

# INDUSTRIES FROM THE INDUSTRIAL HUB CUBATÃO: ANALYSIS OF THE METHODS ENVIRONMENTAL MANAGERS APPLY WITH REGARD TO INTERNAL CONTROL AND ENVIRONMENTAL RISK MANAGEMENT PRACTICES

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**Abstract:** The discussions about the frantic growth have motivated governmental actions to create laws and regulations aimed at curtailing the neglect of nature. That is the context for the city of Cubatão – State of São Paulo - Brazil, which used to be a landmark of economic growth, but led the region to environmental degradation. The industries located there were under external pressure to adapt, leading to an environmental management process that involves internal controls and risk management. Over the years, this process helped Cubatão receive, in 1992, from the United Nations (UN), the title of symbol of ecology and environmental recovery. Environmental risk management and internal control operation mechanisms and strategies were analyzed in four plants installed in the region before the 1990s, and which helped in the city's recovery process. The environmental managers from those companies were interviewed. Content analysis, based on constructs obtained in the theory, was used to analyze the data collected in the interviews, to assess the internal control and environmental risk management practices. We found that the strategies to implement internal control and risk management programs were specific; however, the companies used similar processes to detect, mitigate and measure risks, in light of their particularities. An analysis model of these practices was developed, which can be replicated or improved in further research.

**Keywords:** Internal Controls, Risk Management; Environmental Management.

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## 1. INTRODUCTION

Concerns about the environmental degradation started to appear based on scattered protest group, representing a powerful social movement in the second half of the 20th century, which tends to mold the key elements of the markets and industries in the 21st century (Elkington, 1997). In this context of neglect of the environmental degradation, reports and conferences on the environment started being disseminated, alerting society about the evils of disorganized growth. The Club of Rome stood out, and, in 1972, published a report entitled *The limits to growth*, in which it demonstrated, through mathematical projections, the population growth, the pollution and the exhaustion of the natural resources on Earth (Kraemer & Tinoco, 2004).

Besides these evils, environmental catastrophes are highlighted, like what happened in the facilities of the multinational Union Carbide in Bhopal, India in 1984, when an accidental leakage of methyl isocyanate gas killed more than three thousand people and left more than 35 thousand victims of chronic illnesses (Kraemer & Tinoco, 2004). Thus, mainly as from the 1990's, great ecological evolution took place, which integrated the expression "environmental quality" in the daily lives of people and companies (Kraemer & Tinoco, 2004).

Research by Pablo, Sharma and Vredenburg (1999), Miles and Covin (2000), Gilley (2000) in different industrial sectors demonstrated distinct ways in which companies respond to environmental demands. These include the elaboration, in 1991, of international environmental protection standard ISO 14001, whose objective, according to Valle (1995), is to create an environmental management system (EMS) that helps companies comply with their environmental responsibilities.

In developing these systems, management needs to guarantee forms of environmental risk control and management, as verified in the research by Ferreira (2007) in organizations established in the city of Cubatão. The study identified that the beginning of the environmental management process made companies elaborate management programs to put internal control and environmental risk management techniques in practice.

Hence, considering the city of Cubatão as an example of environmental recovery, which used to be called the city of death (Ferreira, 2007) and then became considered a symbol of ecology and environmental recovery, according to a title awarded by the United Nations Organization (UN) in 1992, besides the need, according to Ferreira (2007), to develop control and environmental risk management for the organizations to achieve their targets and proposed objectives, the problem this research intends to answer is: What are the methods a group of companies from the industrial hub Cubatão apply in internal control and environmental risk management practices?

The central objective is to identify and analyze the methods and perceptions of internal control and environmental risk management practices adopted by the managers from four companies in the industrial hub Cubatão. The specific objectives are to identify, describe and analyze the phases involved in the internal control and environmental risk management process, besides the perceptions on these processes, including top management.

Actions to solve environmental issues in the city began in 1983, with the Environmental Pollution Control Program in Cubatão, managed by the São Paulo State Environmental Agency (CETESB) (FERREIRA, 2007). Since 1992, the UN has considered Cubatão a city that is the symbol of ecology and environmental

recovery (ONU, 1992). Data from CETESB (1994) reveals various recovery aspects. The research allows us to analyze environmental strategies and environmental risk management and internal control operation mechanisms in two plants (chemical and petroleum coke producer-calciner), established before, and two more (metal and fertilizer producer-service provider), established after the Program managed by CETESB.

It is the possibility to prepare and apply a study model of internal control practices and environmental risk management of organizations. The model can be improved in future studies, whose results can be compared to those obtained herein. We intend to emphasize the importance of the internal controls and the environmental risk management of the four companies that are subject matter of this research.

The mechanisms created for the internal control and environmental risk management operations of the two companies established in 1966 and 1975 were analyzed, before the Environmental Pollution Control program developed by CETESB in 1983, which is relevant in the city's recovery process. In addition, the analysis also considered two other large corporations located in the city of Cubatão.

The article has four sessions. The first one describes the context, research question, objectives pursued, justifications and contributions. The second one describes the theoretical platform, with three themes relevant to the research: environmental management; concept of risk, reaching environmental risk and; concept of control, contemplating internal control as an instrument for managing environmental risks. The third one presents the various stages of the research method. The fourth section presents and discusses the findings. Final considerations and references complete the work.

## 2 THEORETICAL PLATFORM

### 2.1 ENVIRONMENTAL MANAGEMENT

The economic, social and political issues that marked the last decades of the 20th century, including the liberalization of trade and privatizations, are responsible for the evolution of environmental management. These processes enhanced the companies' power in these decades, but influenced the change in society's attitude, which started to require accountability for this excess power, mainly through the development of the sustainability concept, which broke paradigms, including that of power concentration.

