressive cases of how to incorporate sustainability into supply chains. Additionally, this research suggests that sustainable supply chain requires an explicit leader (focal company) to encourage the adoption of cleaner production innovations and promote sustainability policies. Petrobrasis a critical entity for the Brazilian oil and gas supply chain. The company has succeeded in building supplier capacity within the country and driving the supply chain toward its strategic objectives. These findings are in line with existing literature (Lambert et al., 1998;Fawcett et al., 2011) by arguing that supply chain management requires a focal company to coordinate the actions and guide the whole supply chain in emerging economies toward more sustainable operations.

Our case study suggests that without innovation, supply chains cannot successfully incorporate environmental and social dimensions into supply chains and achieve enhanced sustainability performance. This assumption can be easily confirmed when scrutinizing the previous literature. For example, aligned with Savitz and Weber (2006), Carter and Rogers (2008) argue that firms and supply chains that become sustainable "do not simply overlay sustainability initiatives with corporate strategies, […][but] also have (or have changed) their company cultures and mindsets". Based on this argument and our case study, I argue that innovations become really mandatory because implementing sustainable supply chains requires substantial (not superficial) changes from all supply chain members, including mindset changing, organizational, cleaner production and business model innovations, for successfully transforming an unsustainable supply chain into a sustainable supply chain. Matos and Silvestre (2012) argue that focal companies must find effective mechanisms to convince supply chain members and stakeholders to shift from single (profits) to multiple (sustainability) objectives. I assert that this transformation has a complex nature, takes time and requires deliberate efforts from all supply chain members to make sense of the changes and apply the new practices into their routines. Most of the times, the business models under which supply chains operate must change, and this is an even more complex change because may impact the way supply chains see their customers and market, their behavior and potentially other aspects of their operations.

## 6. Conclusion

This paper brings at least four key research contributions and associated avenues for future investigation. First, I argue that supply chains in emerging economies face additional barriers to cleaner production innovations and sustainability when compared to supply chains elsewhere, especially in developed countries. From the successful offshore oil and gas case, this research identifies that supply chain sustainability performance in emerging economies is hindered by at least four additional barriers. These are: the lack of adequate regulatory framework for sustainability, high level of bureaucracy and corruption, strong presence of informal economy and lack of trust in the government. I explicitly argue that these barriers reduce the incentives for cleaner production innovations as well as make it more difficult for supply chains to adopt sustainability strategiestoachieve enhanced sustainability performance. I highlight the need for a better understanding of the interdependences, trade-offs and individual impacts of each of these barriers to supply chain sustainability. I also recognize that different emerging economies may have different number, intensity and types of barriers to supply chain sustainability, which are critical to research on sustainable supply chain in different institutional settings. I thus encourage further research on the identification and characterization of additional barriers to sustainable supply chain in different emerging economies. In Brazil, the lack of regulatory policies and high level of informality are fundamental barriers that prevent sustainable supply chain development. I call for further research on the role played by regulations and informality on supply chain sustainability performance, especially in resource-based supply chains.

Second, I argue that supply chain management in emerging economies is permeated by additional levels of uncertainty. The oil and gas case suggests that pressing and controversial social issues such as social exclusion, wealth concentration and high crime/violence rates make the management of supply chains especially complicated. Thus, sustainable supply chains in these settings are required to explicitly consider social aspects, which appear to be more salient in emerging economies than in other settings. This is because these urgent social issues often catch the attention of the society, activist groups and the media and can be highly harmful to supply chain operation and performance. If supply chain members and focal companies do not give the attention these social issues deserve or are unable to identify and measure the risks associated with them, supply chains are then labeled to failure.

Third, although I recognize the impressive advances made by the sustainable supply chain literature, there is a dearth of theoretical and empirical studies considering the insights of supply chains operating in emerging economies. Based on the success of the oil and gas supply chain presented here, I argue that in these settings focal companies play an even more important role than elsewhere to building supplier capabilities and overcoming the proposed barriers. Focal companies are thus fundamental to endorse new cleaner production technologies and promote sustainability in supply chains. More specifically, I argue that in emerging economies the contribution of constructive and active focal companies working to building supplier capabilities and driving the supply chains toward their strategic

objectives improves supply chain sustainability performance. Based on this contribution, I assert that the importance of focal companies in emerging economies is not reflected on the existing sustainable supply chain literature as it should be, and I then call for further theoretical and empirical research on the relative importance of focal companies and how they may impact supply chain sustainability performance. Additionally, I advocate for further research on the interplay between focal company and supply chain sustainability performance in emerging economies, and how they vary in different regions, countries and industries(e.g., high-technology, traditional, and resource-based industries). I also encourage future research on the identification of the specific capabilities required from focal companies to help building supplier capabilities and guiding supply chains in different industries toward enhanced sustainability performance.

Finally, in this paper, I argue that sustainable supply chains can only be pursued or implemented through innovation. The adoption of innovations is the main driver to the needed changes, which allow supply chains to truly integrate the environmental and social dimensions into their business models, without losing market competitiveness. I argue that innovations become really mandatory because implementing sustainable supply chains is a complex process and requires substantial changes from all supply chain members for successfully transforming an unsustainable supply chain into a sustainable supply chain. I identify the need for a better understanding of the interplay between the types of innovations adopted and the sustainability performance of supply chains. I also encourage further research on practical examples of supply chains that were able to successfully undertake this transformation processes (from unsustainable to sustainable supply chains) in different settings and industries. More interestingly, how and why this transformation processes vary in trajectory and length of time in different countries (e.g., emerging and developed economies) and industries (e.g., resource-based, high-technology, etc). I also call for further exploration on which specific business elements from established business models are required to be changed when incorporating environmental and social dimensions into supply chain operations.

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