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Allyson de Freitas
Eduardo Gomes Salgado
Jean Marcel Sousa Lira[1]

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SELECTION OF SUPPLIERS IN THE GREEN SUPPLY CHAIN: CASE STUDY WITH MULTI-CRITERIA DECISION

Abstract: *The Green Supply Chain Management (GSCM) emerges as an alternative to intervene in industrial processes for economic, environmental and social purposes and their management involves strategy, organization and control of the flow of services. The GSCM can improve aspects such as pollution and water waste. Thus, the objective this work was identifies the main criteria in the selection of suppliers of Brazilian companies in the food sector that use GSCM through the Analytic Hierarchic Process (AHP). The results obtained show that the Economic criterion (64.8%) was the most relevant and the sub-criteria considered of major importance were Quality, Cost and Technical Capacity. The environmental criterion had a lower percentage and among the sub-criteria related to the Social criterion, Health and Safety, Education and Working Conditions were the most relevant. However, the economic factor seems to be decisive in the choice of suppliers*

Keywords: *Performance management; Performance measurement; Quality management; ISO 9001; Scientific research.*

1. Introduction

Awareness of the need for environmental protection is increasing worldwide. At the same time, the green supply chain management (GSCM) takes into account environmental criteria and reinforces the competitiveness of the entire supply chain (Lippman, 2001; Pagell & Wu, 2009; Tsui & Wen, 2014). In this way, companies seek agility, adaptability and alignment between their interests. In this aspect, the supply chains of companies are determinant to increase competitiveness and comprehensiveness or, on the other hand, lead companies to bankruptcy if they do not adapt to the speed of the transformations that appear in the manufacturing markets (Thorlakson et al., 2018).

The supply chain is not only management of operations inside and outside a company but also the flow of information and services, from raw material production to reverse logistics (Govindan et al., 2015). Thus, the management of operations corresponds to a field of knowledge that encompasses different academic disciplines and also their respective fields of application of which arises a new form of management of suppliers focused on sustainability, called Green Supply Chain Management (GSCM). GSCM is an alternative to other forms of intervention in business and industrial processes in the scenario of supply and distribution of components seeking a better performance in environmental impact, combining sustainability and social responsibility. According to Lippman, 2001,

[1] Corresponding author: Jean Marcel Sousa Lira
Email: jmslira1283@gmail.com

this form of management cover a range of activities, such as tracking suppliers for environmental performance and working in collaboration with green project initiatives, providing training or guidance to develop suppliers environmental management capacity.

Due to the complexity of supply chains, the GSCM process is not an easy task, as manufactures and companies are structured in a web of rather intricate financial, marketing, and production interactions. Because of this, it is necessary to use the Triple Bottom Line (TBL) with the help of a decision-making method to identify the most important criteria for GSCM-related decision. This Multi-criteria Decision-Making approach allows the evaluation and selection of suppliers through various criteria and sub-criteria, and can use qualitative and quantitative data. Several specialists in the economic, social and environmental areas can establish these data (Wang, 2010). Therefore, the identification and choice of which criteria are more applicable to the management of GSCM is of great importance for companies.

Most of the companies that use GSCM are in the automotive, electronics and mobile telephony sectors (Brandenburg et al., 2014; Fahimnia et al., 2015; Luthra et al., 2013). However, other industrial sectors may benefit from the adoption of GSCM. In this regard, the food sector uses these tools concerned with food security and greater sustainability in food production (Beske et al., 2014). In Brazil, the food sector corresponds to US $ 67 billion in the trade balance, with US $ 33.5 billion in processed foods and a contingent of 35.6 thousand companies (ABIA, 2017). Thereat, the characterization of food companies in terms of management of the sustainable supply chain in the current Brazilian scenario is relevant to the food sector in the country. Thus, this work sought to analyse the relationship between companies and suppliers regarding decision making for the selection of green supply based on economic, environmental and social criteria. Furthermore, this work was concerned with analysing the companies that are in the supply chain of the food sector. For this, the article has more sections after this introduction: the next section brings a literature review; the following explains the research method; section four presents the data and results; and the last section presents the research conclusions.

2. Theoretical background

2.1. Green Supply Chain Management

Green Supply Chain Management is the "greening" of the processes of supply and use of products in companies, aiming to improve the sustainability and efficiency of product supply chains (Seuring & Müller, 2008). This management model is as an alternative to try to reduce excessive production expenditures and waste of materials in supply chains (Childe et al., 2017).

