

**The relevance of sustainable management practices to competitiveness in
manufacturing companies**

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ABSTRACT

This study was conducted with the purpose of investigating the influence, on corporate competitiveness, of strategic management practices based on socio-environmental responsibility. We also sought to understand the interrelationships between the management practices relating to strategy, socio-environmental innovation and sustainable supply chain. We analyzed the aspects of competitive performance with respect to profitability, cost, revenue, market share and image. The methodology applied was quantitative analysis, in a e-Survey, where, in 129 manufacturing industries. The results indicated a large number of significant correlations between many of the management practices studied and competitive performance, especially in terms of image. As for the practices, the ones that stood out were the initiatives to implement actions that integrate sustainable practices (e.g. inclusion of sustainability criteria in the development of new products and processes); and external relations (incorporation of socio-environmental criteria in the selection of suppliers and capital investment). As a limitation, this research was developed to cover the strategic KPI's of a corporate competitive performance, and the future research should contemplate the tactical and operational perspectives. Just a few quantitative researches are done with this propose, and in Brazil, it is quite insignificant, what means that this research is original. The results can be applied to stimulate the enterprises to improve their socio environmental sustainability management practices. Also, this research reinforces some of the SDGs recommended by UN for 2030 agenda which should improve company's attractiveness for financial market and for people and planet.

Keywords: Sustainability; Socio-environmental Innovation; Sustainable Supply Chain; Management Practices; Competitive Performance.

1- Introduction

Many researchers have focused on examine the tension that exists between developing societies that are both innovative and sustainable, because the technological development that results from innovation can lead to considerable environmental impact (Löbler et al., 2012). The US Department of Energy (2016) release a report where they explain the need to adopt practices of innovation in sustainability in all sector of US, governmental and business.

In the corporate world, it is no different; sustainability is already a disturbing factor within the organizations. In France, for example, sustainability is related to everything that is durable or long-lasting (Barbieri et al., 2010), which is more pragmatic, and therefore, better applied to the reality of companies and their business. Known as TBL, the Triple Bottom Line presented by Elkington (1997) is one of the most popular criteria regarding the issue of durable or long-lasting. In this approach, a company that wishes to be more sustainable needs to show progress in the economic, environmental and social dimensions.

The US Department of Energy (2016) mapped the main initiatives to help the community, people, government and business, to adopt the sustainability initiatives to reduce climate change. According to Sachs (2012), the environmental development cannot be dissociated from economic and social themes, and the government collaboration is fundamental to foster decent work and to weak indecent work, in order to build a fair society. Landrum and Edwards (2009, p.4), in turn, claim that “businesses practicing sustainability improve their image and reputation, reduce costs and help boost the local economy,” to which we could add competitive advantage in relation to their competitors. According to Porter and Kramer (2006), companies need to show long-term commitment to sustainability, because it is necessary to have a mutual dependence between corporations and society. The choices must benefit both sides. These authors claim that corporate social responsibility is more than just a set of good practices, it means choosing a unique position to do things differently in relation to competitors, reducing costs and better serving a consumer group. As an example, they mention the gasoline/electric hybrid vehicle, Toyota Prius, which, in relation to pollutant emission reduction, was the first to bring competitive advantage and environmental benefits.

There is a tendency for companies to adopt the theme of innovation with sustainability in their product design, as presented in the Tonelli et al. (2013). This trend has led many companies to join efforts to redefine their strategies, vision and mission, seeking both a method that would be more in line with the planet’s needs and to increase their competitiveness in the market

(AARSETH et al., 2017). For that, they make use of reports and indicators that bring credibility to their production systems, redirecting their innovation processes, production and product distribution, and reorganizing the management of their business as the US Department of Energy (2016).

In the search to seek this relationship between innovation, sustainability and performance, the authors Gomes and Kruglianskas (2011) developed a survey to verify the adherence between the sustainable development of business innovation, and its performance.

Aarseth, et al. (2017) presented Eight sustainability strategies identified from literature, where they describe the strategy with the respective initiatives. All these initiatives also comprise a commitment to learning, because the business models remain unchanged or have slightly changed, that is, they remain guided by the economic dimension above all.

So much so that it is already possible to see in the market the use of numerous indicators to demonstrate a sustainable way of doing business. In this sense, we can mention: Dow Jones Sustainability Index, ISE-Bovespa, GRI reports, among others. There is great dissemination indicators and certifications, which often confuse shareholders and other stakeholders. Overall, these indices, indicators or even certifications are qualitative in nature, as they do not take into account the evolution of metrics related to sustainability. Thus, they guide, therefore, the evolution, without acting on the speed of processing (Marcovitch, 2013). They are highly focused on the internal processes of the companies seeking to prepare the information; and companies that better systematize their information are able to better meet the requisites of indices and certifications.

Given the complexity of the process of transformation of organizations, coupled with the difficulty of using indices and indicators able to reflect such evolutions in the implementation of their strategy with socio-environmental responsibility, in this study, we sought to investigate the influence of socio-environmental management practices in the corporate competitive performance. Therefore, this study seeks to answer the following research question: How socio-environmental sustainability management practices relate to corporate competitive performance?

