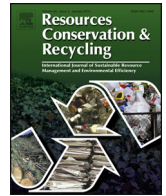




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Mixed methodology to analyze the relationship between maturity of environmental management and the adoption of green supply chain management in Brazil

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ABSTRACT

The aim of this research is to verify the relationship between the maturity levels of environmental management and the adoption of green supply chain management (GSCM) practices by electro-electronic companies in Brazil. In this work a two-phase research was conducted, with one quantitative and the other qualitative. The quantitative phase aimed to test whether a relationship between the maturity levels of environmental management and GSCM exists, while the qualitative phase tried to detail the characteristics of this relationship. The quantitative phase was conducted through a survey with 100 Brazilian electro-electronic companies and the collected data were processed using Structural Equation Modeling. For the qualitative phase, a multiple case study was conducted with three companies located in Brazil. The results indicate that: (1) The main hypothesis was confirmed and considered statistically valid, indicating that, indeed, the maturity level of environmental management influences the adoption of GSCM practices; (2) a coevolution tends to occur between the environmental maturity and the GSCM practices; that is, the more developed is the company's environmental management, more complex GSCM practices are adopted; and (3) the GSCM internal practices tend to present a greater relative adoption than the external practices; these external practices of GSCM tend to be adopted when the company is inserted in a higher environmental stage and/or operates under a scenario of stronger normative environmental pressure. By the way, this is the first research mixing survey and case studies on GSCM in Brazil.

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1. Introduction

Due to their transforming activity, organizations have been generating significant environmental impacts throughout every phase that comprises the production cycle for goods and services (Yang et al., 2013). These environmental impacts are associated with the extraction of raw materials, use of water and energy, air emissions due to cargo transportation, as well as environmental impacts generated during the use of products and their disposal by consumers, with implications to eco-efficiency issues (Govindan

et al., 2014). The recognition of these environmental problems has been generating the need for organizations to seek proactive and more strategic environmental management (González-Benito and González-Benito, 2006).

By adhering to higher maturity level of environmental management, organizations can take advantage of win-win opportunities where corporate performance, environmental performance are improved (Porter and Linde, 1995; Hart and Dowell, 2011). Some studies have revealed a positive correlation between a higher maturity level of environmental management, some variables relevant to the greening of operations/manufacturing management (Jabbour and Jabbour, 2009), human resource management (Jabbour et al., 2010), companies' economic-financial situation (Park and Ahn, 2012), adoption of quality management systems (Zhu et al., 2013), environmental training development in manufacturing/service enterprises (Teixeira et al., 2012).

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However, there is still a research gap and opportunity related to analyzing the relationship between the maturity level of environmental management and the adoption of green supply chain management (GSCM) practices. This matter is relevant, because many companies may embrace GSCM practices without a proper evaluation of their own maturity level regarding environmental management. This occurs because the GSCM theme is emerging as one of the most important approach in the field on environmental sustainability (Hazen et al., 2011; Xu et al., 2013) and because GSCM is being adopted by companies that tend to seek superior environmental performance (Diabat and Govindan, 2011; Zhu et al., 2012a). However, while research on GSCM advances, this research gap remains in the theme's state-of-the-art: *does the maturity level of environmental management relate positively to the adoption of GSCM practices and how does it happen?*

The state-of-the-art gap takes place because research on GSCM generally analyzes the relationship with the environmental performance, with the economic performance (Zhu and Sarkis, 2004) and with the adoption degree of environmental practices in the supply chains according to the institutional pressures found (Zhu et al., 2008c). Sometimes the studies are only conceptual (Seuring and Müller, 2008). Responding this relevant question, it is possible to find some path dependence effect between these two concepts in practice. In this research, maturity level of environmental management is considered based on three evolutionary stages: (1) reactive; (2) preventive; or (3) proactive (Jabbour and Jabbour, 2009). In other side, GSCM definition is based on 17 main practices (Zhu et al., 2008a), which can be clustered into five major categories: (1) internal environmental management; (2) green purchasing; (3) collaboration with customers; (4) eco-design and (5) investment recovery.