Supply chain is the network of services, materials and information flows that unites customer relationship processes; its management must develop a strategy to organize, control and determine the resources involved in the flow of services and materials within the supply chain (Lambert et al., 1998). According to (Carter & Jennings, 2000), the model of sustainable supply chain management is driven by social and environmental responsibility. Because of this, methodologies such as reverse logistics have been used in order to reduce the damages caused by products. This technique has innovated the form of relationship of manufacturing companies with the environment where they are inserted because of the capacity to develop ways of reinserting the wastes of their manufacture in the supply chain (Srivastava, 2008).

There are few alternatives to prescriptive models within the Green Supply Chain Management (Pagell & Wu, 2009). In this

way, some models are appropriate to analyse the induction of socio-environmental practices in supply chains for focal companies (Pagell & Wu, 2009; Seuring & Müller, 2008). These companies are those with which all organizations relate directly or indirectly, from the origin of the chain to the return of wastes to the chain through customers and suppliers (Kemppainen & Vepsäläinen, 2003).

In these models, the elements of integration of sustainability to the Green Supply Chain Management are conglomerates where the external factors are the main catalysts of the internalization of sustainability. In this way, the organizational capacity for design and innovation would be a precursor to a successful Green Supply Chain Management. In addition, a good managerial orientation, committed to the business model that incorporates environmental and social elements is important for the success of management (Stefan, 2013). The Multiple Case Study by Pagell & Wu (2009) identified three main areas that companies should work on to implement Green Supply Chain Management: implement sustainable practices in those who work in the supply chain; focus on supplier continuity; and address topics on sustainability in the organization's daily life. Seuring & Müller (2008) proposed that for the establishment of Green Supply Chain Management, companies would need to "green" the supply process and thus provide "green" products. To ensure that companies providing products are green, an Assessment of Risk and Performance (ARP) should be performed for their suppliers.

In the assessment of Green Supply chain management, the criteria that companies use to select suppliers are as important as the factors that interfere in the implementation (Bai & Sarkis, 2010). According to Chang and Hung (2010), the main selection criteria used by companies in the supplier selection process are operational, economic and environmental performance. . In this way, the choice of the appropriate supplier to perform a given activity, considering strategic objectives for decision making through criteria and sub-criteria is essential for the success of Green Supply Chain Management (Guarnieri, 2015). Thus, the multi-criteria decision aid approach (MDA) is ideally suited to evaluate the judgments of experts to determine the best decision-making (Brans & Vincke, 1985).

2.2. Multi-criteria Decision Aid Approach (MDA)

When evaluating and selecting suppliers, we need to list the criteria in the decision-making process, which is called a multi-criteria decision. This evaluation involves experts who define the qualitative and quantitative criteria and sub criteria, on which the choice of decision should be based (Wang, 2010). Thus, MDA aims to provide decision makers with the tools to solve problems at the lowest cost possible and thereby increase the quality of production and products of the company. However, decision-making in a single absolute criterion is not recommended, since, at least two criteria must be taken into account (citation).

The objectives to be achieved by adopting the MDA approach should be considered simultaneously, since the criteria that represent them allow an evaluation for each proposed alternative (Guarnieri, 2015). In order to apply the MDA approach in the choice of suppliers for green supply chain management, the use of the Analytic Hierarchy Process (AHP) method allows matched comparisons of all elements, as well as an evaluation of the consistency of such comparisons, breakdown in hierarchical levels and visualization of the problem to be judged (Saaty, 2008).

The breakdown implies the construction of a hierarchical network to represent a decision-making problem. At the top of this network are the general problem and below the criteria, sub criteria and alternatives. From

the network, the comparative judgments are carried out, where a comparison matrix is elaborated for each hierarchical level, comparing criteria and sub criteria. These comparisons follow a vector scale with scores from 1 to 9, where in this scale the value 1 indicates indifference, while the 9 indicates the highest preference within each member of the decision group (Saaty, 1990). In this analysis, the priority summary is generated, which consists of a calculation of a given weight for each alternative based on the preferences derived from the comparison matrix. However, for the prioritization of the elements to be coherent, it is necessary that the individuals' perception follow a linear scale, although the stimulus differences have a geometric scale pattern (Forman & Peniwati, 1998).