To answer this question a quantitative survey was made and will be presented later in the text. In addition, this study is the first to be elaborated involving corporate competitiveness, strategic management practices and socio-environmental responsibility. Therefore, it is understood that a study that works with the theme proposed here has the potential to be an important contribution both academic and managerial. Also, more recently study (Beske, Land and Seuring, 2014) describes sustainable supply chain management practices in food

industry is an example of such dynamic environment changing corporate environments and industries, where customers have high expectations for food safety and growing demand for sustainably produced food. In general, another study on environmental assessment (Wang, Li, Sueyoshi, 2014) has appointed an important business concern because consumers are interested in environmental protection, where they try to avoid purchasing products from dirt-imagined companies, which do not pay attention to environmental protection, even if their prices are much less than the ones produced by green-image companies.

In summary, with The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its heart are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action by all countries - developed and developing - in a global partnership. From the 17 SDGs, although all are important, there are three which are more related to this study and we could use as a reference: Number 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation, Number 12: Ensure sustainable consumption and production patterns, and Number 13: Take urgent action to combat climate change and its impacts.

This paper consists of six topics, the first is the introduction, the theoretical framework, the methodology, the analyzes and discussions of the results, the conclusions and references.

2- Theoretical Framework

From the perspective of resource-based view (RBV), the source of competitive advantage can be found, first, on the resources and capabilities of the companies; and second, on the structure of the industries in which they are positioned (Christmann, 2000).

Hart (1995) applied the resource-based theory on the firm (Barney, 1991), in the environmental strategy. According to the author, the competitive advantage depends on the interconnection between different internal firm capabilities and external circumstances – environment. The concept of RBV was already clear to some authors (Andrews, 1997; Chandler, 1962; Penrose, 1959; Hart, 1995).

Similar to Hart (1995) other subsequent studies (Sharma and Vredenburg, 1998; Aragon-Correa, 1998; Sharma, 2000) contribute to the concept of Pro-active Environmental Strategy (PES) as a way of obtaining competitive performance through a strategy that values environmental responsibility. Pro-active strategies are those in which the organization seeks to involve stakeholders in a broad way, such as, for example, the affected communities and regulatory agencies. In addition, in these organizations, large part of innovations and the

business environment use the environmental criteria. The opposite happens with companies that have reactive strategies, that is, companies that meet the environmental requirements required by law, consumer, or other needs.

In the face of a globalized market, innovation is a very important factor for competitive advantage, as it will cause the company to be the holder of a unique gain, which allows it to charge a premium price or a higher price in relation to competitors or better serve a consumer group (Hill and Jones, 2009; Lynch, 2010; Porter and Kramer, 2006). Traditionally, when bringing innovation as a key point of the implementation of a sustainable strategy, the first obstacle considered are the huge investments required. However, it is possible to innovate with small improvements in the products and processes, as well as through large investments, despite the uncertainties involved in this process. It is also possible to innovate by making a differentiation in conjunction with specific communities, in which both win, company and community, building a long-term commitment to sustainability. The examples mentioned by Porter and Kramer (2006) include companies such as Body Shop and Ben & Jerry's.

Nidumolu, Prahalad and Rangaswami (2009) show that there are no alternatives to sustainability, and what companies should do is to, as soon as possible, develop their skills to adapt their strategy, goals and business to this reality. They further state that it is necessary to rethink the product development process and the business model, and that innovation is a key part of sustainability.

As example of the applicability of these strategies is the China increasing consumption projected until 2050, mainly in civil construction to give better life conditions to their habitants, besides additional demand for manufactured products in this country. According to Hashimoto et al (2012), it will be necessary a lot of studies in the industrial sector, mainly in civil construction: steel, iron, paper, cellulose and agriculture to reduce the mineral resources, water, gas emission which cause greenhouse effect. Improvement on steel production process should aim the reduction of sulfur dioxide emission, which will bring relevant contribution to the planet. Chong et al (2012) assure a critical analysis in six main industrial cities in China could reduce the greenhouse effect emissions considerably in the world.

The literature reinforces the importance of radical and incremental innovation to achieve sustainability (Smeraldi, 2009; Kang, 2011). Some trends identified by Smeraldi (2009) involve the use of products and services drive to a focused on the reduction of waste in the value chain (e.g. products designed to use the minimal natural resources; greater eco-efficiency; and greater use of digital technologies for communication).

Once the transformation of innovations begins inside the companies towards sustainability, it is important to analyze which production and distribution models of goods and services are consolidated and supported in physical structures geared towards a business logic in which the concern for the planet is not a determining factor. Therefore, even if the management of innovation plays its role, the organizational operating areas need to transform their models.

With regard to good manufacturing practices (Christmann, 2000), many concepts of a more environmentally friendly production have stood out in the literature in recent decades as a way to bring methods to reduce or eliminate losses and contamination in the environment, namely: cradle to cradle (McDonough and Braungart, 2002); clean production (Unep, 1990), industrial ecosystem that led to the term industrial ecology (Frosch and Gallopoulos, 1989); eco-industrial parks (Cohen-Rosenthal, 2003); closed-loop supply chain (Defee and Mollenkopt, 2009). Initiatives in this direction have been adopted and disseminated by organizations as a way to differentiate and show pro-environmental strategic intention.

In 2015, United Nations (UN, 2015) have launched the SDGs – Sustainable Development Goals. The SDGs agenda count on the involvement and collaboration of main stakeholders from public and private sectors to perform actions and reach the targets until 2030, defined by ONU as “an action plan for people, planet and prosperity”. A Global Pact, agreement from United Nations and company’s sustainable agenda, it’s a main debate in the corporative strategy. Recently, the investors have great attention to this initiative, and started to demand from companies their investment in specific SDGs performance improvement, challenging companies to present better financial results at the same time they contribute to global 2030 goals.

