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ASSESSMENT OF THE USE OF ENVIRONMENTAL MANAGEMENT SYSTEMS AND THEIR IMPACT UPON ORGANISATIONS: The Case of a Brazilian Naval Hub

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ABSTRACT

The environmental issue is currently seen as a factor of competitiveness and not just as a way to respond to legal requirements. Hence, the adoption of an Environmental Management System (EMS) is presented as a differential for companies. Accordingly, the present work aims to evaluate the performance of the various EMSs at companies in a specific Brazilian Naval Hub and identifying the environmental indicators applied for the same. The research objective is pursued by evaluating the results of a field survey. The subsequent data analysis enabled the assessment of the impact of the adoption of an EMS on the operating performance of companies. The analysis also helped in recognizing the environmental indicators used by these companies and in identifying the correlation between variables, such as environmental commitment and cost reduction, among others.

Keywords: *environmental management system; environmental performance; environmental indicators; cost reduction.*

1. INTRODUCTION

Over the years, industrial development has been a source of both positive and negative implications. The environmental problems related to the latter include water pollution, the greenhouse effect, acid rain, excess waste, shortages, soil degradation, and use of non-renewable natural resources, apart from causing misery, poverty, and hunger, among others (Nascimento, 2008).

International conferences and environmental incidents have both contributed significantly in the awakening of environmental awareness as well as in the increase in pressure of public opinion and organisational regulations. This has resulted in evoking greater concern and consideration for environmental issues on the part of organisations (Campos & Melo, 2008).

In this context, companies have chosen to implement Environmental Management Systems (EMS) to enable continuous reassessment of processes in order to achieve methods that are less harmful to the environment and that lead to profit or a reduction in operational costs (Longaray & Porton, 2007).

Subsequent to the implementation of a Naval Hub in its area, the municipality of Rio Grande, located in the extreme south of Brazil, has displayed considerable economic growth in recent years. According to the Statistics and Economy Foundation of Rio Grande do Sul (FEE), the municipality's GDP, which was 3.4 billion dollars in 2006, rose to 8.1 billion dollars in 2011, a relatively significant increase. However, a general lack of planning and structure is evident in the municipality, which brings with it an environmental warning, since the municipality has already had problems related to the environment.

Hence, the present study aims to conduct a performance review of the EMS implementations at the companies in Rio Grande by analysing the environmental indicators applied by them. This will help illustrate the impact that the adoption of an EMS brings to the operating performance of companies in this municipality.

Further to the introduction, this paper presents a theoretical approach to environmental management and analyses the EMS models proposed in the existing literature. Subsequently, the research methodology employed in this study is explained. Finally, the results obtained are presented, followed by the concluding remarks.

2. THEORETICAL FOUNDATION

2.1 Environmental management

Barbieri (2009, p.153) considers corporate environmental management to manifest "the different administrative and operational activities of the company to address the problems arising from its operations or to prevent them from occurring in the future".

The pressure from the introduction of environmental management in organisations is a result of new norms, of restrictions and applications of penalties by means of political and economic factors, as well as of social demands on the part of consumers and non-governmental organisations (NGOs) (Oliveira & Serra, 2010).

Normally, the implementation of an EMS is an optional process. When deciding for its adoption, however, organisations are aiming not just for financial benefits. Rather, they are still assessing the risks of inadequate management with respect to environmental aspects (incidents, disregard of environmental regulations, the inability to raise bank credit and other investment capital, and market losses resulting from competitive malpractice) (Costa, Camelo, Souza & Maia, 2007).

In this context, González-Benito and González-Benito (2006) illustrate the handling of the environmental factor in two ways. One is a proactive approach, whereby the organisation is committed on a voluntary basis to reducing the impact on the environment and improving its environmental performance. The other approach is reactive, whereby only nominal actions are initiated to minimise the environmental impact.

Public environmental agencies can, to some extent, alleviate the pressure placed upon the environmental permit for organisations, since they opt for the voluntary adoption of environmental management policies. These same agencies, in determining and assessing the procedures used by private organisations, can assist them through specific programmes of self-control and self-monitoring (Costa *et al*., 2007).