In the hierarchical analysis, the priorities in decision-making decide for an alternative based on a set of criteria and sub criteria aggregated into a single value, which is calculated in a trade-off. Thus, a score is generated from each performance-based alternative presented in each criterion and sub-criterion. Finally, the best alternatives will be the ones that obtained the highest score (Vargas, 1990). However, the AHP method has a limitation that refers to "choice", reducing the number of alternatives to a smaller set. On the other hand, the "ordering" tries to organize the alternatives in ascending or descending order; while the "classification" method tries to classify the alternatives into groups by categorical or ordered similarity (Ho, 2008).

Among the most used criteria in decision-making, "Cost" is the first, followed by "Quality" and then "Delivery". In this way, cost is the predominant factor in the negotiations despite the growing demand for sustainable products and services. Thus, evaluations for decision-making are still closely linked to structural analyses of economic performance (Alonso & Lamata, 2006). Therefore, the selection of suppliers is perceived from the point of view of the problem, from the perspective of the activities of the purchasing criterion. Perhaps this is why the work relating to the multi-criteria approach in the choice of suppliers to compose green supply chain management are not as numerous.

3. Methodology

3.1 Data Collection

A total of 24 questionnaires were used to choose pre-defined environmental, economic, and social criteria and sub-criteria are most used in decision making for suppliers within sustainable supply chain management (SSCM). Of these, 18 questionnaires were applied in three companies of the food sector located in the southern region of the State of Minas Gerais, which for trademark protection reasons will be treated in this work as ALFA 1, 2 and 3. Once the companies were selected, employees from various sectors within the companies were interviewed, being six employees per company. Among the employees interviewed, it was established that three of them would be senior managers in charge of the management sector, while the other three would be in charge of purchasing, quality control, sustainability, and any other position involved in the supply chain process. The other 6 questionnaires were applied to experts from the Environmental Sciences area of a University in Minas Gerais. From these data the pairwise comparisons were established according to the rank of importance attributed to each criterion (Environmental, Economic and Social) and sub-criteria (within each criterion) by companies (represented by employees), specialists (represented by university academics) and total (both groups).

3.2 Data Analysis

The Analytic Hierarchy Process (AHP) method was used to establish the ranking of the criteria and sub-criteria in the different groups evaluated. This method consists of

breaking down the problem into several related factors in a hierarchical construction. By means of this set of factors, the model considers the priorities among the alternatives, comparing them in pairs for each criterion/sub-criteria, through the matrices and based on the numerical scale of Saaty & Vargas (1987) (Table 1).

Table 1. Fundamental Scale of Thomas Saaty

Intensity	Score	Evaluation Form
1	Same importance	The two activities also contribute to the objective
3	Small importance of one over the other	Experience and judgment favor one activity over another
5	Large or essential importance	Experience or judgment strongly favor one activity over another
7	Very large or demonstrated	One activity is very strongly favored over the other. It can be demonstrated in practice
9	Absolute Importance	Evidence favors one activity over another, with the highest degree of safety
2,4,6,8	Intermediate Amounts	When you search for a compromise condition between two settings

The pairwise matrices of judgment, obtain values of importance of the criteria and values of performance of the elements of the hierarchy in relation to its superior level. The matrix of judgments and the attribution of values should be made by experts on the issue addressed in the problem (Mangla et al., 2015) to form square matrices of order n and their eigenvectors. Thus, the chosen alternative takes into account a set of criteria and sub-criteria aggregated into a single value, score. Being that, the best alternatives will be those that obtained the highest scores.

The equation 1 shows the relationship between the decision matrix A and the eigenvector ω, which equates to the importance of one of the criteria, or one of the alternatives within one of the criteria, where λ is the eigenvalue and A is a square decision matrix of order m

$$A\omega = \lambda\omega$$

Equation 2 applies in the calculation of the number of judgments for each matrix.

$$\boldsymbol{Q = \sum_{i=1}^{N=1} Ni \frac{(Ni - 1)}{2} (2)} \qquad (2)$$

Each judgment matrix must have its weighted matrix calculated, i.e. each element of the matrix column is divided by the sum of the column elements. What makes the sum of the elements of the column equal to 1. From this, the calculation of the priority vector (normalized weights) is done by averaging the elements of each line. Once the matrix is normalized, it is time to check which of the criteria or alternatives is the most relevant. The equation (2) of (Nydick & Hill, 1992) assists us in the peer-to-peer comparison for each component of the problem represented by a pairwise comparison matrix. If n items are to be compared to a given matrix, according to equation (2) a total of n judgments are required.

