Application of a framework to assess the level of sustainability of a company

Rodrigo A. Resina*, Juliana V. Mendes*, Virginia A. S. Moris*

*Post Graduate Program in Production Engineering, Center of Science and Technology for Sustainability, Federal University of São Carlos, Campus of Sorocaba, 18052-780 São Paulo, Brazil

Email: rodrigo.a.resina@gmail.com, juveiga@ufscar.br, vimoris@ufscar.com

Abstract

The quest for sustainable development is becoming more widespread among government, private organizations and members of civil society motivated primarily by environmental imbalance and social problems. So it conceptualizes, measures and works toward sustainability has become the goal of many of these organizations. This study aimed to apply the framework developed by the Lowell Center for Sustainable Production (LCSP) to measure the "level" of maturity in the sustainability of a large petrochemical company, ranking sustainability indicators already used by it. The research examined aspects related to the applicability of the framework, emphasizing the difficulties encountered in relation to its application. Also enabled a greater understanding of how the framework can help companies assess the maturity level where they are and how they can improve their level of maturity in sustainability, according to the above framework. It was conducted during the research: the literature research and an exploratory case study with data collection by structured tables. It was observed too the positive effectiveness of the framework and the company had most of its indicators classified at Level 3 for the LCSP framework, as that Level has the scope to assess the natural environment and human health.

Keywords: sustainability, sustainable framework, sustainability indicators, measurement of sustainability.

1 Introduction

Considering the current dilemmas of society related to sustainable development, the civil society, governments, non-governmental organizations, and private organizations search the adoption of tools or methods that will help manage the organizational actions related to sustainability (Veleva e Ellenbecker, 2001a).

Throughout the years, Veleva et al (2003) and Rametsteiner et al (2011) are remarkable, it can be noticed a growing number of companies that are developing and utilizing indicators of sustainability. These indicators have as their function to describe the current conditions and tendencies and help on comprehension and discernment of how the human being and the organizations work, and provide better comprehension of how actions taken on the organizational side affect the different dimensions of sustainability (RAMETSTEINER et al, 2011). Mastroti & Souza (2011) emphasize that, currently, it is unthinkable to adopt a tool/method that supports the management of the sustainability indicators without contemplating its three dimensions, the known: social, economical and environmental.

Considering the relevance of the management of these indicators in the search for sustainable development, the Lowell Center for Sustainable Production (LCSP) developed a framework that qualifies the set of indicators of the company, named LSCP framework that can be used by companies to measure and, throughout the time, monitor its actions relating to sustainable development (VELEVA e ELLENBECKER, 2001a)

The use of indicators of sustainability can provide adequacy about the environmental legislation and good practices for the society that, direct and indirectly, relations to the organizations. Strategically, the company with elevated levels of sustainability can get competitive advantages in a environment that is progressively getting more conscious and critical about sustainable development.

This way, facing the importance that the tools to measure sustainability can have in an organizational context , this work has as its objective, to spread the application of a method in an organization, the LCSP framework, and contribute to the edification of knowledge in this subject.

The case study was chosen in the chemical industry because, as stated by Delgado (2007), the production aspects are considered to be the most polluting. The author adds that the relevance of the chemical industry is growing and can be observed by an increase of 0.8% of Brazilian GDP in the period 1990 to 2004.

This paper presents a theoretical review about sustainable development, sustainability, indicators of sustainability and sustainability frameworks. In the following paper it is presented the application of the LSCP framework at a petrochemical industry, the analysis of results and conclusions.

2 Theoretical review

The concept of sustainable development comes from a long historical process of critical reassessment of the relationship between society and the environment. Because it is a continuous and complex process, many approaches appear to define sustainability (BELLEN, 2005).

The term "sustainability" comes from the Latin meaning *Sustentare*: to sustain, support, maintain in good repair, maintain, resist. The most known definition of sustainability contained in the Brundtland Report, which was developed from the World Commission on Environment and Development (WCED), States that sustainable development is what meets the needs of present generations without compromising the ability of future generations to meet their own needs (WCED, 1987,) and also adds a need to create balance between the economic, social and environmental (BELLEN, 2005).