2.2 Environmental Management Systems (EMS)

According to NBR ISO 14001, EMS can be defined as being a component of the management system that includes the organisational structure, responsibilities, practices, procedures, processes, and resources in order to implement, develop, review, and maintain the environmental policy of a company. Based on the NBR series ISO 14001, the defining principles that verify the organization's progress in relation to the environment are: (1) Environmental Policy, (2) Planning, (3) Implementation and Operation, (4) Verification and Corrective Action, and (5) Critical Analysis.

Regarding the configuration of an EMS, Barbieri (2009, p.153) states that, "the conducting of environmental, specific, episodic, and isolated actions does not constitute an EMS in itself, even when they require significant resources [...]".

An important consideration is to understand what led the organisation to the implementation (of an EMS). This helps in understanding the link between EMS and business performance (Darnall, Henriques, & Sadorsky, 2008). Regarding the requirements for the adoption of an EMS, Iraldo, Testa, and Frey (2009, p.1445) mention that, "the planning capacity of a company is crucial for the implementation of an EMS to really be effective".

To ensure efficiency in the performance of an EMS, aiming at increased competitiveness, the successive monitoring of a set of environmental performance indicators is necessary (Campos & Melo, 2008).

Regarding what comprises an environmental policy statement of an organisation, Barbieri (2009, p.170) reports that it states, "general intentions and principles in relation to its overall environmental performance, providing a framework for action and defining its environmental objectives and targets".

2.2.1 Models for evaluating the performance of an EMS
There are several sustainability related performance evaluation models for organisations. Based on the existing literature, the five most cited models were chosen, which reflects their key importance to this study.

2.2.1.1 ISO 14031
The ISO 14031 Standard aims to evaluate the environmental performance (EPE), which is a management tool and an internal process, developed with the aim of providing management with reliable and verifiable information. It employs a continuous basis in order to verify whether the environmental performance of the company complies with the criteria determined by the company's administration (ABNT NBR ISSO 14031, 2004).

An assessment of ISO 14031 clarifies that it includes administrative as well as operational performance indicator models. The grouping of management indicators occurs as follows: implementation of programme policies, compliance, financial performance, and community relations. The grouping of operational indicators is as follows: materials, energy, support services regarding the organisation's operations, facilities and equipment, supply and distribution, products, services provided by the organisation, waste and emissions (Campos & Melo, 2008).

It can be concluded that, in order to measure the environmental performance of the processes of a company, operational indicators are the most appropriate. These can be gathered based on the inputs and outputs of the equipment and the physical facilities of the company (Campos & Melo, 2008).

2.2.1.2 Global Reporting Initiative (GRI)
Regarding the sustainability report entitled the Global Reporting Initiative (GRI), Bortolin, Lemos, Oiko, Rodriguez, & Malheiros (2008, p.8) explain that, "this kind of document should provide a balanced and reasonable description of the sustainability performance of the reporting organisation, including both positive and negative information".

Recognised and implemented worldwide, the GRI model contains approximately one hundred indicators that are constantly adjusted and enhanced. Its main attribute is the ability to adapt to all types, sizes, sectors, and localities of companies. Although there is no single way to prepare a report, its benchmarks serve as a guide for standardisation, since this provides essential checks for measuring the extent of the sustainable progress of organisations (Bortolin *et al*., 2008).

According to Breier, Jung, and Caten (2011), "the definitions used by the GRI are in accordance with other performance measurement models. The indicators proposed by the GRI serve the concept of the triple bottom line, addressing the social, environmental, and economic dimensions".

2.2.1.3 Verein Deutscher Ingenieure (VDI)
The model devised by the Association of German Engineers is intended to provide an objective and effective focus regarding costs in order to correlate sustainable management requirements and business actions (products and services), ensuring the clarity and traceability of the resulting information. The set of guidelines contained in the manual for the sustainability of organisations is intended to generate the information needed for setting objectives and sustainable goals (Breier, Jung, & Caten, 2011).

2.2.1.4 Institution of Chemical Engineers (IChemE)
Prepared by the Association of Chemical Engineers (IChemE), this guide provides sets of indicators that could be used for the measurement of the sustainable performance of a production unit, thereby helping engineers to make progress regarding the environmental, social, and economic efficiency of operations. These sets of indicators are selected by experts and need to be interpreted according to the characteristics of the processes to be analysed. The model enables the output of the process to split up all the measures. The taxes generated are used to relate the measures of impact upon the production units or economic value (Araujo & Oliveira, 2008).