The motivation for companies considers sustainable topics in their activities are related to risk management, business opportunities generation and regulatory trends. Additionally, the financial sector started to use the adoption of sustainable practices by the companies to give them credit and cost reduction potential investments.

3- Methodology

The research in question is considered to be descriptive, because it analyzes the characteristics of a given population or phenomenon, and also establishes a relationship between the variables (Gil, 2002). At the same time, it is exploratory, since the second part, qualitative, seeks to provide an in-depth analysis of the subject under study, making it more explicit based on the results obtained from the quantitative phase. This analysis consists of a first phase, quantitative, and a second phase, qualitative, through the approach of mixed sequential methods.

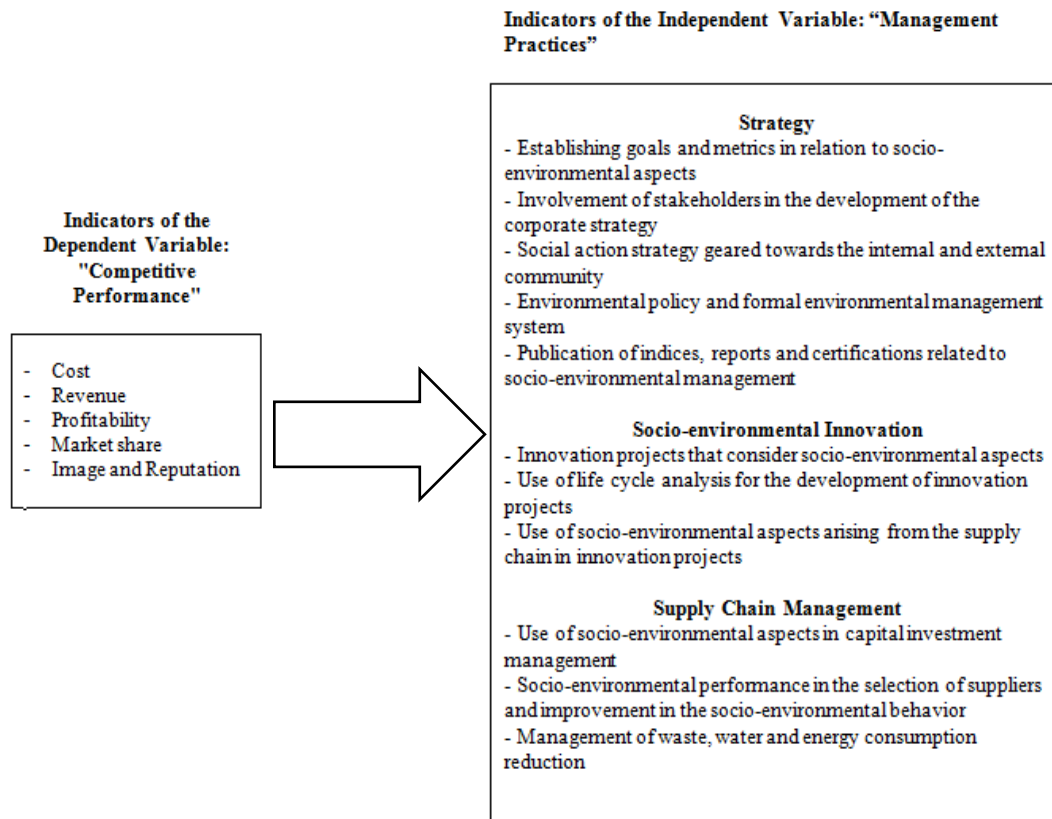
Tashakkori and Teddlie (2003), the use of mixed methods research is able to better answer the research question, makes stronger inferences and has the opportunity to point a wider range of divergent views. The advantage of this research method is the opportunity to simultaneously answer both confirmatory and exploratory questions as well as verify and develop theory in the same study.

The variables used in this study are classified as independent and dependent. It is worth noting that, among the variables, there is the occurrence of relationships and that, in each relationship, there are independent and dependent variables (Cooper and Schindler, 2003).

Dependent variable is the variable that defines the phenomenon that is to be measured and undergoes the effect of independent variables. In this study, the dependent variable is Competitive Performance. Considering the indicators of the dependent variable Competitive Performance, we sought, in the literature, the ones that are most relevant (Hart, 1995; Hart and Ahuja, 1996; Aragon-Correa, 1998; Sharma and Vredenburg, 1998; Sharma, 2000; Christmann, 2000; Sharma, Aragon-Correa and Rueda-Manzanares, 2007, Menguc, Auh, Ozonne, 2010; Delgado-Cebalo et al., 2012; Porter and Kramer, 2006). The Competitive Performance was analyzed through the following indicators: i) cost; ii) business revenue; iii) profitability; iv) market share; and v) image and reputation.

The independent variable has the purpose of explaining the dependent variable, in which the effects are measured with regard to their relationship. The independent variable is: i) strategy; (Hart, 1995; Hart and Ahuja, 1996; Harma, 2000, Stead and Stead, 1996; Elkington, 1997; Sharma and Vredenburg, 1998; Kang, 2011; Gibson, 2012, OECD, 2005); ii) socio-environmental innovation - SEI (Sharma, Aragon-Correa and Rueda-Manzanares, 2007; Porter and Kramer, 2006; Sachs, 2014); and iii) supply chain management - SCM (Christmann, 2000; Kang, 2011; Hart and Ahuja, 1996; Sharma and Vredenburg, 1998). To select the indicators of these sub-variables, we considered in the literature the studies of several authors and reports and indicators/indices/socio-environmental reports. The Figure 1 highlights the framework.