The WCED (1987) related that the industrial planning and the decision process of the governments and the industrial must take into account issues about resources and environment. It is possibility to reduce the amount of energy and resource necessary for future growth through the use of the resource efficiently and stimulate the recycle and reuse of the materials.

Veleva et al (2001) defines sustainable production as the creation of goods and services; using processes and systems that, do not pollute, enable the conservation of energy and natural resources, are economically viable, are safe and healthy for employees, the community, consumers and society.

Veleva and Ellenbecker (2001b) describe six main aspects of sustainable production for Lowell Center for Sustainable Production (LCSP):

- Energy and material use (resources)
- Environment
- Social justice and community development
- Economic Performance
- Employees
- Product

The literature (Bellen, 2005) has presented studies that go towards sustainable development and provide tools to measure and evaluate sustainable processes through indicators.

"The term indicator originates from the Latin *Indicare*; finding, pointing, advertising, estimating" (HAMMOND et al, 1995). The main functions of indicators are evaluation of conditions and trends, comparison between places and situations, assessment of conditions and trends in relation to the goals and objectives, to promote information and warning conditions and anticipate future trends (TUNSTALL, 1994 apud BELLEN, 2005).

Sustainability indicators have emerged as appropriate tools for all organizational levels (VELEVA et al, 2003) and can be used as a basis for regional and industrial transformations (EBIHARA & AMANO, 2005).

For Rametsteiner et al (2011) "sustainability indicators are at the same time a means to compile and structure knowledge and to express societal and political norms and priorities". These authors add that the indicators developed are "results of continuous improvement process, particularly with regard to integrating emerging knowledge" (RAMETSTEINER et al, 2011).

Dahl (2012) complements that "there is thus critical need for sustainability indicators to capture the dynamics of changes and trends and the trajectories of important features of both earth system and social and economic pressures". That is because "one of the characteristics of technological process and globalization is the accelerating rate of change in many economic, social and environmental processes" (DAHL, 2012).

According to Bonniot and Spangenberg (1998) sustainability indicators should be simple and the number of indicators should be limited and its calculation methodology transparent.

To Veleva and Ellenbecker (2001b) the main goals of sustainable production indicators are:

- Generate knowledge on sustainable business.
- Inform decision makers that are promoting consciously information about the current status and trends in company performance.
- Promote organizational learning.
- Provide the organization with a tool to measure their achievements for the goals and targets towards sustainable production (internal benchmarking).
- Allow a comparison between the performance of organizations with respect to the environment, social and economic aspects of production.
- Provide a tool to review the company's mission, and return the results to interested stakeholders.
- Provide a tool to motivate the involvement of stakeholders in decision making.

The Lowell Center for Sustainable Production (LCSP) has identified four key dimensions of the indicators of sustainable production (VELEVA and ELLENBENCKER, 2001b).

1 *Unit of measure* · is a metric used in the calculation of indicators such as kilograms, tons, dollars, percentages, times, etc.

2 *Type of measure* · (Absolute or Relative) is an indicator that can be measured as a total (example: total energy used per year in kWh) or relative terms (energy used per unit of product / service per year).

3 *Measurement period* · is the time reference period which demonstrates the indicator was calculated (fiscal year, calendar year, quarter, month, etc.).

4 *Scope* · determines how far the company wants to go (product lines, ability, suppliers, distributors, life cycle of material or product, etc.).

To Veleva and Ellenbecker (2001b) some of the qualities desirable for indicators of sustainable production are:

- Ensuring sustainable production.
- Based and calculated using reliable data.
- Comprising of essential and supplementary indicators.
- Addressing indicators for all six aspects of sustainable production.
- Including a manageable number of indicators.
- Easy to implement and evaluate.
- Simple in its meaning, and purpose.

"Indicators should be able to improve the public image of the company and create a competitive advantage through differentiation of products and services" (PORTER, 1998 apud VELEVA et al., 2003). Each company must be analyzed by observing its peculiarities. According to Bellen (2005), the indicators are not universally applicable, so it is necessary to know the specifics of each company as well as their characteristics and applications.

According to Veiga (2010) evaluation, measurement and monitoring of sustainability necessarily require a set of indicators, it is statistically inconceivable to merge into a single index within only two of its three dimensions (economic and social environment).