2.2.1.5 World Business Council for Sustainable Development (WBCSD)
The sustainable development model created by the WBCSD can be employed in various organisational sectors and, therefore, represents a flexible approach.

The objective of this model is to assist governments, businesses, individuals, and other organisations to achieve sustainability through the following two factors: economic advancement and respect for the environment. Performance control and the setting of objectives are provided via indicators (Breier, Jung, & Caten, 2011).

According to Bortolin *et al*. (2008, p.187), "the concept of eco-efficiency was developed by the World Business Council for Sustainable Development (WBCSD) and widely recognised by the business world".

This model guides organisations in measuring eco-efficiency based on three indicators that represent the main influences upon business value or the environment: 1) the value of the product or service, 2) environmental influence during the production of the product/service, and 3) environmental influence during the use of the product/service (Bortolin *et al*., 2008).

The WBCSD proposes a model with three levels for the provision of information: categories, aspects, and indicators. This model has similar features to those of ISO 14031 and the GRI. The division of the indicators occurs on two fronts: environment and economy (Breier, Jung, & Caten, 2011).

3. RESEARCH METHODOLOGY

This work is based on the methodological framework proposed by Roesch (2010), which can be represented by project purpose, design, collection techniques, and data analysis.

As Figure 1 illustrates, regarding the purpose, this work is suitable for the research of results assessment. According to Roesch (2010), this type of research aims at evaluating the effectiveness of a programme, policy, or plan. This research was designed to distinguish the environmental indicators used by the Rio Grande companies in that it evaluated the performance results of the EMSs deployed by them. To this end, the project had a predominantly quantitative character in relation to the required research instruments and the subsequent data collection and analysis.

According to Roesch (2010), the quantitative method provides the researcher, using standardised data, the use of summaries, comparisons, and generalisations, based on statistical analysis.

As for the design to be applied, a field survey was selected that, according to Gil (2008), is characterised by the request of information from a particular group of people regarding the problem studied, in order to perform a quantitative analysis and achieve the results and conclusions. As an attempt was made to recognise the environmental indicators used by the Rio Grande companies, the work had a predominantly descriptive character. Regarding the data collection technique, the instrument used was a multiple-choice questionnaire with twenty questions, developed through the 'Google drive' tool and based on the existing literature. This tool provides a basic data tabulation, so it is possible to collect the data practically and quickly.

Regarding the studied sample, the intent was to have a minimum of thirty companies, for convenience. A sample of 44 responses was obtained.

With regard to analysis techniques, descriptive statistical methods of data evaluation were chosen. The Spearman correlation coefficient was calculated to display the relationship between the variables.

4. RESULTS

The data analysis begins by assessing the existence of an environmental policy in companies, where it was found that the vast majority (91%) has at least a reasonable level of commitment towards the guidelines, standards, and tools aimed at this issue, as reported in Figure 2.

With regard to the intervals at which the companies provide environmental training to their employees, 45% indicate that this training is offered very often, 36% claim it is offered infrequently, and only 16% state that their company offers constant training.

Of the available pollution control tools, those used most often include the environmental permit (34%) and the collection of materials/waste separation (32%). Next, 13% companies have pollution control equipment (PCE), 12% rely on control of pollution related to sound/gas/chemical products and/or others, and, finally, 9% employ monitoring of risk areas. It is noteworthy that, regarding this question, each respondent could select more than one alternative, and thus, there were 121 valid responses, with the presented percentages being relative to that total, as in Figure 4.

With regard to cost reduction, another main objective of this research, it was observed that the majority (64%) of the companies indicate that being concerned with environmental policy has resulted in a reasonable cost reduction. On the other hand, 23% claim that there has not been any cost reduction, and 7% report an insignificant reduction.

The analysis of the environmental performance indicators used by the companies reveals that 31% use water as an indicator, followed by materials (25%), emissions (20%), energy (13%), products and services (10%), and suppliers and transportation (2%).

Among the indicators of economic performance, the most often cited was production costs (44%), followed by net income (24%), investments (23%), and capital return (9%).

Finally, among the social performance indicators, the one most often cited was health and safety (47%), followed by training and education (37%), number of employees/trainees (12%), and human rights (3%). Freedom of association was not mentioned even once.