Figure 1–Conceptual model of the research.



Source: authors.

The measurement of the variables was based on the 7-point Likert scale. In the literature studied, it was found that most quantitative studies used in the theoretical framework uses the 7-point Likert scale. Preston and Colman (2000) report in the light of findings, there is some support for seven-point scales, but the popularity of five-point scales seems to be less justified. Lewis (1993) found that 7-point scales resulted in stronger correlations with t-test results.

The research was conducted in partnership with Federation of Industries of the State of São Paulo (FIESP), from January to March 2014, and applied to the sector of manufacturing industries that produce tangible goods. Questionnaires were sent to a sample of 8,241 companies, of which approximately 70% are small enterprises, according to the criteria of the Brazilian Micro and Small Business Support Service (Sebrae). We obtained 129 answers.

4- Analyses

The questionnaire was intended to be answered by the Sustainability and / or Reputation manager or other person in the organization familiar with sustainability aspects of the company. With the help of FIESP an e-mail containing the research instrument was sent to all companies registered by FIESP (non-probabilistic sample), according to the universe described above. In addition, connections were also made to large companies, with the help of the FIESP Call Center (intentional sample). The results are a total of 132 respondent companies.

Then the data were tabulated, and a procedure was done to evaluate if the respondent evaluated in the same way all the items of the questionnaire, that is, the respondent provided the same score in all the research questions. This led to the elimination of three questionnaires, which caused the final sample to result in 129 cases, with different sizes, Table 1.

Table 1– Business surveyed

Number of Employees	Frequency	%
Less than 99	46	35,7
100 to 499	51	39,5
More than 500	32	24,8

Source: authors.

Of the respondent companies, almost half of the sample work in the manufacturing industry (49.6%), 16% in the machine manufacturing sector and 11% in the car manufacturing sector. The rest of the sample, 23,0%, is diluted in the other sectors (Table 2).

Table 2 – Business surveyed

Sector Description	Frequency	%
Consumer goods	64	49,6
Assets	21	16,3
Automobile	14	10,9
Others	30	23,2

Source: authors.

Of those responsible for completing the questionnaire, 53% (68 cases) hold positions at higher hierarchy levels such as partners, directors, managers, coordinators or supervisors.

With SPSS (Statistical Package for the Social Sciences) and using the internal consistency test (reliability test) through the consistency index Cronbach's alpha, we verified the questionnaire consistency in relation to strategy, socio-environmental and innovation, obtaining a cronbach's alpha is above 0.70, recommended lower limit (Hair, 1998), as described in Table 3.

Table 3 – Cronbach's alpha Consistency

Components	No. of Indicators	Cronbach's alpha
Strategy	9	0.880

Competitive performance	7	0.878
Sustainable innovation	4	0.933
Sustainable supply chain	6	0.904
Competitive performance	7	0.898

Source: authors.

The second step was the use of a correlation analysis that was performed using Spearman's correlation coefficient, which is a non-parametric technique that establishes the existence of a correlation between two variables (Nascimento, 2013), which can be used for indicators with interval measurement. In this test the sample was of 74 respondents, who completely answered the research questionnaire. The statistical tests were performed at a significance level of 0.05 ($\alpha = 0.05$). Significance level refers to a type of error: probability of rejecting the hypothesis (null) when it is true. We identified management practices with significant correlations in relation to competitive performance in the different sub-variables studied, as highlighted in Tables 4, 5 and 6.

Table 4 –Correlation matrix I – strategy and competitive performance

		Competitive performance						
		Cost	profit	sales	market	image	reputation	
		q2.2	q2.3	q2.4	q2.5	q2.6	q2.7	
1.1 - Establishment of goals in relation to socio-environmental aspects	q1.1	r	0.274	0.185	0.005	0.021	0.435	0.168
		p	0.018	0.118	0.966	0.856	0.000	0.152
1.2 - Establishment of metrics in relation to socio-environmental aspects	q1.2	r	0.261	0.184	-0.018	0.023	0.328	0.052
		p		0.119	0.876	0.844	0.000	0.662
1.3 The involvement of stakeholders (most relevant) for the development of the corporate strategy	q1.3	r	0.168	0.235	0.163	0.196	0.363	0.187
		p	0.153	0.045	0.166	0.094	0.002	0.111
1.4 – Social action strategy geared towards the internal and external community	q1.4	r	0.290	0.332	0.387	0.396	0.598	0.330
		p	0.012	0.004	0.001	0.000	0.000	0.004
1.5 – Social action strategy geared towards the internal and external community	q1.5	r	0.195	0.244	0.131	0.193	0.319	0.222
		p	0.095	0.037	0.267	0.100	0.006	0.057
1.6 – Formal environmental management system	q1.6	r	0.188	0.119	0.017	0.030	0.211	0.083
		p	0.110	0.316	0.885	0.798	0.073	0.483
1.6- Consistency of the environmental policy disclosed with the nature of the organization's activities	q1.7	r	0.056	0.089	-0.025	-0.022	0.192	-0.034
		p	0.633	0.453	0.836	0.851	0.103	0.772
1.8 – Strategy of publication of indices, reports and certifications related to socio-environmental management	q1.8	r	0.201	0.260	0.166	0.120	0.273	0.046

		p	0.086	0.026	0.156	0.308	0.020	0.696
1.9 – The corporate strategy from the socio-environmental perspective, compared to competitors.								
	q1.9	r	0.220	0.281	0.209	0.298	0.598	0.378
		p	0.060	0.016	0.074	0.010	0.000	0.001

Source: authors.