Tachizawa (2011) explains that the evolution process of environmental management was born from this direction of power to society, in response to the requirements of the new ecologically correct client. The author alerts that organizations that fail to make strategic decisions integrated into the environmental and ecological issue will lose competitive advantage.

Nilsson (1998) defines this concept as analogue to quality management, in which the company, through guiding planning, aims to achieve preset environmental targets. One characteristic of this management is the top level's participation in decision making, which will send clear messages on the entire corporation's involvement in the project.

Anderson (1999) explains that organizations can develop their own environmental management systems or certify them based on national or international standards, including Commonwealth's BS 7750, the European Community's standards, in addition to the regulations of EMA and ISO 14001. Trevizan (2002) emphasizes that, in many circumstances, internal standards without proper certifications are insufficient to exempt the organization from environmental problems.

This fact led to the need for exemption in the creation and implementation of this kind of standards. Then, an independent and external assessment became required to certify the environmental standards the companies use. In Brazil, companies accredited by Inmetro and apt for this action started to engage in certification (Trevizan, 2002).

According to ABNT (1997), "The essential objective of the International Environmental Management Standards is to provide organizations with the elements of an effective environmental management system, which can be integrated with other management requisites" (p. 2), which helps them to achieve the environmental and economic objectives.

The perception of relevance of use of control techniques was investigated by Kowalski, Fernandes and Faria (2010), who analyzed the importance of internal controls for electric energy Santa Catarina Cooperatives, in which the most important items were education for employees, compliance with legal requirements, followed by controls on fines and environmental damages. In studies conducted with US companies in various industries, Hunt and Auster (1995) found that the environmental department of proactive companies has determined, motivated, high-level people with a concept of environmental management that goes beyond the idea of policing and of pollution prevention. Since the construction of its first plant in Wolfsburg, Germany, in 1938, Volkswagen has considered environmental aspects through the use of production processes based on reduction of water use and recycling, due to the scarcity in the region near the factory (Welford, 1994).

There are companies that take a proactive attitude towards the environment. They continuously seek to better train themselves to meet environmental challenges and promote environmental protection and responsibility, externally and in their organizational structures, to ensure that businesses are successful economically and commercially.

One standard, highlighted by Anderson (1999), is ISO 14001, whose objective is to detail the requisites of an environmental management system, allow companies to prepare and put in practice a policy that takes into account the legal requirements and any others they define, and affect the environmental aspects.

Another characteristic of the ISO 14001 standard is the continuous improvement concept, which stimulates the improvement of the environmental management system, even after its implementation (Valle, 1995). Epstein and Roy (2001) emphasize that ISO 14001 can contribute to organizational learning, developing the environmental managers' capacities, skills and knowledge.

## 2.2 RISK CONCEPT

The risk concept is comprehensive, has been used in several knowledge areas and is interpreted in the context of its assessment. Assaf Neto (2007) supports this interpretation, mentioning that the risk considers the context of the person who interprets it. Hence, for a travel insurance broker, the risk can be a plane accident while, for an entrepreneur, it can be the failure of the business. In general, the term risk is associated with potential, sustainability, vulnerability or damage (Dagnino & Carpi Junior, 2007). Assaf Neto (2007) asserts that risk is the "[...] capacity to measure the state of uncertainty of a decision through knowledge about the probabilities associated with the occurrence of certain outcomes or values" (p. 215).

Another important aspect in the study of risk is to establish its distinction from the uncertainty concept. Sandroni (1996) explains that the risk is based on the assumption that, when analyzing a set

of actions, the stakeholders know the possible outcomes and their probabilities. When the expectations are unknown, this represents uncertainty.

### 2.2.1 Environmental Risk Management

Concern exists with the increasing environmental stress the Earth is subject to (World Economic Forum, 2013). For organizations, involvement in this process is based on the management of environmental risks, which, according to Anderson (1999), is going through the regulatory phase, in order to become a full part of the business and the strategic management. Sanches (2000) explains that top management's involvement is fundamental for the company's initiatives with regard to the environment and that, after this commitment, the next phase would be action, integrating all hierarchical levels of the organization.

Teets et al. (1994) highlight that management of environmental issues should reach the entire organization, ranging from the president to the final employee, including the risk manager. For the author, the key to cope with this demand is the ability to identify, analyze and establish policies, practices and preventive procedures.

Dagnino and Carpi Junior (2007) consider that the environmental risk is a synthetic term that shelters others, as it implies the environment in a broad sense, including both the natural environment and that constructed by man (social and technological). According to Veyret and Meschinet de Richemond (2007), environmental risks "[...] result from the association between the natural risks and the risks deriving from natural processes, aggravated by human activity and by the occupation of the territory" (p. 63).

Nossa (2002) asserts that one problem in this process is the environmental risk assessment. Fariman, Mead and Willians (2001) argue that the problem is due to the involvement of beliefs, judgments, attitudes and feelings, besides social and cultural values in the assessment and judgment of risks.

According to Teets et al. (1994), the environmental risk assessments do not differ from the experiences and technical knowledge the professional risk managers use in their daily work. The Committee of Sponsoring Organization of the Treadway Commission – COSO (2004) prescribes that, to identify risks, it is relevant to know about the external and internal events that affect the organization. These events "[...] are incidents or events originating in external or internal sources that affect the implementation of the strategy or the achievement of the objectives" (Committee of Sponsoring Organization of the Treadway Commission, 2004, p. 4). External events can be economic, political, technological, social and environmental aspects. Internal events include infrastructure, staff, process and technology.

These events can be identified through a combination of techniques with support tools. Management can use intergroup seminars as a way to exchange information and knowledge, based on support tools like software, in order to advise participants (Committee of Sponsoring Organization of the Treadway Commission, 2004).