Then, the Consistency Index (CI) is calculated using the maximum eigenvalue (λmax) obtained with the number of elements analysed (Equation 3). The maximum eigenvalue is calculated by multiplying the matrix of judgments by the priority vector. The result obtained is then divided by the priority vector.

$$\boldsymbol{IC = \frac{(\lambda\, máx - n)}{(n - 1)}} \qquad (3)$$

AHP has the advantage of measuring the consistency of the degree of judgment for each sampled person. Thus, the model can calculate the consistency for paired comparisons (Equation 4).

Clearly explain conceptual and theoretical framework, innovation description and results:

$$\mathbf{CR} = \frac{\mathbf{IC}}{\mathbf{RI}} \qquad (\mathbf{4})$$

The equation is used to calculate the CR, Consistency Index (CI) and the Random Consistency Index (RI). In using the AHP method, it is important that there is a consistency of judgment in paired comparisons. Thus, a CR below 0.1 is expected, since CRs greater than this value require that experts re-analyse their analyses so that they can be used. In this work, the hierarchical structure for the evaluation of the criteria and sub-criteria was showed in figure 1. While, answers of the 24 interviewees were gathered in spreadsheets set up in Excel and later were ranked by the AHP.

The research began by applying the judgment of importance to the three criteria, using pairwise comparison. Table 2 gives an expert assessment of a food industry.

Subsequently, the importance judgments for the sub-criteria were applied, in which a pairwise comparison was made between the activities. In Tables 3, 4 and 5 is an judgments made by one of the experts of the academy.

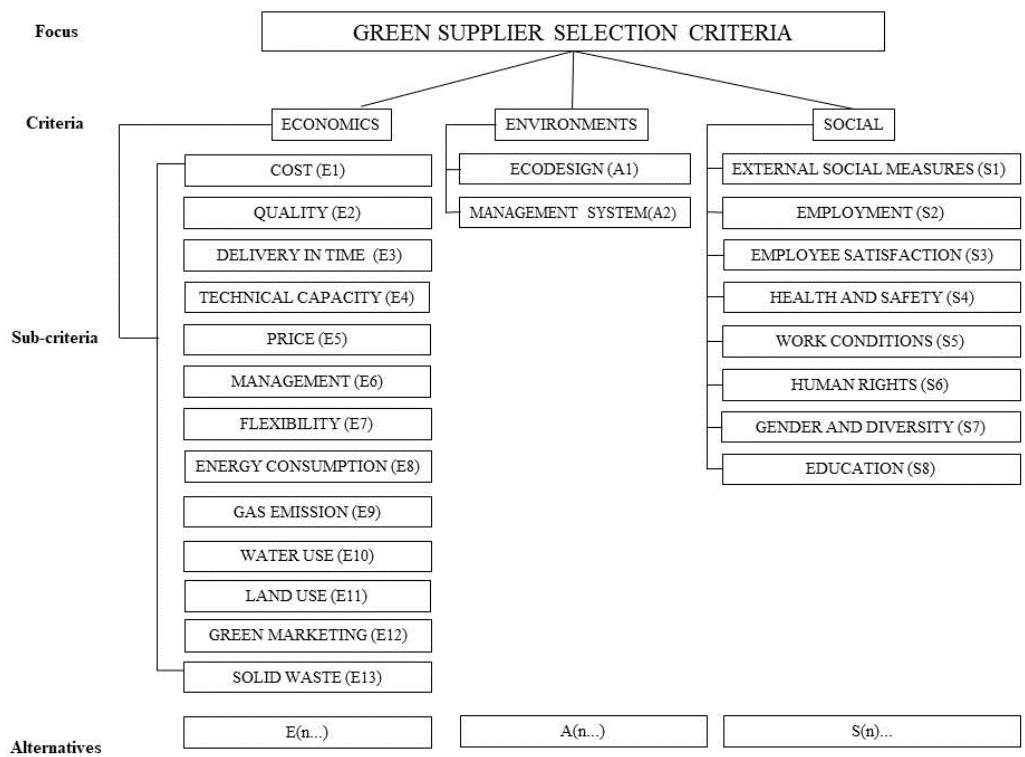

Figure 1. Criteria and Sub-Criteria Sustainable Supply Chain Management (SSCM)

Table 2 - Judgments of the Main Criteria - Expert 1

TBL criteria	Economic	Environmental	Social	Priority
Economic	**1**	5	5	71.43%
Environmental	1/5	**1**	1	14.29%
Social	1/5	1	**1**	14.29%

Table 3 - Judgments of the Economic Sub-criteria - Expert 1.