Table 5 – Correlation Matrix I – socio-environmental innovation and competitive performance

			Competitive performance					
			cost	profit	sales	market	image	reputation
			q2.2	q2.3	q2.4	q2.5	q2.6	q2.7
3.1 – The consideration of socio-environmental aspects in innovation projects								
	q3.1	r	0.434	0.401	0.178	0.164	0.532	0.311
		p	0	0	0.129	0.102	0	0.007
3.2 - The investigation of potential environmental problems during the development of new projects and actions								
	q3.2	r	0.393	0.353	0.131	0.131	0.499	0.345
		p	0.001	0.002	0.265	0.122	0	0.003
3.3 - The use of life cycle analysis for the development of innovation projects								
	q3.3	r	0.208	0.203	0.057	0.139	0.289	0.162
		p	0.076	0.085	0.629	0.237	0.013	0.169
3.4 - The consideration of socio-environmental impacts from the supply chain in innovation projects								
	q3.4	r	0.331	0.287	0.148	0.199	0.394	0.208
		p	0.004	0.014	0.21	0.089	0.001	0.076

Source: authors.

Table 6 – Correlation Matrix I – socio-environmental supply chain and competitive performance

			Competitive performance					
			cost	profit	sales	market	image	reputation
			q2.2	q2.3	q2.4	q2.5	q2.6	q2.7
4.1- The use of socio-environmental aspects in the management of capital investments								
	q4.1	r	0.417	0.466	0.396	0.497	0.569	0.227
		p	0.000	0.000	0.000	0.000	0.000	0.000
4.2- The socio-environmental performance in the selection of suppliers								
	q4.2	r	0.243	0.234	0.124	0.244		0.201 0.122
		p	0.037	0.046	0.294	0.037	0.089	0.301
4.3- Actions that promote improvements in the socio-environmental behavior of Suppliers								
	q4.3	r	0.361	0.430	0.220	0.304	0.320	0.193
		p	0.002	0.000	0.060	0.009	0.006	0.099
4.4- Management of waste reduction								
	q4.4	r	0.163	0.129	-0.009	0.085	0.34	0.251
		p	0.165	0.276	0.341	0.473	0.00	0.031
4.5- Management of water								

consumption reduction	q4.5	r	0.279	0.143	0.029	0.129	0.440	0.335
		p	0.016	0.228	0.805	0.275	0	0.004
4.6- Management of energy consumption reduction								
	q4.6	r	0.394	0.235	0.115	0.219	0.521	0.290
		p	0.001	0.045	0.327	0.061	0	0.012

Source: authors.

In the matrix (Tables 4, 5 and 6), correlations between 0.50 and 0.70 (moderate and with $p = 0.000$), correlations between 0.71 and 0.90 (high and with $p = 0.000$) and also cells with non-significant correlations ($p > 0.05$, slight or small correlations). And we see significant correlations between the indicators of the independent variables and dependent variables. It is possible to see, for example, the significance of various indicators of management practices and image, indicating the relevance thereof to competitiveness.

In general, one can notice higher correlations between the block of variables related to the issue of sustainable innovation. This group also includes expressions 4.4, 4.5 and 4.6 regarding the management of waste minimization and water / energy consumption. Later, in the factor analysis, it will be verified that these variables make up one factor.

The third step of the quantitative analysis consisted of an exploratory factor analysis (EFA) (multivariate analysis technique), applied to the indicators of the independent sub-variable – “management practices”, consisting of 19 indicators, seeking to summarize in a relatively small number of factors the interrelationships of the original indicators.

Initially, the factorability of the correlation matrix of the 19 items of the instrument was examined; it was considered to be factorable: Kaiser-Meyer-Olkin (KMO) = 0.873 and Bartlett’s test of sphericity = TEB: $\chi^2 = 1135$; $p = 0,00$. Since the goal was to identify possible latent constructs, EFA was carried using the extraction method Principal Components Analysis and Varimax rotation. To determine the number of factors to retain, the “eigenvalues greater than 1.00 rule” and the Scree test were used.

The results of the EFA indicated four factors with eigenvalue greater than 1.0. The Scree test confirmed the EFA solution. These results indicate explained 72,71% of the total variance. Table 7 shows these results.

Table 7 – factors and percentage of cumulative variance

Factor	Auto Value	% variance	% variance accumulated
1	9,912	52,166	52,166
2	1,507	7,933	60,099
3	1,405	7,395	67,494
4	0,99	5,21	72,704

Source: authors.

The data were stratified into 19 questions in 4 factors (factor 1 - social and environmental actions; factor 2 – strategy; factor 3 - Sustainability chain; factor 4 - Formal structuring) described in the Table 8.