When assessing the possible events, companies can measure the extent to which they influence their strategies and objectives. Based on these assessments, management will start identifying and assessing the risks, taking into account expected and unexpected events, its appetite for risk, its size, complexity of its operations and the level of regulation of its activity (Committee of Sponsoring Organization of the Treadway Commission, 2004).

Teets et al. (1994) report that, to start identifying the risk, one needs to know the environmental laws required to perform the activities; in addition, an audit process is needed to assess the environmental

risks associated with the workplaces. In the identification of the environmental risks, Anderson (1999) suggests the use of flow charts, questionnaires, records of past losses, financial statements, among others.

Moura (2000) defends that, in identifying and measuring the risk levels, their impact and the probability that the fact will occur should be considered. Thus, one tool is the application of the risk matrix prepared by Moura (2000), defined by Paul, Fernandes, Rodrigues and Edit (2007) as “[...] a tool that can be employed in the risk analysis of different kinds of processes” (p. 50). According to Berganini Junior (2005), when establishing the tabulation process of risks in a matrix, the organization can gain a clear and structured perception of the events that can affect it in terms of frequency and severity.

The COSO (2004) presents important issues that should be taken into account in the identification of risks. In that sense, the time horizon used to assess the risks should be consistent with the related objectives and strategies. Hence, the organization will not ignore risks inherent in the process, which can occur over long periods of time.

The data collected for the study should be investigated within the organization's history, so as to provide a more objective base than subjective projections. Nevertheless, although internally collected data is more insightful, external data serves as the base to improve the analysis.

The COSO (2004) highlights the problem inherent in the administrators' judgment. As a subjective analysis of the risk perspectives, managers should acknowledge the limitations of the process. One way to reduce the impact of the subjectivity is the internal and external empirical data collection, which will grant greater credibility to the judgments.

Ehrentreich (2009) reports that, after the preparing the risk analyses, an action plan is needed. According to the COSO (2004), that is the phase of “response to the risks”, as it establishes the way the organization will deal with them. Through this response, the organization needs to assess, in case of their occurrence, the impacts, costs and benefits.

The final process, presented by Moeller (2007), is risk monitoring. Ehrentreich (2009) adds that these actions are related to the risk control, which the companies adopt to maintain their risk profile below the desired limit of tolerance. According to the author, in this phase, it is fundamental that companies can compare their current risks with the established tolerance. Hence, the organization can decide what action should be taken, which can involve the transfer of some risks or even their maintenance, in case the cost is higher than the benefit.

One important aspect of corporate risk management is its increasing modification. According to the COSO (2004), “[...] the responses to risk that were effective in the past can become innocuous; and, consequently, the control activities lose their efficacy” (p. 83). The COSO (2004) reports that these changes can be caused by changes in the organizational structure, the arrival of new managers, or process changes.

## 2.3 CONTROL CONCEPT

When analyzing the etymological meaning of control, the term refers to the idea of supervision of activities, in order to avoid possible deviations from the established standards. Control is a human act that assumes the knowledge of how people conduct certain activities, thus establishing, when possible, the desirable patterns of behavior (Peleias, Caetano, Parisi & Pereira, 2013).

As regards its historical meaning, the term control seems to have been used for many centuries. It was at the beginning of the 20th century though that it gained notoriety, mainly through the work of authors like Taylor (1906) and Fayol (1916) (Gomes & Salas, 1997).

In the historical perspective, it is inferred that control is an instrument to measure outcomes and performance. Koontz and O'Donnel (1974) highlight that the term "[...]" implies the verification of the performance in relation to a standard, and the correction of deviations in order to guarantee the achievement of objectives as planned" (p. 221). According to Welsch (1983), control is "[...]" the action needed to verify whether the objectives, plans, policies and standards are being complied with" (p. 41).

### 2.3.1 Internal Controls as a Risk Management Instrument

The term internal control gained new proportions at the end of the 1980's and early 1990's, due to the financial scandals, culminating in the cases of Enron and WorldCom. Thus, an intense corporate governance movement started in the United States and the United Kingdom, in order to demonstrate the need for new management practices, aiming to guarantee greater transparency and credibility to the market (Dias Filho, Martin & Santos, 2004).

Ehrentreich (2009) emphasizes the financial scandals in relation to the establishment of the COSO, comprising several US entities, which aimed to guide the organizations on their internal control systems and on risk management. In 1992, the CCOSO issued a report called *Internal control – Integrated structure*, defining internal control as:

A process through which the Board of Directors, the management and/or other employees gain reasonable assurance of the compliance with the objectives specified. It consists of nine components, interrelated with integrity, ethical values, competency and control environment, serving as the base for other components, which are: set objectives, assess risks, information systems, control procedures, communication, change management and monitoring. ( p. 1).

In 2004, the COSO II, which Ehrentreich (2009) considered as an evolution of the COSO, published a document entitled *Enterprise Risk Management – Integrated Framework*, which is focused on risk management. This new publication revised and expanded the earlier document, but did not revoke it, according to the COSO's publication (2004):

This Enterprise Risk Management – Integrated Framework expands the internal control, providing a more robust and comprehensive view of the broad topic involving the risk management of environments. This new conception does not intend to and does not replace the internal control structure, but incorporates it and allows the companies to apply this new business risk management structure to satisfy both its internal control needs and expand the risk management processes.

In the new structure, the strategy related to the high-level objectives was added, aligned with the company's mission. The COSO I established five interrelated components for the structure of the internal control system: control environment, risk assessment, control activities, information and communication and monitoring. In the new document, the component "control environment" was replaced by "internal environment" and three further components were created, as demonstrated in Figure 1.