This question is even more noteworthy when the analytical perspective focuses on the Brazilian electro-electronic sector. Because this sector is responsible for great quantities of electronic waste, it has been the target for stricter environmental legislation (Dou and Sarkis, 2013). According to Govindan and Cheng (2011) globalization has prompted manufacturing firms to come to terms with environmental legislation and regulations, resulting in the manufacturing industry realizing the importance of adopting environmentally friendly supply chain management practices. For example, the New Brazilian Environmental Policy for Solid Waste (Lino and Ismail, 2012) has several implications for this sector, as do a future government decrees that will encourage the Public Sector to purchase environmentally friendly electro-electronic products, promoting environmental improvements throughout the Brazilian supply chain (Sciarretta and Rolli, 2011). As the New Brazilian Environmental Policy for Solid Waste is requesting reverse logistics planning for companies and for municipalities (Jabbour et al., 2014), GSCM and the environmental maturity level of Brazilian companies should be higher. Additionally, Seuring and Gold (2013) highlight the scarcity of research on sustainable supply chain in the context of developing countries. Thus this research in Brazil may contribute with the literature, mainly because Brazil is the main economy in Latin America and this region corresponds to 7% of world GDP (Jabbour and Jabbour, 2014).

Thus, Brazilian electro-electronic organizations are being pressured to adopt more evolved environmental management, which would be hypothetically related to adopting GSCM practices, such as green purchases. In order to bridge this existing gap in studies about environmental management and GSCM, this research is to verify the relationship between the maturity level of environmental management and the adoption of GSCM practices by electro-electronic companies in Brazil. The results were obtained through a survey conducted in two phases, mixing quantitative and qualitative methodological procedures. According to Sieber (1973), consistent studies can mix methods, with options for both

quanti-quali and quali-quali sequencing. In this particular study, it was employed the quanti-quali sequencing because it enables to verify the validity of a certain hypothesis to the further understanding on the statistically tested relationship by means of a more in-depth research. To date no GSCM study was found as presenting the following information:

- The quantitative phase is based on a survey conducted at 100 companies from the sector mentioned. Data were analyzed using Structural Equation Modeling. This phase will determine whether there is any relationship between the maturity levels of environmental management and GSCM.
- Following the quantitative phase, the qualitative phase involves conducting three case studies in an attempt to understand the “how” and the “why” of the results found in the quantitative phase.

The combination of the quantitative method and the qualitative method, although strongly recommended for research on operations management (Fleury and Fleury, 2009), is still not being properly addressed for research in GSCM, dominated by quantitative approaches (Brandenburg et al., 2014). In addition, although the relationship between the environmental management maturity and the adoption of GSCM practices may seem apparently intuitive, no research was found to date to confirm such relationship bearing statistic and qualitative evidence. The statistical evidence will accept or reject this relationship in the Brazilian context, and the case studies will discuss in detail this relationship. This kind of mixed approach is recommended in the literature (Sieber, 1973; Fleury and Fleury, 2009). In case of acceptance of this research hypothesis, managers will know that is necessary to pay attention to the level of environmental management before the adoption of GSCM.

The discovery of relationship between the maturity level of environmental management and GSCM can reveal that companies interested in adopting practices for the environmental improvement of the supply chain in which they are inserted should, first, be concerned about their level of environmental management, and then about adopting GSCM practices. Thus, these companies should be concerned about the search for more proactive and strategic environmental management, because this context may be an important antecedent for adopting GSCM practices. In others words it is possible to find some path dependence effect between these two concepts in practice.

In order to achieve the objective proposed herein, Section 2 presents conceptual bases concerning Environmental Management and GSCM. The methodological procedures are presented in Section 3; the quantitative and qualitative results are shown in Section 4. Section 5 presents the discussions based on the quantitative and qualitative results, while comparing them with the state-of-the-art literature. Section 6 presents the conclusions.

2. Conceptual background

In this section, the literature related to the environmental management and green supply chain management is discussed in a detailed manner.

2.1. Environmental management

Environmental management is understood as the incorporation of concern and opportunities related to the environment in a corporate context, making production processes and products more environmentally appropriate. In this context, environmental

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