Table 8 - Factor analysis result

		Components			
		1	2	3	4
3.4 - The consideration of socio-environmental impacts from the supply chain in innovation projects	Factor 1	0,834	0,180	0,295	0,285
3.2 - The investigation of potential environmental problems during the development of new projects and actions		0,824	0,246	0,211	0,266
3.3 - The use of life cycle analysis for the development of innovation projects		0,791	0,107	0,281	0,247
3.1 – The consideration of socio-environmental aspects in innovation projects		0,778	0,375	0,238	0,192
4.5- Management of water consumption reduction		0,715	0,480	0,300	0,000
4.4-Management of waste reduction		0,582	0,367	0,458	-0,031
4.6- Management of energy consumption reduction		0,537	0,503	0,384	0,015
1.1- Establishment of goals in relation to socio-environmental aspects	Factor 2	0,324	0,803	0,037	0,231
1.2 - Establishment of metrics in relation to socio-environmental aspects		0,250	0,737	0,118	0,352
1.4 – Social action strategy geared towards the internal and external community		0,120	0,700	0,478	0,088
1.5 – Social action strategy geared towards the internal and external community		0,473	0,516	-0,224	0,269
1.3 The involvement of stakeholders (most relevant) for the development of the corporate strategy		0,241	0,442	0,345	0,417
1.9 – The corporate strategy from the socio-environmental perspective, compared to competitors.		0,385	0,420	0,378	0,316
4.2- The socio-environmental performance in the selection of suppliers	Factor 3	0,183	0,080	0,830	0,189
4.3- Actions that promote improvements in the socio-environmental behavior of Suppliers		0,363	0,151	0,725	0,256
4.1- The use of socio-environmental aspects in the management of capital investments		0,434	0,110	0,613	0,219
1.6 – Formal environmental management system	Factor 4	0,178	0,048	0,225	0,818
1.8 – Strategy of publication of indices, reports and certifications related to socio-environmental management		0,105	0,342	0,066	0,777
1.7- Consistency of the environmental policy disclosed with the nature of the organization’s activities		0,278	0,261	0,379	0,559

Source: authors.

A little different from the group of indicators included in the questionnaire, which has a more granular perception of the indicators, these factors were formed according to the perception of the research respondents and refer to a vision of managers of Sustainability and/or Reputation or any other person in the organization familiar with sustainability aspects of the company.

Thus, the original data was reduced from 19 indicators to four factors: i) Factor 1 – Actions of social-environmental practices: in this case, all indicators of the independent sub-variable SEI are considered and almost all indicators of the independent sub-variable sustainable SCM, except those that involve suppliers, capital investment and energy; ii) Factor 2 – Strategic actions: in this group of indicators we included only the actions regarding the definition of strategy and goals; the company wants to see the development of sustainability in its business, that is why it is called strategic actions only; iii) Factor 3 - External relations: for this group of indicators, the name external relations is due to two factors: a) suppliers: they are at the beginning of the SCM and the starting point for production; and b) capital investment; and iv) Factor 4 - Formal structuring: this group includes the indicators relating to reports, indicators, policies, that is, everything that is necessary to formalize and document the evolution of sustainability within the companies.

Then, we use logistic regression analysis to describe the relationship between the dependent and independent variables. Initially, the objective was to use multiple linear regression to identify variables that make it possible to highlight what makes a company competitive.

As dependent variable we have the competitive global company performance. As an independent variable we have issue on practices related to strategies (9 expressions); issue on sustainable innovation (4 expressions); question covers sustainable productive chain (6 expressions)

Whatever the multiple regression analysis to be used for modeling, it is necessary to have (at least) a sample 10 or 15 times the number of regressors, which would result in a minimum sample of 190 to 235 cases. This premise was not reached in this study, whose final sample size was 129 cases. Therefore, the factorial analysis was done in order to reduce the regression variables. Thus, instead of using the original questions, we used the factors (factorial scores) of the regressor or independent variables.

The linear regression analysis has as prerequisite the normal distribution of the residues, which is tested through the normal distribution of the response variable. The Kolmogorov-Smirnov Test (KS), results in 2,158, was carried out for this purpose, the P is 0,000. The

results indicated that the variable "global competitiveness indicator" does not have a normal distribution, which makes multiple linear regression analysis unfeasible. But logistic regression analysis is a possible technique to be used, since it does not need to meet the normality of residues

As a result, it was observed that only factor 1 "actions of socio-environmental practices" and factor 3 "external relations" have their averages differentiated in relation to the success / failure of the integrated competitive performance indicator ($p < 0.05$ and $0.05 < p < 0.10$, respectively), as represented at Tables 9 and 10.

Table 9 - Original variable and variable created

Variables tested	Integrated_ind.	N	Average	Standard Deviation	T	p
Factor 1	0	50	-0.21	1.061	-3.635	0.001
	1	22	0.52	0.614		
Factor 2	0	50	-0.08	1.065	-1.067	0.290
	1	22	0.20	0.871		
Factor 3	0	50	-0.15	0.938	-1.952	0.055
	1	22	0.35	1.110		
Factor 4	0	50	0.02	1.029	0.093	0.927
	1	22	-0.01	0.964		

Source: authors.

Table 10 - Logistic regression results

		B	S.E.	Wald	p	Exp (B)
Factor 1	Socio-environmental practices	0.928	0.337	7.585	0.006	2.529
Factor 3	External relations	0.595	0.304	3.84	0.05	1.814
Constant		-1.042	0.308	11.448	0.001	0.353

Source: authors.

And the equation formulated indicating the probability of being competitive is: **Probability (being competitive) = $1 / (1 + \exp (-z))$**

Where: **$z = -1.042 + 0.928 (\text{factor1}) + 0.595 (\text{factor 3})$**

The Factor 1 "actions of socio-environmental practices" is the most relevant, the one with the most significant effect on the integrated competitive performance indicator, but factor 3 "external relations" also have a significant influence on the indicator. Both factors indicate effect different from zero ($p \leq 0.05$) according to the coefficient test shown in Table 12.