FIGURE 1: INTERNAL CONTROL COMPONENTS ACCORDING TO COSO II

Component	Description
1. Internal environment	It is the essence of the organization and influences the other control components. The factors associated with the environment are: integrity, ethical values, management style, administrative philosophy, among others.
2. Establishment of objectives	Objectives should be previously defined and aligned with the organization's mission, so that inherent risks are consistent with the organization's guidelines.
3. Identification of events	Identification of internal and external events affecting the organization's objectives; a distinction should be made between risks and opportunities.
4. Risk assessment	Identification of the risks that can influence the achievement of the objectives, constituting the base for their management.
5. Response to risks	Actions should be elaborated and taken in accordance with the identified risks, in line with the organization's risk tolerance limits.
6. Control activities	Policies and control that help to guarantee the achievement of objectives, taking into account the associated risks. It happens at all levels and functions and includes approvals, authorizations, verifications, among other activities.
7. Information and communication	Relevant information should be captured, identified and disseminated to all members responsible for the internal controls. This component also includes dissemination to external groups, such as clients, suppliers and stockholders, among others.
8. Monitoring	Includes the assessment of the company as a whole, in which deficient internal controls should be informed to top management.

Source: Adapted from Trapp (2009, p. 133).

According to COSO II (2004), the objectives and components are interrelated. In line with Imoniana and Nohara (2005), the three most studied bases in the organizations are: control environment, control procedure and monitoring and, less highlighted: information and communication systems. Bogoni (2008) considers that the control environment identifies the company's philosophy with regard to internal controls, risk management, integrity and ethical values.

Imoniana and Nohara (2005) indicate two control and monitoring activities: prevention or detection. Prevention control involves impeding errors or anomalies in the course of the process, and is more efficient and less costly than detection, because it avoids errors and, consequently, expenses to correct them. On the other hand, error detection control is more expensive, as the error is detected while processing the data, but is essential, as it measures the efficiency of preventive control (Migliavacca, 2004).

Control activities should be implemented in a weighted, conscious and consistent manner in the organizations, avoiding their mechanical establishment, without focusing on the actual problems and motives that led to their implementation. After the implementation, monitoring to verify the efficacy of the control is fundamental. Controls can be considered appropriate when their eight elements, according to the COSO II, are functioning as planned (Imoniana & Nohara, 2005).

The final element the authors highlight is communication and information, which is fundamental for the proper functioning of control. In this transmission process, it is relevant to establish insightful data to assess the reliability of information, besides appropriate and timely communication to the correct people.

In the implementation of control systems, the indicators also deserve analysis. These represent information on the evolution indices of each unit in a synthetic and integrated form, referring to the internal situation or external variables (Gomes & Salas, 1997).

Despite their advantages, internal controls come with limitations, as they can offer but reasonable assurance to managers and Board of Directors on the achievement of the organizational objectives (Boynton, Johnson & Kell, 2002). One way to avoid errors is to guarantee the efficient implementation of control systems (Barragan, 2005). According to the author, one way is to permit an adaptation of the process, in which employees and collaborators of the organization are responsible for the system.



### 2.3.2 Internal Environmental Control

As regards the environmental internal control practices inside organizations, Teets et al. (1994) highlight the controls to prevent pollution, treat, store and allocate toxic materials, internal or external audits and emergency planning for any eventuality, mainly for those that can jeopardize the company.

Anderson (1999) highlights that, among the practices adopted to prevent environmental risks, waste control is a profitable fundamental component for environmental management. This is because, when a harmful substance contaminates the air or hydric resources, its recovery becomes difficult and expensive. Brilhante (1999) highlights that its effects can be chronic and acute, demanding continuous action over the years.

The habits the companies adopt to undertake and disseminate environmental practices, such as pollution control targets and the adoption of internal control standards to monitor the environmental risks, are known as acts of self-regulation (Sanches, 2000). These new practices mark a change in the businessperson's participation context, in terms of awareness and environmental responsibilities.

According to Sanches (2000), this proactive posture the companies demonstrate is evidenced through the incorporation of factors linked to the environment in their targets and strategies, considering the environmental risks and impacts in their processes and products. One example of an environmental program applied with a product focus is the Design for the Environment (DEF). In line with Hart (1997), this program allows companies to analyze the product's full effects on the environment during the creation phase, besides examining how clients dispose of the product.

Another fundamental component according to Anderson (1999) is disaster planning. North (1997) emphasizes this concern by explaining two problems the industries face: the fear of explosion of chemical products and of workplace accidents. To avoid these risks, many companies perform audits in their facilities every 18 months. In cases of average risk, the inspections take place every three years and, in case of low risk, on average every five or six years.

The operational control based on the implementation of the environmental management system and its further certification in line with standard ISO 14001 is presented in Figure 2.

FIGURE 2: OPERATIONAL CONTROL BASED ON ISO 14001

Steps for the operational control (ISO 14001)	Orientations
Identification of needs	To accomplish this task, the organization needs to consider all of its activities, including management functions, such as sales, research and development, and the routine operations in the process. A careful analysis is needed of how suppliers or service providers affect its environmental management capacity.
Establishment of controls	Controls can take different forms: procedures, instructions, physical control or any combination of the former. It is important to choose the appropriate method, which depends on a number of factors: people's skill and complexity and environmental significance of the operation. Provisions are needed to measure and assess controls.
Preparation and response to emergencies	The organization should implement detailed procedures to identify potential emergency situations and accidents that cause environmental impacts as well as mitigation actions. To execute these programs, the organization should consider, among others, the nature of the local risk, the actions required to minimize environmental damage, staff training, internal and external communication plans and periodical tests.
Monitoring and measuring	The organization should have a systematic approach to regularly and effectively measure and monitor its environmental performance. These measures involve information collection, which can be qualitative and quantitative.
Assessment in compliance with legal requisites	It is important to assess the organization's compliance with the legal requisites applicable to its environmental aspects. Several processes can be used: audits, inspections of facilities, project analyses, interviews and direct observation, among others. The organization should establish a frequency and method that suit its size, type and complexity.
Corrective and preventive actions	After identifying the cause of non-compliance, it should be investigated, so that the corrective action is applied at the appropriate place. By treating non-compliance, this plan should consider actions to mitigate it, changes for its correction and the preventive actions to block the relapse of the problem. In case of problems in which non-compliance is not identified, a preventive action is recommended.
Control of registers	Registers are important because they show the ongoing operation and the results of the environmental management system, making its control essential. The key characteristics involved as the means of identification, collection, indexation, filing, storage, maintenance, recovery and retention.