Economic Sub-criteria	C	Q	D	TC	P	M	F	Priority
Cost	1	1	2	1/5	1/3	3	1	9.89%
Quality	1	1	7	1	3	7	5	27.50%
Delivery	1/2	1/7	1	1/5	1/4	2	1/2	4.43%
Technical Capacity	5	1	5	1	3	7	5	31.61%
Price	3	1/3	4	1/3	1	7	3	16.74%
Management	1/3	1/7	1/2	1/7	1/7	1	1/3	2.89%
Flexibility	1	1/5	2	1/5	1/3	3	1	6.94%

Table 4 - Judgments of the Environmental Sub-criteria - Expert 1

Environmental Sub-criteria	ED	MS	EC	GE	LU	WU	GM	SW	Priority
Eco design	1	3	1/6	1/6	1/6	1/6	5	1/5	4.3%
Management System	1/3	1	1/7	1/7	1/7	1/7	7	1/7	21.27%
Energy Consumption	6	7	1	1	1	1	7	1	8.7%
Emission of Gases	6	7	1	1	1	1	9	1	26.14%
Land Use	6	7	1	1	1	1	9	1	8.76%
Water Use	6	7	1	1	1	1	9	1	8.76%
Green Marketing	1/5	1/7	1/7	1/9	1/9	1/9	1	1/9	6.65%
Solid Waste	5	7	1	1	1	1	9	1	16%

Table 5 - Judgments of the Social Sub-criteria – Expert 1

Social Sub-criteria	SM	E	ES	HS	WC	HR	GD	ED	Priority
Social Measures	1	1/3	1/3	1/5	1/4	1/5	1	1/6	8.76%
Employment	3	1	1	1/5	1/2	1/3	2	1/5	11.27%
Employee Satisfaction	3	1	1	1/4	1/2	1/3	2	1/5	12.52%
Health and Safety	5	5	4	1	3	2	5	1	16.76%
Work Conditions	4	2	2	1/3	1	½	3	1/3	15.72%
Human Rights	5	3	3	1/2	2	1	4	1/2	12.53%
Gender and Diversity	1	1/2	1/2	1/5	1/3	¼	1	1/5	8.04%
Education	6	5	5	1	3	2	5	1	14.38%

The criteria and sub-criteria for the selection in Sustainable Supply Chain Management (SSCM).

4. Results and Discussions

The whole data collection took less than two months and Aggregation of Individual Priorities (Saaty, Peniwati, & Shang, 2007) was applied to comparisons. The experts were considered as equally important, that is, their priorities had the same weight when aggregated. Thus, the aggregation of the judgments of the criteria and sub-criteria were shown in table 5.

Table 5 - Overview of the data surveyed.