When the satisfaction towards "Socio-environmental practices" increases 1 unit, the chance of being a competitive organization virtually increases 2.5 times. When the satisfaction towards "external relations" increases 1 unit, the chance of being a competitive organization

According to Table 12 and 13, the adjusted logistic function obtains approximately 70.8% (success rate of the model) of cases with estimates of integrated indicator consistent with the variable indicator observed (respondent's answer), with 86% of cases involving respondents who evaluated this indicator with values assumed by the indicators of the variables 6 or 7 (considered a success in terms of competitive performance) and 64% in other cases (negatively in terms of competitive performance, with scores between 1 and 5).

As a result of the logistic regression analysis, there is the probability for a company to have or not competitive performance, depending on the combination of independent variables. If the probability is greater than or equal to 0.50, the company belongs to the category "have competitive performance"; otherwise, it belongs to a failure or not competitive.

The Hosmer and Lemeshow test measure the difference between the actual and estimated values of the dependent variable – have competitive performance – and indicates (or not) the proper adjustment of the model. The model has a proper adjustment when the chi-square value is not significant. Chi-square = 8.722 and $p = 0.368$ ($p > 0.05$) evidence an adjusted model!

It was only possible to estimate the model related to the total sample of respondents without taking into account any no for an answer and through the use of factors.

The second phase used the qualitative approach to understand the perception of the companies sampled on the list of sustainability management practices at the strategic level and competitive performance of the business.

Three companies were interviewed in this phase, a small national company, a metallurgical manufacturer of trophies; and two large companies, one from the food industry and the other from the chemical industry, both foreign multinationals.

5 - Conclusion

We conclude, with this result, that the respondents of the sample under study only believe that a company can be competitive if, after the strategic discourse or reports, the company actually turns everything into practical actions, generating new products, improvement or transformation projects with regard to socio-environmental aspects. In addition, the respondents believe that working with suppliers can do a difference to seek competitive performance.

Approximately 40% of the correlations analyzed between management practices and competitive performance were significant, and some of them were moderate, especially in

relation to image, as an indicator that is part of competitive performance, which suggests that, despite being slightly intense, there is a relationship between these macro-variables.

In strategy, some management practices stand out in terms of significant correlations in relation to competitive performance, such as: “comparison of the corporate strategy, from the socio-environmental perspective in relation to competitors”; and “social action strategy geared towards the internal community,” which indicate correlations to competitive performance.

The correlation of social action strategy geared towards the internal community with all the competitive performance items is an example of the occurrence of significance in virtually all the indicators considered. This is probably due to the fact that today’s managers, in sustainable companies, have a much more comprehensive role than in the past, as articulators and responsible citizens. These managers have a key role in the internal communities of the companies, mobilizing employees, so that they can be multipliers of new sustainable practices. One issue to be noted is the practice of comparison with other companies, which has three significant correlations, showing that it is an important factor and it may affect competitiveness.

Another significant correlation with some of the competitive performance indicators is “the establishment of goals in relation to socio-environmental aspects.” It is understood that many companies have been seeking to build these goals to be in line with the GRI reports disclosed to shareholders and that have a direct impact on the company’s image. It is worth noting that it is important for the organization to have a policy to guide the functional areas of the business and involve new participants or stakeholders, which were not previously considered. In the discussion with the large multinational companies on the subject of sustainability reports, there was no local knowledge regarding the preparation of a specific internal sustainability report, except the GRI-type certification or sustainability reports. Therefore, it is possible that some studies are conducted in the parent company and allow the definition of sustainability goals, such as CO₂ impacts, waste recycling, replacement of toxic materials, but disclosed in the form of specific goals to the subsidiaries, seeking to implement the actions without necessarily measuring the impact on the planet in a transparent manner to the employees.

The transition from old SCM model (focus on maximizing financial performance with no or little attention to environmental performance) to a new SCM model (sustainable or green SCM – with TBL in their approach) is still a paradigm in most SCM. Recommendations on supply chain risks management by mitigation strategies focus on reducing the severity of the

consequences if an adverse event happens, pursuing strategies to identify and mitigate the risks and take advantage of the potential reward (Silvestre,2016).

The SEI management practice “consideration of socio-environmental aspects in innovation projects” stood out in terms of moderate and significant correlation, especially regarding the competitive performance indicators for profit, cost and image, probably for being the starting point to any process of, even if still in the early stages of the sustainability construction process. However, it was found that the sales growth and market share indicators do not indicate significant correlations. Probably, it was often due to the difficulty to position the products in terms of price and the low production scale.

Interestingly, the SEI management practice “use of life cycle for the development of innovation projects” indicated no significant correlations in relation to competitive performance. Possibly due to the scarce or absent use, in most companies, of this tool in the innovation process. The methodology is still little known by most companies in Brazil, and therefore, it is difficult to make a better use of it for competitive performance, although it is very relevant to one of the companies interviewed in the qualitative phase, which has been widely using it to improve its portfolio of existing products and develop new products.

Raising awareness of the population in relation to changes in their routines and actions is still a challenge to be overcome through more forceful initiatives, such as legislation, more strategic government decisions in the medium and long term, etc.

In the field of SCM, it is interesting to note the relevance of correlations with competitive performance, as noted in the socio-environmental management practice “use of socio-environmental aspects in the management of capital investments.” As seen in the literature, the study conducted by Christmann (2000) shows that it is necessary to have “complementary assets” to implement good environmental practices and gain competitive advantage. Therefore, capital investment is a necessity for most companies that wish to implement new sustainable processes and products.