Critical analysis of environmental management system	The organizations should determine intervals to analyze the environmental management system and assess its relevance, appropriateness and efficacy. The analysis should include the activities, products and services within the scope of the system. The data that can be used as inputs are the stakeholders' communications, the environmental performance, the achievement of targets and objectives, the situations of corrective and preventive actions, among others.
Opportunity for improvement	Continuous improvement is a key attribute of environmental management. The environmental management processes should be subject to continuous assessment, in order to identify options for improvement. Some examples of improvement include: establishing processes to assess materials, improving identification of applicable legal requisites, improving training, redesigning distribution networks, reducing particle emissions, among others.

Source: Adapted from Brazilian Association of Technical Standards (ABNT) (2004, p. 29).

### 3 METHOD

The research is descriptive, qualitative and exploratory. In the field research, for the data collection. The four companies surveyed were invited to participate in the survey through the manager of CETESB, Cubatão Agency, and one of the authors working at CETESB. The parameter used to select companies was the indication of those that, according to CETESB, adopt internal control practices and environmental risk management in their operations.

The first company that showed interest in participating was the coke production and calcining industry, in which, in addition to the interview, there was a visit inside the factory. The interview with the accounting representative was held on a different date at the São Paulo office.

The second visit happened in a chemical industry. On the day of the interview, it was found that the room of the manager in charge is located inside the factory, where it was not possible to make the recordings. Thus, the interview took place in another location of the industrial plant. Information on the accounting area was provided the same day by the environmental manager.

In the steel industry, scheduling was fast. However, the interview did not occur with the environmental manager indicated by the manager of CETESB. As for the accounting area, the interview was conducted through a video conference, after contacts with the accounting manager in Belo Horizonte and through a co-author of the work. The conference took place the same day of the visit.

The company that took the most time to make the appointment was logistic service provider. The interviews were carried out in two phases: the first, with the environmental manager indicated, and the second, with an employee from the area who described the entire environmental system. In relation to the accounting area, the company was unable to provide information on the day.

All the interviews were recorded, transcribed and sent to the interviewees for validation. In continuity, they were analyzed using the content analysis technique.

The semi-open interview technique was used. The content analysis technique (Bardin, 2004, p. 40) was applied. Ferreira (2000) highlights that the content analysis is used when one wants to go beyond the meanings, beyond the simple reading of what is real. It applies to what is said in interviews or testimonies or written in newspapers, books, texts or pamphlets, as well as the image of movies, drawings, paintings, posters, television and all non-verbal communication: gestures, postures, behaviors and other cultural expressions.

For the application of this analysis, the theoretical concepts studied were explored and related to the real world, based on observable phenomena and collected data. The objective was to create constructs that represent an empirically robust form of the previously defined theoretical concepts (Martins, 2005). The theoretical concepts explored were divided in two groups, based on the general and specific objectives: environmental internal controls and environmental risks.

After establishing the constructs, different categories were defined that identified the actual values, true goals, methods, among other characteristics of the collected information. The intent was to infer

on the true understanding and effective application of the companies studied about the presented theoretical concepts. Figure 3 was prepared, showing the constructs used as the base to categorize the data surveyed in the interviews and documents collected at the organizations.

FIGURE 3: CONSTRUCTS ORDERED BY VARIABLES, REFERENCES AND QUESTIONS FOR THE INTERVIEW SCRIPT

Constructs / Dimension	Variables Analyzed	References	Question
Factors involving the environmental risk management practices	1 – Internal and external vulnerabilities	Committee of Sponsoring Organization of the Treadway Commission (2004) and Associação Brasileira de Normas Técnicas (2004)	7
	2 – Identification and measuring	Teets et al. (1994); Anderson(1999); Moura(2000); Berganini Junior(2005)	8
	3 – Acceptance, mitigation, sharing or rejection of environmental risk	Committee of Sponsoring Organization of the Treadway Commission (2004) and Teets et al. (1994)	9
	4 – Action and monitoring plans	Ehrentreich(2009) and Committee of Sponsoring Organization of the Treadway Commission (2004)	10
	5 – Perceptions of top management	Teets et al. (1994); Sanches (2000) e Tinoco e Kraemer (2011)	11
Factors involving the internal control practices	1 – Main environmental controls practiced	Anderson(1999) and Brilhante(1999)	12
	2 – Application in corporate activities	Imoniana & Nohara (2005); Associação Brasileira de Normas Técnicas (2004); Barragan (2005)	13
	3 – Forms of registers and storage	Associação Brasileira de Normas Técnicas (2004)	14
	4 – Forms of assessment and attitudes towards deviations	Associação Brasileira de Normas Técnicas (2004) and Barragn (2005)	15
	5 – Critical perceptions	Boynton, Johnson and Kell (2002); Ehrentreich (2009); Associação Brasileira de Normas Técnicas (2004) and Gomes and Salas (1997)	16

The questions presented in topic 4 were structured based on Figure 3.

## 4 PRESENTATION AND DISCUSSION OF RESULTS

The initial analysis considered the company and the interviewees’ general data, based on the two constructs elaborated. The interview excerpts do not indicate the interviewees and companies. For ethical reasons, preservation of interviewees and organizations’ identity was guaranteed.