The Report by the Commission on the Measurement of Economic Performance and Social Progress states that the measurements of sustainability are necessary projections and not only observations and adds that it is necessary require some preliminary answers to normative questions. The report also adds that "the problem is global, especially in its environmental dimension and what really matters most is the contribution that each country may be giving to global unsustainability" (VEIGA, 2010 p. 48).

Bellen (2005) raised the worldwide broadcast systems indicators. The most often mentioned were: the Ecological footprint, the dashboard of sustainability and the barometer of sustainability. The three indicators presented try to aggregate the data and result in a quantitative analysis. For Bellen (2005), the Dashboard of sustainability and the Barometer of sustainability have more impact on decision makers and is used for visual representation for future analysis. The author adds that the Ecological Footprint has a one-dimensional focus on aspects of environmental sustainability. The Barometer of sustainability analyzes social and environmental aspects of sustainability or Dashboard for when the analytical basis is more complete, because it explores the social, economic and environmental.

The literature also presents a LCSP framework by Veleva et al (2003). This framework was developed as a tool for organizing and helping companies evaluate the effectiveness of its set of sustainability indicators. The framework has five hierarchical levels to categorize the indicators, as illustrated in Figure 1, explained below:

Level 1: Categorize indicators that are to pursue changes against a company to comply with regulations. This is the minimum number of items that the company needs to attend current legislation.

Level 2: This level measures the performance of the production process and use of materials. The indicators used are related to cost reduction and therefore are widely used by businesses.

Level 3: Indicators of this level assess the effects generated by operating activities in the company on the environment. For example, CO2 emitted by energy used in millions of tons.

Level 4: Analyze the supply chain and product life cycle, in the other words, attempt to assess the overall chain. These kinds of indicators measure the level of reuse; recycling and use of renewable materials. For example: CO2 emitted in the transportation.

Level 5: Kinds of indicators that show the action of companies which provide broad sustainability to the society. Sustainable production is not an isolated activity. The social, economic and environmental issues must be considered. The 5 level indicators measure the effects of production on the quality of life, human

development and assimilation capacity of the negative impacts on the environment. For example, percentage of water collected from the source compared to the percentage of return

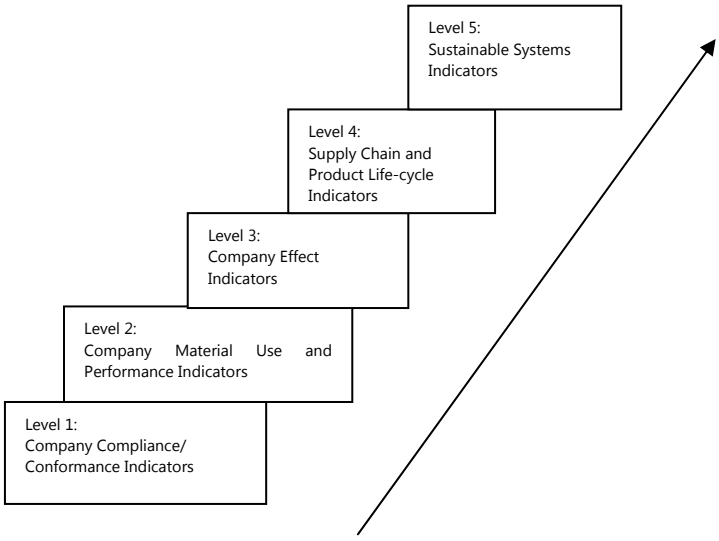

Figure 1 – LCSP Framework. Source: Adapted of Veleva et al (2003).

Veleva et al (2003) performed a case study with six multinational pharmaceutical companies in order to classify them and determine the level of sustainable employees in its operations; following the framework. It was chosen for these pharmaceutical companies to adopt policies of social welfare, environmental protection and conduct their business responsibly. Three of these companies implement management report for sustainability, called the Global Reporting Initiative (GRI). The aim of this study was to classify the indicators already adopted by companies in the levels developed by researchers at the LCSP. As a result, the authors found that most indicators concentrated at level 2 and concluded that this is connected to the search for cost reduction and increasing competitiveness. Another relevant fact is that neither company had indicators of level 5. The Companies that had applied the GRI, had a larger number of indicators.