It is noteworthy that in those questions that relate to the indicators, each respondent could select more than one alternative, and thus there were 127 valid responses concerning environmental performance indicators, 88 concerning economic performance, and 91 concerning social performance, with the presented percentages being related to these totals.

Regarding the environmental assessment models used, 59% indicated the Global Reporting Initiative (GRI), followed by ISO 14031 (38%), the Association of Chemical Engineers (IChemE) (2%), and the Association of German Engineers (VDI) (2%). No one mentioned the use of the WBCSD. It is notable that for this question, each respondent could select more than one alternative, so there were 61 valid responses, with the presented percentages being relative to that total, as shown in Figure 9.

The final part of the analysis of the data involves a presentation of the results of the calculation of Spearman's correlation coefficient conducted among the questions chosen for convenience. This coefficient requires the variables that are supposedly correlated to be measured on an ordinal scale. In this way, the correlation is calculated by using positions.

The value of r (correlation) will present a variation of +1 to -1. The value of approximately +1 means that the variables have a strong positive relationship, i.e., they behave in a directly proportional manner; increasing the value of one variable will lead to a corresponding increase in the other variable. If the value found is approximately -1, the variables have a strong negative relationship, i.e., they behave in an inversely proportional manner. Conversely, if the value found is zero, the variables are completely unrelated (Levin and Fox, 2004).

The correlation (r) can be represented by the formula: $$r = \frac{\sum(Ri-\bar{R}).(Si-\bar{S})}{\sqrt{\sum(Ri-\bar{R})^2\sum(Si-\bar{S})^2}}$$

Where, Ri is the position relative to the individual ‘i’ of the first variable. Si is the position relative to the individual ‘i' of the second variable, and

$\bar{R}$ *and* $\bar{S}$ are the average positions of the first and second variables, respectively.

To perform the correlation analysis, questions 3, 4, 8, and 9 of the questionnaire were chosen for convenience.

First, for the Spearman correlation coefficient to be applicable, the variables involved in the analysis had to be quantified so that they could be represented as ordinal variables. Question 3 took the value of 4 for a strong commitment and the value of 1 for the lack of commitment. Question 4 took the value of 4 for a permanent concern and the value of 1 for the lack of concern. Question 8 took the value of 4 for excellent results and the value of 1 for poor results. Question 9 took the value of 4 for a significant reduction of costs and the value of 1 for the lack of cost reduction. Thus, for every question, all these variables could be represented in an ordinal manner, ranging from 1 to 4, with the value of 4 being the closest to satisfactory, and the value of 1 being the farthest from satisfactory.

For the correlation analysis regarding questions Q3 and Q8,

$$r = \frac{1{,}204.50}{\sqrt{(3{,}833.50).(5{,}251.50)}} \qquad r = 0.27$$

This suggests a positive correlation, indicating that the greater the commitment to environmental policy, the better the operating performance of the company.

ISSN: 2047 - 0398
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For the correlation analysis regarding questions Q3 and Q9,

$$r = \frac{1{,}559.00}{\sqrt{(4{,}259.00).(4{,}876.50)}} \qquad r = 0.34$$

A positive correlation is observed, which supposes that the greater the commitment to environmental issues, the greater the reduction of company costs.

For the correlation analysis regarding Questions Q4 and Q8,

$$r = \frac{1{,}012.00}{\sqrt{(3{,}630.00).(4{,}560.00)}} \qquad r = 0.25$$

It is observed that there is a positive correlation, which shows that the greater the concern for the environment, the better the operating results of the company.

For the correlation analysis regarding Questions Q4 and Q9,

$$r = \frac{1{,}243.00}{\sqrt{(4{,}007.22).(4{,}292.00)}} \qquad r = 0.30$$

Finally, it is observed in the analysis that there are two questions with a positive correlation, which shows that the greater the concern for the environment, the greater the reduction of company costs.

While concluding the data analysis, it can be seen that the greater the existence of an environmental policy, the greater the concern with the environment. Similarly, a greater provision of environmental training to employees will result in more significant cost reduction and a better operating performance.

The conclusions are valuable for this study, since they prove that the use of an EMS has a significantly positive impact on the company's operating performance.

5. CONCLUDING REMARKS

This study aimed to conduct a performance analysis of the Environmental Management Systems used by companies in the municipality of Rio Grande, through the recognition of the environmental indicators applied by them. The study has achieved its main objective, concluding that the adoption of an EMS has a positive impact on the operating performance of the companies.