The companies were classified per activity area: one calcination industry, one Iron and Steel Industry, one chemical industry and one logistic service provider. The interviewees were classified according to their roles in the companies: one coordinator, three environmental specialists and one environmental control leader. The results are limited to the data of the managers who contributed to this research.

### 4.1 Description and Analysis of the Interviews

The first two questions identified the companies’ respondents. Questions were asked about the ages, professional backgrounds and initial and current roles in the organizations. The subsequent questions identified the companies’ characteristics. Questions were asked about the origin of the capital, activity, revenues and the number of employees.

Figures 4 and 5 display the companies and employees’ characteristics.

FIGURE 4: CHARACTERISTICS OF INTERVIEWEES

Company	Age	Professional Background	Initial Function	Current Function
Calcination Industry	61	Business Administrator	Head of Supplies Department	Area Coordinator of Quality, Safety, Environment and Health
Iron and Steel Industry	48	Chemical Engineer	Analyst	Environmental Specialist
Logistic Service	50	Chemical Engineer	Junior Process Engineer	Environmental Specialist
	35	Business Administrator	Administrative Aid Occupational Safety	Semi-senior Environmental Analyst.
Chemical Industry	49	Chemical Engineer	Process Engineer	Environmental Control Leader

FIGURE 5: CHARACTERISTICS OF ORGANIZATIONS

Company	Origin	Activity	Revenues (R\$)	Employees
Calcination Industry	50% - Brazilian and 50% International	Production and Calcination of Petcoke	500 million per year	127 employees and about 200 collaborators
Iron and Steel Industry	Brazilian	Steel Production	10 to 15 billion per year	5300 employees and 6 to 7 thousand collaborators
Logistic Service	Brazilian	Integrated Logistics Services	Not informed	6 thousand employees
Chemical Industry	Brazilian	Chemistry	600 to 700 million per year	430 employees

## 4.2 Blocks of questions about Environmental Risk management practices

Question 7 asked about internal and external factors influencing the environmental risk strategies.

FIGURE 6: ANSWERS TO QUESTION 7

No.	Selected Statement
1	"The company is located in a hub, although my product is inert, not causing damage to health, but because it is located in a hub I can be affected by companies in the region."
2	"The events normally result either from the new legal requisites, new legislation that is being issued, some more restrictive standards, some different governmental orientation..."
3	"For some types of service here at the company, suppliers even go through qualification processes, so, to hire certain services, the company has qualification criteria..."
4	"The company uses the Hazop method – fault tree, besides the preparation of worksheets with aspects and impacts and hazards and risks."

The interviewees' statements allowed us to identify that the factors that affect the implementation strategies of environmental risk management programs are company-specific and relate to the main theoretical concerns analyzed. In the calcination industry, there is a concern with geographic location within an industrial hub, presenting factors such as leaks and fires that may be caused by other industries and compromise their environmental strategies. According to COSO (2004), before identifying risks, it is essential to know internal and external events that may compromise the organization.

At the Iron and Steel Industry, events that affect its environmental strategies refer to the legal requirements, according to the specialist's statements. In the Service Provider, the factors identified as external vulnerabilities refer to the work developed by the company's suppliers. This need is verified by ABNT (2004), when presenting the steps for the implementation of ISO 14001, together with the importance of a careful analysis of how suppliers or service providers affect the environmental management capacity of organizations.

The Chemical Industry highlights methods for identifying events that affect its risk management. According to COSO (2004), one way of identifying events that cause risks is the use of support tools, among which, the use of software.

Question 8 asked about the risk measuring and identification process.

FIGURE 7: ANSWERS TO QUESTION 8

No.	Selected Statement
1	"...you move on to the probability that that will occur, if it's low, medium or high... Then you cross the severity with the probability, if it's a tolerable, moderate or critical risk."
2	"...sometimes, we turn to a specialized consulting service; depending on the case..., but when we talk about mapping, at least for us to start, that is a priority or that is not a priority, significant, we use our experience..."
3	"...you elaborate a scenario without considering any control, which would entail a certain situation and then you'd have a certain risk score and obtain the operating control measures, the mitigation, prevention measures, what this risk would be, this numbering..."
4	"analyzes factors of frequency, probability, consequence and severity."

The four companies use similar risk identification, mitigation and measurement processes based on risk matrixes, analyzing factors such as probability, severity and frequency. These identification,

mitigation and measurement procedures are in line with Moura’s (2000) findings, which present the matrixes of risks that cross gravity and severity, as well as frequency and severity.

At the Iron and Steel Industry, consultancies are used in this process. Teets et al. (1994) explain that it is appropriate to set up audits that assess the environmental risks associated with workplaces.

Question 9 asked about the criteria used to accept, mitigate, share or avoid these risks.

FIGURE 8: ANSWERS TO QUESTION 9

No.	Selected Statement
1	"...then I assess if there's any legislation, in fact it exists, there's legislation for everything, if there's any stakeholder, board, CETESB, it can be internal or external."
2	"A leakage of a certain product happened, we are going to do this, I am going to add person number 1, number 2 and number 3 and we're going to charge, I have such resources."
3	"...as we had a license recently, for permission to discharge another product, another fertilizer, we had to revise the risk analysis group..."
4	"Environmental management, depending on the certain risk the area will act!"

In the Calcination Industry, the main criterion is based on legislation. In other companies, mitigation procedures are supported by situations involving technical policies and studies. According to COSO (2004), this phase is known as a “response to risks” because it will establish how the organization will deal with them.

In this analysis, situations that are in line with the risk management objectives described by COSO (2004) are inferred, in the sense that when conducting preliminary studies, the company can identify the different groups of risks and, then make decisions on whether to accept, mitigate, reduce or avoid the risk.

Question 10 asked about the action plan and the monitoring mechanisms of the environmental risks.