The above framework allows companies to have their practices and actions in relation to sustainability assessed and classified by the indicators used. The tool is generic and works with several indicators that are categorized in Level 1, 2, 3, 4 or 5. It provides for the adoption of indicators according to the segment of the company's operations -- enabling a better comparison between companies in the same sector.

The LCSP framework is not a quantitative indicator like the Ecological Footprint, Dashboard of sustainability or the barometer of sustainability, but a framework that assesses the degree to which a company is in relation to sustainability.

"For generations, the world seemed so large as to be inexhaustible, but between our population growth and the scale with which science and technology have multiplied our impacts, planetary limits or boundaries suddenly seem very near or have already been overstepped" (MOLDAN, 2012). Dahl (2012)

related a "long way from realizing the full potential of indicators to support the increasingly urgent transition to sustainability" and included "scientific information such as indicators is usually not sufficient to motivate fundamental change, yet the achievement of sustainability will require fundamental changes in lifestyles, consumption patterns, resource use and economic system" (DAHL, 2012).

Dahl (2012) affirms that just values can "move the society towards sustainability, such as justice, moderation, solidarity and respect for the environment and its limits, contradict the dominant materialistic and self centered values of the economic system and the consumer society" (DAHL, 2012).

The themes covered in this topic are related to indicators, frameworks and measurement of sustainability. The review conducted in the scientific literature that the framework allows the evaluation of Lowell is applicable to production systems and covers the triple bottom line focus in its scope (economic, social and environmental). The following section describes the method used and the research that was developed.

3 Application of the LCSP Framework at a Petrochemical Industry

The analysis of the applicability of the LCSP framework demanded to conduct a study in a structured manner, is detailed below.

First, a theoretical study was conducted to increase knowledge about sustainability, enabling future discussions and basing the analysis of the case study.

A case study was subsequently conducted at a petrochemical company a petrochemical company that commercializes polymeric resins, copolymers, soda and other substances used in the chemical industry. The company is a leader in thermoplastic resins in Latin America and the third largest producer in the Americas. According to the company, it bases its strategic competitiveness on technological autonomy, coupled with a commitment to promote sustainable development. The organization is part of the Corporate Sustainability Index of the Stock Exchange of São Paulo, and is certified by Bureau Veritas Quality International (BVQI) ISO 9001 and also ISO 14001 certification for Environmental Management.

The conduct of the case study was adopted because, according to Voss et al (2002), is the history of a past or current phenomenon, was shaped by multiple sources of evidence. Data can be included from direct observation and interviews, as well as access to public and private archives. Meredith cited by Voss et al (1998) said "the use of case study for exploratory research, where the variables are unknown and the phenomenon is not fully understood, it needs to develop research ideas and questions about the problem".

A current phenomenon in the present study is the search for a sustainable corporate segment in order to use a framework that can classify the company in relation to sustainability.

As a research proposal, the case study was defined in a company, due to the specific period in the initial design. Analysis emerged from the knowledge gained from the application of the framework, showing theoretical studies on a visual application (CmapTools).

The first part of the case study consisted of data collection. Structured tables were developed that allowed the collection of indicators related to energy and material use (resources), the environment, social justice and community development, economic performance, employees and product. Roadmap explanatory and regular meetings guided the collection.

Data collection was conducted with a representative of the team responsible for the management of sustainability, reporting directly to the Director of Sustainability. The company said the indicators are used for the control and measurement of sustainability. All indicators collected met the minimum requirement, according Veleva and Ellenbecker (2001b), holding the unit of measure, type of measurement (absolute or relative), the measurement period and scope.

The analysis of information collected was supported by a conceptual map used to facilitate the classification of the indicators in the levels of the framework. Such analyzes are presented in the next topic and aim to discuss the applicability of the LCSP framework.

4 Analysis of results

By applying the LSCP framework, the result is the quantification of the survey or the number of indicators used by the company, at each hierarchical level. Thus, it isn't possible to say that the company is sustainable at some level, but rather that its measured activities focuses on a specific level.