	Companies Average				**Academics Average**				**Companies + Academics Average**			
	Local (%)	Rank	General (%)	Rank	Local Weight (%)	Rank	General weight (%)	Rank	Local (%)	Rank	General (%)	Rank
ECONOMIC	46.20				35.73				40.96			
Cost	13.83	4	6.39	4	14.78	4	5.28	8	14.30	4	5.83	4
Quality	19.59	1	9.05	1	23.13	1	8.26	1	21.36	1	8.66	1
On-time Delivery	12.57	6	5.81	6	7.55	7	2.70	20	10.06	6	4.25	10
Technical Capacity	15.71	2	7.26	2	17.05	2	6.09	2	16.38	2	6.68	2
Price	13.31	5	6.15	5	13.61	5	4.86	9	13.46	5	5.51	6
Management	15.28	3	7.06	3	15.56	3	5.56	6	15.42	3	6.31	3
Flexibility	9.71	7	4.48	7	8.32	6	2.97	18	9.01	7	3.73	15
ENVIRONMENTAL	26.40				31.12				28.76			
Eco design	8.28	7	2.19	20	9.39	7	2.92	19	8.83	7	2.55	20
Management System	15.66	2	4.13	10	9.86	6	3.07	17	12.76	4	3.60	17
Energy Consumption	14.16	3	3.74	12	14.51	3	4.52	11	14.34	3	4.13	13
CO_2/CO/CH_4 Gas Emissions	13.14	5	3.47	15	18.59	1	5.78	4	15.86	1	4.63	9
Land Use	12.66	6	3.34	17	12.21	5	3.80	15	12.44	5	3.57	18
Water Use	15.71	1	4.15	9	13.42	4	4.17	12	14.56	2	4.16	12
Green Marketing	6.52	8	1.72	23	6.81	8	2.12	22	6.66	8	1.92	22
Solid Waste	13.89	4	3.67	13	15.20	2	4.73	10	14.54	6	4.20	11
SOCIAL	27.40				33.16				30.28			
External Social Measures	7.22	7	1.98	21	6.97	7	2.31	21	7.10	7	2.15	21
Employment	13.31	4	3.65	14	11.91	5	3.95	14	12.61	4	3.80	14
Employee Satisfaction	11.98	6	3.28	19	11.18	6	3.71	16	11.58	6	3.49	19
Health and Safety	18.92	1	5.18	7	18.25	1	6.05	3	18.59	1	5.62	5
Work Conditions	15.58	2	4.27	8	17.16	2	5.69	5	16.37	2	4.98	7
Human Rights	12.33	5	3.38	18	12.25	4	4.06	13	12.29	5	3.72	16
Gender and Diversity	6.17	8	1.69	24	5.93	8	1.97	23	6.05	8	1.83	23
Education	14.49	3	3.97	11	16.36	3	5.42	7	15.42	3	4.70	8

The economic criteria prevailed over the social and environmental criteria to companies (46.7%) and academics (35.73%). Within the economic criteria the quality sub-criteria was ranked first in the choice of companies and academics. The ranking order among the economic sub-criteria for the two groups is the same with variations in the weights assigned. The quality has been considered the most important economic sub-criterion may be related to the possibility of interruption the manufacturing process in the production line due to problems with the products that are purchased. Generally, companies option by products that are more expensive from certain suppliers, as long as they are able to offer quality in these products in Sustainable Supply Chain Management (Wong et al., 2012). This result is also aligned with the choice of suppliers, which place quality as the main criterion in relation to companies (Beynon & Curry, 2000). Technological Capacity, with 15.71%, occupied the second position and Management System with 15.28% was the third. The importance attributed to these criteria can be related to the understanding of both groups in the need to implemented an assessment framework to measure company performance and this should be done involving all stakeholders, thus contributing to strategic, tactical and operational decision making (Bhattacharya et al., 2014).

Regarding the environmental criteria, the use of natural resources, agrochemicals, carbon emissions, hiring of child labour, compliance with environmental legislation, and others are taken into account. In general, the environmental criteria had 28.76% of importance. However, when looking at the data of the Environmental Sciences academics, this number rises to 31.12%, while companies while for companies that number drops to 26.4%. In fact, environmental issues have currently had a market value for manufactures, since companies need to meet environmental requirements or run the risk of financial damage caused by negative image (Kannan et al., 2013).

The sub criteria rank established by companies is different from that of academics. While the former provided the first position for Water Use (15.7%), the latter considered CO2 / CO / CH4 gas emissions (18.59%) as the main criterion in the choice of supplier. For the academics, the use of water is only the fourth place (13.42%), while the companies consider CO2 / CO / CH4 gas emissions (18.59%) as the fifth sub criterion in the ranking. In companies the sub-criterion that comes second is Management System (15.66%), which demonstrates a concern with the way in which companies have seen the managerial question of the processes, especially when they are considered new suppliers.

The concern of companies in decision-making turns to the internal question of the chain process, which we find worrisome, since the problem largely comes from supply. The next 25 years should require a 17% increase in the availability of water for irrigation and 70% in urban supply, which, together with other uses, should represent a 40% increase in total demand (Jabbour et al., 2013).

Another sub-criterion that was observed as a priority for the food sector is Energy Consumption (14.16%), occupies the third position in the ranking. The sub-criterion solid waste (13.50%) ranked in fourth is also a major concern of companies in this sector. This concern can be related to the institution of National Solid Waste Policy was enacted in Brazil (Law 12,305/2010), establishing the guidelines for the management of solid waste and the responsibilities of generators. Thus, the concern of companies regarding this sub-criterion in the GSCM is related to the legal implications that can be generated. The legal implications may also be the cause in the choice of social sub criteria.