FIGURE 9: ANSWERS TO QUESTION 10

No.	Selected Statement
1	"...example, from Monday to Friday, I do PH, flow and mud concentration, every month I do everything again and, every two years, but what I am seeing here is that the PH has to be within this range, because it's all law."
2	"...that monitoring is done like this, or it's an administrative management based on documents, on what was sent, contracts, what it guarantees in the contract, how it is, if everything is correct, or it's real monitoring, I go there, take a sample and send it to the laboratory and to check."
3	"...always do the training and always prepare the team to know how to act in an actual situation and within the simulations we do internally."
4	"there is no specific treatment in the company, there's collection, identification and coding of this waste, to be forwarded to companies that deliver recycling services."

In the Calcination and Chemical Industries, monitoring actions refer to the legislation. At the Iron and Steel Industry, they are based on contracts. In this situation, the importance highlighted by Ehrentreich (2009) relates the control actions to the interest of companies in maintaining their risk profile below the desired limit. In the Service Provider the focus is upon employee training, one of the foundations presented by ABNT (2004), in response to emergencies.

Question 11 asked about the top management’s perception of the environmental risk management.

FIGURE 10: ANSWERS TO QUESTION 11

No.	Selected Statement
1	"I think that the mere fact of having been indicated by the CETESB management to add up to the execution of your work, it's a source of pride for us..."
2	"...they know, because it's one of their aspects; control of these environmental risks, besides the issue that it is permanent, everything is verified by monitoring, what is an accident risk, ..."
3	"The top management is very active. ..., including investments, in short, it is very active and strongly involved in these issues."
4	"The management recalls the case of Bhopal in India. The view is to manage, not just for the sake of managing. The risk is strongly considered, the company is very concerned with its image and the financial part these risks can cause."

In the last dimension, themes related to perception of top management were: control, knowledge, policy and pride. All companies demonstrated the involvement of top management with the policies implemented. According to Sanches (2000), this involvement of top management is fundamental to the company's initiatives in relation to the environment.

The Chemical Industry presents a concern with financial risks and its image, associating cases with other companies in the same segment. Situation presented by Tinoco and Kraemer (2011), who described the case of the facilities of the multinational Union Carbide in Bhopal, India.

### 4.3 Blocks of questions about factors involving internal control practices

Question 12 asked about the main environmental controls.

FIGURE 11: ANSWERS TO QUESTION 12

No.	Selected Statement
1	"...emission control, practically within the process I mentioned more about the manga filters, but there are washers that do the entire control; in the case of the effluents..." and "... a cleaning of these particles and this product is also traded. A product with low value added, but we might say that the petcoke is fully used."
2	"...related to the emissions of particles in the air and water."
3	"...when he went to deliver waste on the waste patio, he's going to check, check whether it's segregated, if there is any further material contamination in particles and with the effluents..."
4	"...effluent treatments, before the discarding by the stations, in compliance with the legislation."

The main controls highlighted by the companies refer to emissions of particles, effluents and waste. Special mention should be made of programs for the reuse of by-products from the manufacturing process, as reported by the Calcination Industry Coordinator. According to Anderson (1999), reuse is a fundamental and more profitable component for environmental management.

Question 13 asked about the establishment of environmental controls.

FIGURE 12: ANSWERS TO QUESTION 13

No.	Selected Statement
1	"...so inside a management system, I have the manual, which is the level 1 document that defines all company guidelines; at the operational level, I have secondary-level procedures, like the survey of aspect and impact for example."
2	"So, in fact, he finds out about the result of his operational performance when we have monitoring, when we do monitoring, we inform him, then we charge him for corrective action and the system previews that, opens a non-compliance, he acts and you monitor again."
3	"The company is concerned with the updates of these control standards."
4	"In the organization, a kind of laboratory is established."

Risk controls are established in the Calcination Industry by means of a manual, centralized in the area of Quality, Safety, Environment and Health, based on the standard requirements, demonstrating the environmental aspects of the operational activities for all areas.

At the Iron and Steel Industry, the mechanism for establishing controls shows that areas will only identify that something is not following a pattern after environmental inspections. In the Service Provider, unlike the Iron and Steel Industry, there is a constant concern with the updating of the controls in the areas. For Imoniana and Nohara (2005), this question is fundamental for the proper functioning of controls.

In the Chemical Industry, laboratories were implemented, in which graphs of efficiency of results of internal and external audits are presented. It is inferred that the company is concerned with disclosing to employees the control system, which, according to Barragan (2005), allows a better adaptation of the process.

Question 14 asked about the registration and storage forms of the environmental controls.

FIGURE 13: ANSWERS TO QUESTION 14

No.	Selected Statement
1	"...how do I store this document, it is kept at the user's room in a folder inside a cupboard, filed in chronological order..." and "...the evidence that I am monitoring is the register."
2	"...system, computerized, we have access, the area representatives have access, the managers also have access."
3	"Today, we work with the system ..., which is where we register the cases of non-compliance, opportunity for improvement and the operating procedures."
4	"...graphs, worksheets with trends are prepared. These are stored in the environmental sector."

Records are stored by companies in computer systems by representatives of the areas. In the Calcination Industry, the registration and storage mechanism is carried out in folders. According to ABNT (2004), registration is one of the steps for implementing controls, as they evidence the continuous operation and results of the management system.

Question 15 asked about the forms of assessment and actions taken in cases of deviations in the environmental controls.

FIGURE 14: ANSWERS TO QUESTION 15

No.	Selected Statement
1	"...the deviation from compliance, how it should be and what happened, identifies the cause, and what you are going to do" and "...then you need to open an action plan."
2	"...who answers this is the manager himself, the representative, of course, he does this intermediation, but the responsible for the implementation is the manager."
3	"...they include it in the SAP system, then we go there, the planning staff we can ask them for a certain kind of equipment, he can look there and say "this parameter is verified every three months", then we are able to check if it was executed within that period, the maintenance order, if any deviation was identified."
4	"... assessments in groups."