The framework also allows the company to be aware of daily measurement and how they can improve its system of measurement in the future, formulating indicators of higher levels in the LCSP framework hierarchy. The LCSP framework is easy to apply, because the scopes are very clear and distinct, making the simplified classification of the indicators. It seemed to be a good tool for continuous improvement practices. However, it was found that conceptual knowledge is extremely important to the modal and its scope.

A major problem found is related to the classification of unclear indicators which can have two or more focus points, for example, the noise indicator provides the environmental compliance and also provides an improvement to the environment. In such cases the indicator is classified at the highest level of the hierarchy proposed by LCSP (in this example, level 3: the natural environment and human health and not level 1: Compliance and enforcement). The index number of records of fines and infringements clearly enables the company to comply with the regulation and is therefore classified as level 1 in the framework.

The CmapTools used in the analysis part has a visual list of indicators with the focus of each level and provide a volume of indicators at each level.

Twenty seven indicators were collected in the company for the management of sustainability. All indicators have already been classified according to the LSCP framework shown in Table 1.

A map was concocted to try to relate the six aspects of sustainable production (use of energy and materials environment, social justice and community development, economic, employees, and product) against the indicators collected by each scope of each hierarchy level proposed by LCSP.

The results showed that for the aspect of energy and use of material which provided three indicators, rated as level 2, they are related to the production input (power). It was raised nine indicators of natural environment, eight of them being classified at level 3 and only at one level 1, because it is directly linked to factors of legislation. Only one indicator was raised in the aspect of cost performance which shows an identity of level 1, since it refers to penalties incurred if not complying with legislation. For the aspect of community development and social justice were collected six indicators, and four indicators to level 3 and two indicators to level 1. About seven employees were identified and all are indicators of the level 3, referring directly to human health. Finally, the product appearance is not lifted by any indicator.

Table 2: Indicators were classified into levels

Sustainability Productive Indicators			
Aspects of SP	**Indicators**	**Metrics**	**Level**
Energy and Material use	Power consumption (relative)	GJ	2
	Energy consumption by source type (Absolute)	GJ	2
	Water consumption (relative)	m^3	2
Natural environment (including human health)	Environmental Noise community	Hz	3
	Gaseous emissions total (absolute and / or Relative)	-	3
	Specific gaseous emissions (CFCs, NOx, SOx ...)	-	3
	Total wastewater (relative)	-	3
	Pollution load in wastewater (BOD, COD ...)	BOD/Kg e COD /Kg	3
	Solid Waste liquid or paste (relative)	-	3
	Level of service of legal environmental requirements	%	1
	Resources for investment in environmental improvements (Absolute and / or Relative)	Número de projetos	3
	Resources allocated to fund environmental control (treatment of emissions, effluents or wastes)	R$	3
Economic performance	Number of records of fines or violations of environmental agencies	Number of fines	1
Community development and social justice	Level of service of legal requirements (labor relations, pension and other)	Number of labor lawsuit	1
	Number of records of fines or violations of supervisory boards (work, social security ...)	R$	1
	Human development index of the communities where it has manufacturing operations	Variation in HDI	3
	Resources for improving community relations with neighboring communities	R$	3
	Resources for training in social, health and safety (time or economic)	R$	3
	Visits from community	Number of visits	3
Employees	Accidents result people	Number of accidents	3
	Diseases recorded number (rates)	Quantities of diseases	3
	Relations between the highest and lowest salaries	rate	3
	Number and quality of benefits available to the workforce	Number	3
	Funds for capital improvement of working conditions	R$	3
	Loss of working days due to accidents or occupational diseases	Number of days	3
	Turnover rate of staff	rate	3
Products			

Source: Own Prepared.

It can be seen in Table 2 that 74% of the indicators were classified as level 3, in other words, the enterprise is focusing of measurement the environment and community. By analyzing the company was noted of effective efforts related to promoting social and environmental responsibility. As an example, the continuous effort to improve production processes to reduce emissions of greenhouse gases. The company also has policies for recycled water and increase of the efficiency of processes to avoid waste and high water consumption.

The company manages the environmental impacts of activities, products and services through a specific program for the Health, Safety and Environment (HSE) certified by ISO 14001 in all factories. The program sets annual performance targets in all aspects of manufacturing plants and measures such as: eco-efficiency, energy consumption, water consumption, waste water generation and solid waste, climate change, biodiversity and environmental monitoring, compliance, innovation and investment.