The social criterion was the second most important in general (30.28%), however with

27.4% was slightly below the environmental criterion in companies. Thus, in companies, social sub-criteria have less weight in decision making regarding GSCM. However, or academics the value attributed to the social criterion (33.16%) was higher than the companies and in both the social criterion was more important in relation to the environmental one. Ocorreu troca de posição dos subcritérios entre os ranques das empresas e acadêmicos para Employment e Human Rights. In the first sub-criterion companies consider more important than academics, while in the latter the opposite is observed. In other sub criteria, Health and Safety (18.92%) occupies the first position with, for decision-making, while Working Conditions (15.58%) occupied the second position, while Education (14.49%) occupied the third position. Thus, when we think about the support that large companies offer their suppliers, and confront the benefits that are minimal and compare with health data, we can conclude that the social sub-criteria only have weight for ranking, but not for possible interventions that would change the realities of suppliers.

Concern about the adoption of social criteria is mainly focused on the preservation of human health, especially with intoxication due to the use of pesticides. (Amemba et al., 2013) reports that there is a prevalence of 7% of at least one agro toxic intoxication during the life of farmers, which is close to that found in Brazilian regions, the prevalence of 12% of pesticide intoxication in rural workers in Serra Gaúcha, finding a range of 7% to 22% in regions of Sri Lanka. Lack of knowledge of companies and farmers themselves about the complexity of the process of pesticide exposure / intoxication, together with the absence of integrated actions involving the use of agrochemicals in production, the non-use of individual and collective protection equipment and low schooling are factors that are implicit in these data.

However, it was observed that the selection of suppliers, adopting social sub-criteria, is already a paradigm shift in the manufacturing industry. In Brazil and in the world, programs have appeared for the insertion of women, creation of ecological parks among other actions so-called sustainable that were mentioned. Thus, if the Health and Safety sub-criterion was ranked first in the GSCM, criteria such as Gender and Diversity (6.17%) and External Social Measures (7.22%) could gain more importance for decision-makers.

5. Conclusion

Based on the data collected and analyses carried out, the economic criteria have a greater weight in relation to the environmental and social criteria in the companies of the food sector regarding the GSCM. In addition, it was found that environmental issues have become important because of their economic character. The search of these companies for sustainability based on stamps, audits, green marketing, eco design, has apparently made the environmental issue a trade of better places in the supply chains. However, these concerns imply important environmental actions for water conservation, correct disposal, and actions to preserve the region surrounding the companies, reforestation, among others. Thus, this work will assist managers in making decisions regarding their suppliers, using the main criteria and sub-criteria. As a result, it will be possible to have a parameter more compatible with the reality of the sustainable markets and in that sense contributing to a more autonomous decision-making process where the economic priorities do not surpass the other environmental and social criteria.

In the companies of the food sector, the economic issues are more important, nevertheless, it was given visibility to the environmental questions in the last years in terms of market value. Such a change, although still small, has been beneficial in preserving the environment. In a sector as complex as the purchase of materials and

services or in the supply that is also highly polluting, which contributed to insert these criteria in the selection, helps us greatly to diminish the demands for the natural resources of the planet. Finally, future work may include research of one of the most essential stakeholders of the supply chain that are the suppliers. Further research may include an approach on the relevance of suppliers' perspectives in the decision-making process. Find out what the demands and needs of the chain members are necessary, since many of these potential suppliers could become great partners of large companies and are often excluded from their suppliers framework by lack of knowledge of the processes of buying and selling and the technical support needs that most of the time is not offered. In addition, the use of the AHP method applied again in other industrial sectors on the perspectives of the chains to compare with those of this work providing a greater consistency in terms of sustainable and relevant criteria and sub-criteria in the decision making process.

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Allyson de Freitas
Universidade Federal de Alfenas/UNIFAL,
Alfenas,
Brazil
allysonfreitas81@gmail.com

Eduardo Gomes Salgado
Universidade Federal de Alfenas/UNIFAL,
Alfenas,
Brazil
egsalgado@yahoo.com.br

Jean Marcel Sousa Lira
Universidade Federal de Alfena/UNIFAL,
Alfenas,
Brazil
jmslira1283@gmail.com