Controls are mostly evaluated based on external and internal audits. In the case of the internal audits, by laboratories of the company, as at the Iron and Steel Industry. In the Chemical Industry, the assessments are made by groups of other areas to spread the problems and reduce the probability of occurrence.

In the Calcination Industry, firstly a nonconformity is identified. In situations of simple causes, the company solves the problem with internal approval of the managers of the areas, but in situations that demand investments, plans that involve other areas and activities are created. When this plan is completed, an internal or external audit will check whether it has been fulfilled.

At the Iron and steel industry and the Service Provider, both internal and external audits are carried out periodically in the search for nonconformities. According to ABNT (2004) there should be a continuous evaluation to identify improvement processes.

Question 16 asked about the critical perception of the environmental controls.

FIGURE 15: ANSWERS TO QUESTION 16

No.	Selected Statement
1	"Everything that happens in the course of the year, even the standards require that a critical analysis be done by top management. So I collect that information for the whole year, but the organization defines the periodicity of this critical analysis, nobody required it, the company defined doing it yearly."
2	"...we raise our concerns and management takes actions, it can ask questions, so, that's when we present the critical analysis of the system performance and they do their critical analysis..."
3	"So, in fact, we have a corporate guideline and then there are these reports, these meetings with the directors, that's where they have contact with the areas and propose these targets, propose the system and we propose the challenge of doing the analysis of our process really, the more we can evolve..."
4	"Meeting every six months. The top management analyzes the non-compliance reports and the clients' complaints. Registers of non-compliance are prepared. Environmental indicators are presented per sector."

In terms of critical perception, differences are perceived in the way companies portray their indicators to top management. In the Calcination Industry and the Steel industry, controls are analyzed annually, through reports sent to top management. The Iron and Steel Industry works with indicators, which, according to Gomes and Salas (1997), summarize and integrate information on the evolution indexes of each unit, allowing prediction and comparison of business evolution and more precise definition of priorities, thus facilitating control.

In the Service Provider and in the Chemical Industry, the existence of actions for the continuous improvement of the processes is inferred. In the Chemical Industry, meetings are held every six months to analyze reports and customer complaints. Emphasis is given to the importance assigned by ABNT (2004) in this area of continuous improvement, reported in the steps of operational control.

Figure 16 presents a summary of the empirical evidence of internal controls and environmental risk management described by the interviewees. The classification and presentation are carried out based on the two major themes of the theoretical platform.

FIGURE 16: SUMMARY OF THE EMPIRICAL EVIDENCE OF CONTROLS AND MANAGEMENT OF ENVIRONMENTAL RISKS PRESENTED BY COMPANIES

Constructs / Dimension	Variables Analyzed	Characteristics	Question
Factors involving the environmental risk management practices	1 – Internal and external vulnerabilities	- Geographic location - Legal requirements - External Vulnerability (Suppliers) - Risk identification software	7
	2 – Identification and measuring	- Risk matrix - Consultancies	8
	3 – Acceptance, mitigation, sharing or rejection of environmental risk	- Legislation - Policies and technical studies	9
	4 – Action and monitoring plans	- Legislation - Contracts - Employee training	10
	5 – Perceptions of top management	- Control, knowledge, policy and pride - Financial risk and image	11
Factors involving the internal control practices	1 – Main environmental controls practiced	- Control over particle issue, effluents and toxic waste - Reuse of by-products	12
	2 – Application in corporate activities	- Manuals - Environmental audits - Laboratories that disclose information	13
	3 – Forms of registers and storage	- Computer files - File folders	14
	4 – Forms of assessment and attitudes towards deviations	- Internal and external audits (laboratories) - Some are conducted to detect non-compliances, whereas others are conducted after non-compliance correction.	15
	5 – Critical perceptions	- Indicators - Continuous improvement	16

Questions presented in topic 4 were structured based on Figure 3.

## 5 FINAL REMARKS AND RECOMMENDATIONS

The main objective of this article was to identify and analyze the methods and perceptions of internal control and environmental risk management practices adopted by managers of four companies in the industrial hub of Cubatão. Regarding aspects of environmental risk management, we have studied characteristics related to the theoretical platform, which deal with issues such as vulnerability to external and internal factors, methods of identification and measurement of risks, monitoring situations, criteria used to mitigate risks, monitoring and perceptions of the process by senior management. Findings related to internal controls presented in the theoretical platform were: main controls, forms of establishment, recording and storage mechanisms, identification and evaluation procedures and critical perception.



When identifying the methods used, they were found to be in line with the sources brought to the theoretical platform. It was verified that the companies use similar ways to treat several analyzed situations, perceived in other researches such as the one of Kawalski, Fernandes and Faria (2010), who verified environmental practices in electric energy Santa Catarina State Cooperatives, in which they emphasize items of environmental education for employees, compliance with legal requirements, followed by controls on fines and environmental damages.

There are characteristics common to all, such as the use of audits to analyze environmental controls. Empirical differences were found in the results, for example, that demonstrated that companies work with audits, after finding nonconformities and seek to validate their processes, and others that use them to ensure that nonconformities will not occur.

The research has limitations, such as the biases of the interviewees about the subjects questioned, the problem of noise in communication, besides it was not possible to interview members of the top management of the companies. However, this work, in addition to achieving its objectives of identification and analysis of companies, through these management models, actively participated in the recovery process of the city of Cubatão, allowed development and testing of a study model of internal control practices and management of environmental risks. This model can be used or perfected in other researches that have the same objective.

We suggest the continuity of research in this area, using or improving the model developed, through case studies in companies, verifying in practice the actions of risks and internal controls developed by these organizations. Finally, results provide support for other researchers to feel motivated to study the subject, which still lacks development in the accounting literature.

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