The company invests in social projects in a planned way, monitored (technical visits) and systematic, it avoided actions merely for welfare, focusing on projects that involve the community in developing the action. Social projects are linked to culture (music courses), professional education (hydroponics, beekeeping and fish farming) and environmental education among others. A note to the company's commitment in focusing on improves and its performance regarding factors related to the natural environment.

Table 2 also shows that 14.8% of indicators were classified as level 1 and 11.2% level 2. It was noted that larger number of indicators are level 3 which is different from the case study cited by Veleva and Ellenbecker (2001b) in the America pharmaceutical industry, where higher number of indicators were level 2, because this enables cost reduction and economic benefits for the company.

None of the 27 indicators provided by the company were to measure the scope of a supply chain or product life cycle, so it didn´t achieve level 4 indicators. The same was observed with indicators at level 5, which seek to measure the three pillars of sustainability (economic, social and environmental) into a single aggregate index. In the case of pharmaceutical companies analyzed by Veleva et al (2003) level 5 indicators were not raised.

5 Conclusion

Considering the study carried through a national petrochemical industry, the LCSP framework showed revealed itself to be viable. This tool makes a diagnostic analysis related to the support towards the company possible. It also allows the identification of one determined level based on the current indicators, and how the LCSP framework must formulate new indicators as well. These indicators will be capable to control other focuses in higher hierarchic levels in the future.

Each level presented by framework LCSP has a clear and well-defined target, facilitating the sorting of the indicators separately. However, with the application of the framework, it cannot be affirmed that the company is sustainable; but, it can be said that the gamma of collected indicators takes the sorting of the company to one determined level.

During the research, one difficulty that appeared was the sorting of indicators that signalled to cover two or more levels. In this case, it was stipulated that the indicator must be categorized in the highest level of hierarchy (the greatest indicators have wider target ranges). A second thing that can be pointed out was the necessity of a larger dissemination of concepts and indicators of environmental, social, and economic support in the companies and that distribution's effective use as an important tool for environmental managing.

The studied company presented a greater number of indicators classified as level three, illustrating a greater concern with environmental and communal aspects. The practices of using and reusing the natural resources in a responsible way are noticeable and are being presented very clearly. The monitoring and evolution of its environmental indicators present continuous improvement in its goals stipulated in all the industrial units. The main indicators can easily be followed in the support reports emitted by the

company; currently the publication of this document is becoming common. A marking feature of this type of document is how clearly the data is being presented.
It was noticed with the study of case that the framework can be applied to the national enterprise culture, because the current management techniques are globalized. However, it is important to point out that the peculiarities of each company and each sector must be pondered in analysis as reported by Bellen (2005). A suggestion for future research would be to carry a comparative study between companies from the same sector, like the petrochemical industry sector, utilizing the studied framework.

Confirming the proposals of Veleva and Ellenbecker (2001b) the indicators of sustainable production demonstrated that they are capable of generating knowledge in businesses to the involved companies, benefiting the decision makers and promoting conscientious information on the current status and the trends in the performance of the company about the measurement system. Additionally, they can promote organizational learning to the involved managers, and insertion of sustainability in strategical planning, showing that they can be a good tool to promote a continuous improvement.

The use of sustainability indicators makes the companies more transparent and facilitates the practice of benchmarking, as well as the monitoring of its environmental, social and economic performance, besides the fact that it assists the company in carrying through a reasonable comparison aiming at sustainable development with companies of the same sector using the same framework of measuring.

Currently sustainability gains force in the framework of enterprise management and many companies are guided strategically towards gaining knowledge and improving its performance to become more sustainable (ALMEIDA, 2009). Measuring sustainability is a new subject and a challenge, what motivated the realization of the research. However, additional researches in this area can amplify the scientific knowledge and support the companies in their way to fulfil their strategies in sustainability.

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References

ALMEIDA, F. Business experiences in sustainability: progress, problems and motivation of managers and companies. 1 ed. Rio de Janeiro: Elsevier, 2009.