In the introduction, this paper presented an overview of the environmental issues and the central objective of the research. Then, there was a theoretical review of environmental management as well as of the various EMS models. Next, the research methodology was presented, followed by the results obtained. The results indicated the level of commitment of the companies with respect to the environmental policy, training offered to employees, the main pollution control tools used, the maximum applied environmental, economic, and social indicators, the benefits of addressing environmental issues, as well as the evaluation models that were most used. Consequently, a consensus was reached that the adoption of an EMS provides better operating performance for companies.

Regarding the limitations of this study, the data collection phase took place during a complicated period for the companies (the end of the year), which resulted in impeding the collection of this data. Another challenge was the period of stagnation in the business as of January 2014. Further constraints included the difficulty faced in contacting the businesses and the limited time available for a deeper analysis of the data. The reliability of the data due to the companies not being identified can be seen as another limitation. Finally, the application of statistical techniques was not as extensive as it could have been.

In summary, this research provides a database that can be useful for future studies on the subject. This will help retain the focus on sustainability in upcoming research.

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Figures and Tables

METHODOLOGICAL STRUCTURE				
Purpose	**Character**	**Design**	**Collection Techniques**	**Analysis Techniques**
		Field Experiment	Interview	
			Questionnaire	
Applied Research	**Quantitative**	**Descriptive Research**	Observation	**Statistical Methods**
			Tests	
Evaluation of the Results		Exploratory Research	Indices and Reports	
			In-Depth Interview	
Formative Evaluation		Case Study	Use of Diaries	Content Analysis
			Participant Observation	
Research – diagnostic	Qualitative	Research – action	Group Interview	Theory Construction
			Documents	
Plan Proposition		Participant Research	Projective Techniques	Discourse Analysis
			Life Stories	

Figure 1 – Methodological structure of research
Source: Adapted from Roesch (2010)

Existence of an environmental policy in the companies

	N	%
There is a strong commitment to guidelines, standards, and tools aimed at environmental issues.	22	50%
There is a reasonable commitment to guidelines, standards, and tools aimed at environmental issues.	18	41%
There is little commitment to guidelines, standards, and tools aimed at environmental issues.	2	4%
There is no commitment to environmental policy.	2	5%
Total	44	100%

Figure 2 - Existence of an environmental policy in the companies
Source: Prepared by the author

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SPECIAL ISSUE – V|4|N|5|, January | 2015