The sustainable SCM practices “environmental performance in the selection of suppliers” and “actions that promote improvements in the socio-environmental behavior of suppliers,” indicated, overall, significant correlations with the indicators of the dependent variable competitive performance, respectively, cost and profit. This demonstrates the real socio-environmental interest of the company, as it requires internal mobilization and external coordination to define and implement these actions

With SGDs recommend by UN Agenda for 2030, the companies' actions should have a better guide to their actions, and also be rewarded by their efforts in the market. Sustainable strategy should guide improvement on product innovation and improved supply chain end to end.

The opportunities can be related to development and or product redesign, process optimization can be related to the company's relationship with different stakeholders. Some advantages can be obtained from sustainable practices in their strategy, such as: Cost reduction, talent retention, productivity increase, end to end supply chain cost reduction, market share increase, sales increase, risk reduction, shareholders value increase and profit increase. Most of this is reinforced by some studies conducted by Harvard Business School (HBR, 2013) which indicate a return on companies net equity with good sustainable practices in about 5% higher than other that do not consider this theme.

In this research, the interviews of the qualitative phase conducted in large manufacturing industries, it was found that there are internal criteria for the selection of suppliers, which are eliminatory, especially those related to issues addressed in SA 8000 and to environmental controls, to avoid major problems in the future. However, the use of actions that promote the socio-environmental behavior of suppliers is deemed of greater relevance to the key suppliers of the company, those with greater financial representativeness; or strategic, according to another non-financial criteria.

This external coordination should lead companies to develop shared management practices, such as eco-industrial parks, which have been built in other countries, such as Denmark and Belgium. According to industrial ecology, not only a strong interrelationship of socio-environmental management practices is required within the company, but also in the relationship between companies, seeking to move in the same direction in the socio-environmental evolution, integrating other companies and communities, optimizing the flows of materials focused on turning "outputs" into "inputs" for new processes.

In the supply chain field, in turn, there are significant correlations in relation to competitive performance in the aspects of water and energy consumption reduction, which may perhaps be explained by the fact that they represent expensive resources for the companies.

However, the SCM practice "management of waste reduction" and the correlation with the indicators of the dependent variable of competitive performance showed low significance in these correlations, except with image. This is odd, because companies have been strongly pressured to comply with solid waste management laws. Possibly, it is still focused on waste management rather than necessarily on waste reduction, since it often implies significant

changes in the production processes, requiring capital investments that depend on innovation that has not yet been achieved.

In the logistic regression analysis of the four factors of the socio-environmental management practices used to describe the relationship between the dependent and independent variables, it is concluded that the factor 1 “actions of socio-environmental practices” and the factor 3 “external relations” are the factors that have a statistically significant effect on the response indicator Integrated Indicator of competitive performance, and probably should result as significant covariates in the binary logistic regression analysis.

Therefore, it became clear that competitive performance is deemed satisfactory when there is in fact the implementation of changes in products, process and also in capital investment and suppliers. This may indicate that the respondents probably believe less on the strategic discourse, reports, indexes, policies and more on actions that show the actual changes.

Another relevant aspect found in the interviews with the manufacturing industries is the difficulty to coordinate, in a structured manner, socio-environmental initiatives within the TBL (Triple Bottom Line) concept. The need to involve many experts with specific knowledge in a relatively new subject, in addition to different stakeholders, in the company’s management routines require the development of more appropriate management models.

As a recommendation for further studies or research, we suggest, without limitation, studies in the field of industrial ecology in greater depth, such as: a similar study of socio-environmental management practices in specific sectors of the industry or with industry-size; a similar comparative study of socio-environmental management practices in other countries; the development, based on the experience of this study, of a similar study for the service sector, which grows significantly in the country; a study of the role of leadership in the socio-environmental context; the study of more robust metrics to be incorporated into the daily routine of the company’s management, as well as the reduction of water and energy consumption and waste generation. In other words, metrics that can show the impact on the planet caused by the consumption of toxic substances, the use of specific natural resources, in summary, metrics that can reveal the evolution of the attention to the planet and not only metrics that are restricted to the four walls of the company; study and analysis of the feasibility or criteria or practices to be used in the development of eco-industrial parks in Brazil, in order to help companies leverage these initiatives; study of the practices involving the development of socio-environmental strategies and their consequences on the company’s actions in the field of innovation and supply chain. The development of monitoring methods, such as specific balanced scorecards that show the evolution of the implementation of the

strategy in these areas; and the development of stakeholder management models that can be implemented within the companies, since, according to the qualitative research, it has been a challenge for them.

All these efforts for future development on more sustainable supply chains is fundamental to reach planet needs as stated on by BOVÉ and SWARTZ (2016), where it is mentioned around 1.8 billion people are expected to join the global consuming class by 2025, a 75 percent increase over 2010. A concern on consumer-packaged-goods (CPG), for example, is related to their poor sustainability performance, as measured in environmental and social impact. To make and sell goods, consumer businesses need affordable, reliable supplies of energy and natural resources, as well as permission from consumers, investors, and regulators to do business. A huge change needs to be done in this segment, as CPG companies needs to reduce 90% of their greenhouse gas emissions to meet 2050 goals (the Paris Agreement, reached by 195 countries at the United Nations climate-change summit in December 2015, aims for reducing global greenhouse-gas emissions enough to prevent the planet from warming by more than two degrees Celsius).

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