ALMEIDA, F. The challenges of sustainability: A break urgent. 6 ed. Rio de Janeiro: Elsevier, 2007.

BELLEN, H. M. V. Sustainability indicators: a comparative analysis. 1 ed. Rio de Janeiro: FGV, 2005.

EBIHARA, M.; AMANO, K. Eco-intensity analysis the sustainability indicators related to energy and material flow. Emerald Management of Environmental Quality: An International Journal, vol. 16, n. 2, p. 160-166, 2005.

DAHL, A. Achievements and gaps in indicators for sustainability. Elsevier: Ecological Indicators, v.17, p. 14-19, 2012.

DELGADO, J. JS Sustainable Development and the Brazilian chemical industry: Analysis of business and positions of its proposal to split strategies. Federal University of Rio de Janeiro, Rio de Janeiro, p. 1-231, 2007.

DEPONTI C. M., ALMEIDA, J. Indicators for assessing the sustainability of local rural development contexts. Federal University of Rio Grande do Sul, Porto Alegre, p. 62-69, 2001.

GRANT, J. The Green Marketing Manifest. Emerald: Strategic Direction, v.24, n.6, p. 25-27, 2008.

HAMMOND, A.; ADRIAANSE, A.; RODENBURG, E.; BRYANT, D.; WOODWARD, R. Environmental Indicators: A systematic to measuring and reporting on environmental policy performance in the context of sustainable development. Washington, D.C.: World Resources Institut, 1995.

KUNSCH, M. M. K., OLIVEIRA, I. L. Communication in management of the sustainability of organizations. 1 ed. New York: Broadcast Publishing, 2009.

MASTROTI, R. R. ; SOUZA, D. G. Systems of indicators and good practices of enterprise sustainability. In AMATO NETO, J. (Org) Sustainability and production: theory and practices for a sustainable management. 1 ed. São Paulo: Atlas, 2011.

MOLDAN, B. ; Janoušková, S. ; HÁK, T. How to understand and measure environmental sustainability: Indicators and targets. Elsevier: Ecological Indicators, v. 17, p. 4 – 13, 2012.

PEATTIE, K., CRANE, A. Green marketing: legend, myth, farce or prophesy? Emerald Qualitative Market Research: An International Journal, v. 8, n. 4, p. 357-370, 2005.

RAMETSTEINER, E. ; PÜLZL, H. ; ALKAN-OLSSON, J. ; FREDERIKSEN, P. Sustainability indicators development – Science or political negotiation? Elsevier: Ecological Indicators, v. 11, p. 61 – 70, 2011.

SPANGENBERG, J. H.; BONNIOT O. Sustainability indicators: A compass on the Road Towards sustainability. Wuppertal Institute for Climate, Environment, Energy, n.81, p. 3-34, 1998

VEIGA, J. E. Sustainability Indicators Advanced Studies Journal, v.24, n.68, p. 39-52, 2010.

VELEVA, V. ; ELLENBECKER, M. Indicators of sustainable production: framework and methodology. Elsevier: Journal of Cleaner Production, v.10, p. 520-549, 2001a.

VELEVA, V. ; ELLENBECKER, M. Indicators of sustainable production: a new tool for promoting business sustainability. Baywood publishing Company: New solutions, v.11, p. 41-62, 2001b.

VELEVA, V. ; HART, M. ; GREINER, T. ; CRUMBLEY, C. Indicators for measuring environmental sustainability: A case study of the pharmaceutical industry. Benchmarking: An International Journal, v.10, n.2, p. 107-119, 2003.

VELEVA, V. ; HART, M. ; GREINER, T. ; CRUMBLEY, C. Indicators of sustainable production. Elsevier: Journal of Cleaner Production, v. 9, p. 447-452, 2001.VOSS, C. ; TSIKRIHTSIS, N. ; FROHLIC, M. Case research in operations management. International Journal of Operations & Management, v. 22, n. 2, p.195-219, 2002.

WERBACH, A. Strategy for Sustainability: A new way to plan your business strategy. 1 ed. Rio de Janeiro: Elsevier, 2010.

WORLD COMMISSION ON ENVIRONMENT AND DEVELOPMENT. Our common future 1 ed. New York: Oxford University Press, 1987.