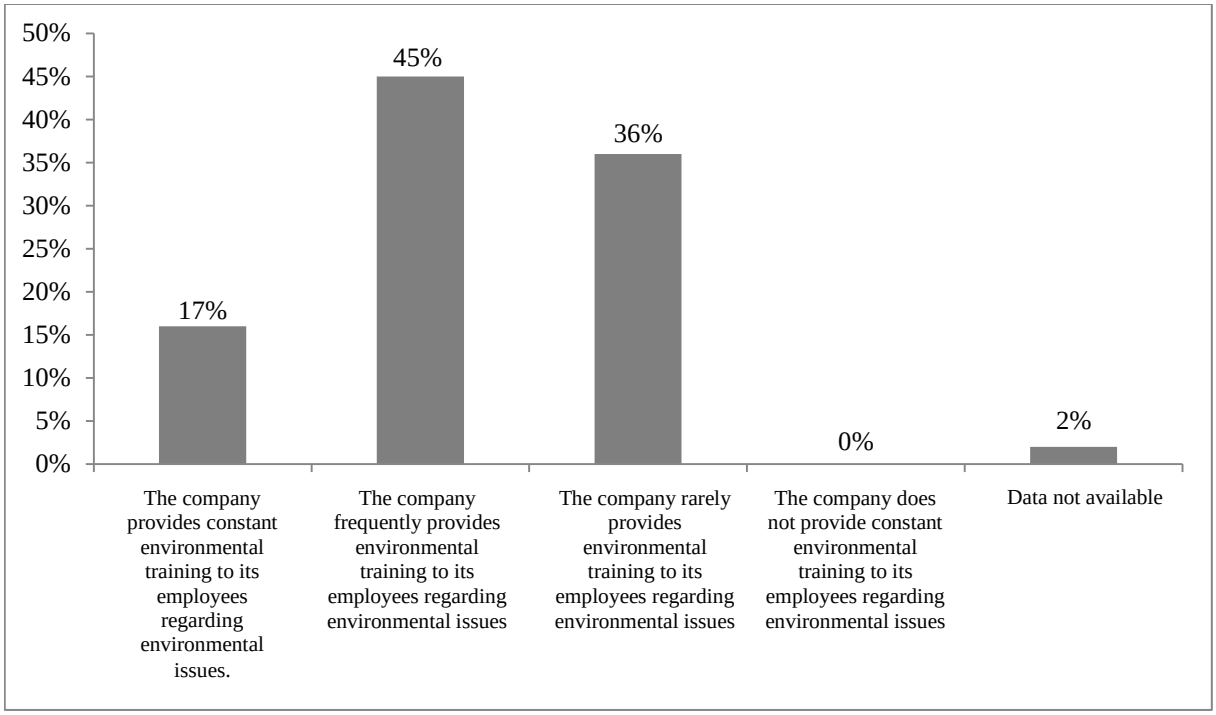

Figure 3 - Frequency with which the companies offers training to their employees
Source: Prepared by the author

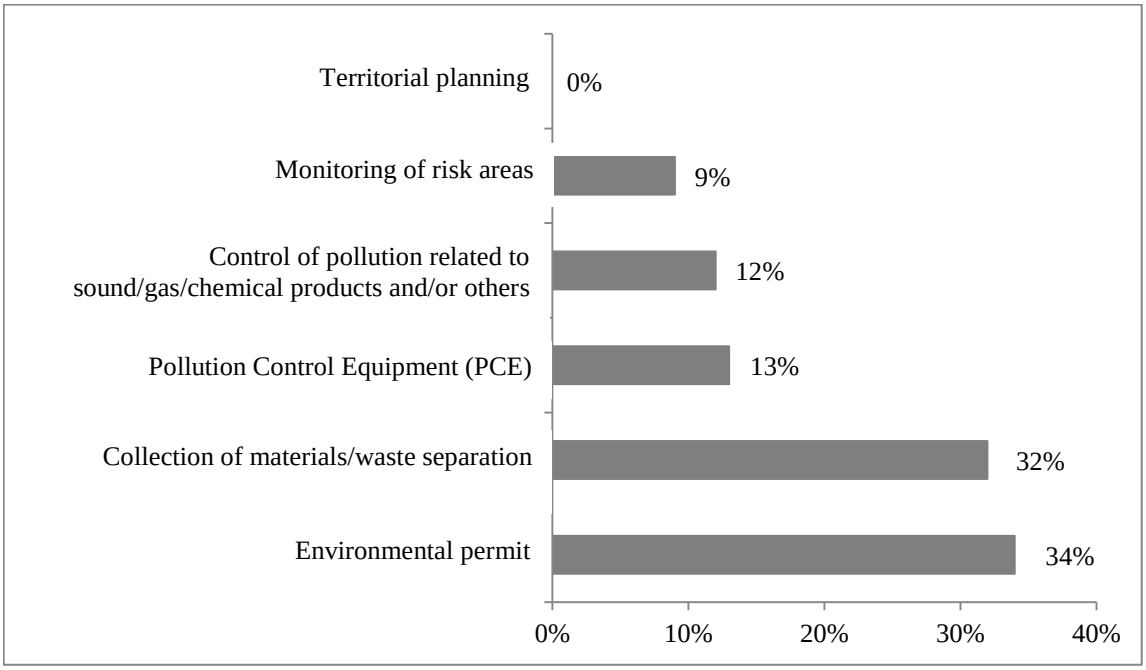

Figure 4 - Pollution control tools
Source: Prepared by the author

ISSN: 2047 - 0398
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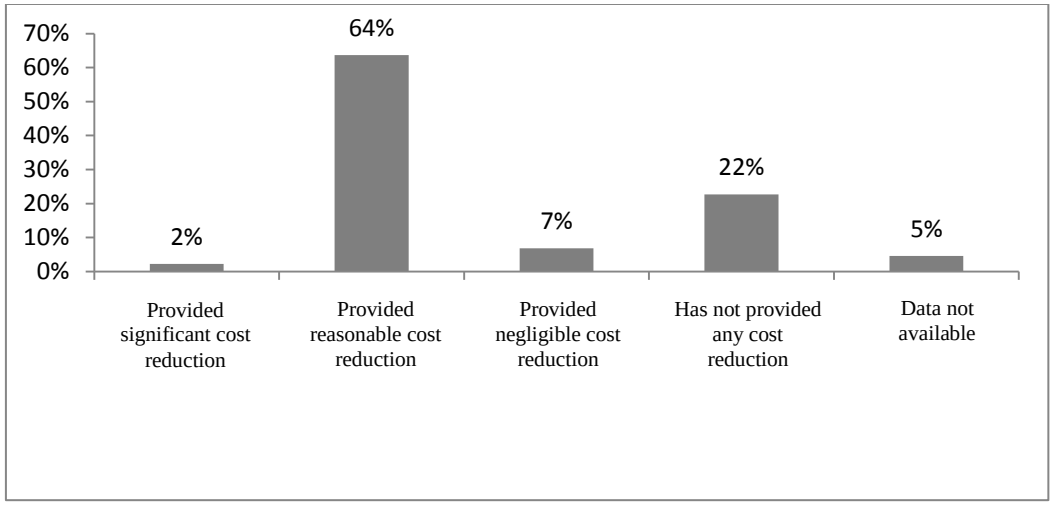

Figure 5 - Cost reduction
Source: Prepared by the author

'Environmental performance' indicators used by the companies

	N	%
Water	39	31%
Materials	32	25%
Emissions	25	20%
Energy	16	13%
Products and Services	13	10%
Suppliers and Transportation	2	1%
Total	127	100%

Figure 6 - Environmental performance indicators used
Source: Prepared by the author

'Economic' performance indicators used by the companies

	N	%
Production Costs	39	44%
Net Income	21	24%
Investments	20	23%
Capital Return	8	9%
Total	88	100%

Figure 7 - Economic performance indicators used
Source: Prepared by the author

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SPECIAL ISSUE – V|4|N|5|, January | 2015

'Social' performance indicators used by the companies

	N	%
Health and Safety	43	47%
Training and Education	34	37%
Number of Employees/Trainees	11	13%
Human Rights	3	3%
Freedom of Association	0	0%
Total	91	100%

Figure 8 - Social performance indicators used
Source: Prepared by the author

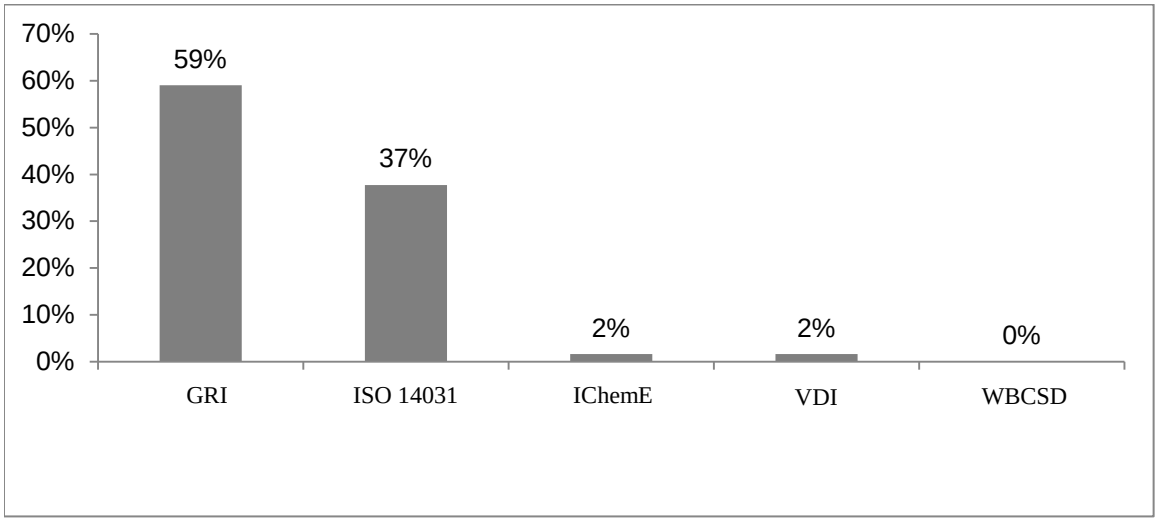

Figure 9 - Models of environmental assessment used
Source: Prepared by the author