ENVIRONMENTAL COST MANAGEMENT IN BRAZILIAN PRIVATE HOSPITAL

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ABSTRACT

This study aims to identify the procedures used by Brazilian private hospitals in the management of environmental costs. We applied a survey composed of assertions with five-point Likert scales to the respective accountants and managers in the environmental area of 1.188 hospitals. Data from 101 hospitals (8.5% of the population) were collected in October 2017 and analyzed using descriptive statistics. Literature hypotheses were tested using the Mann-Whitney test, Spearman coefficient, and multiple linear regression. The results show that accounting and environmental cost management practices are not significantly employed in hospitals overall. Accountants display limited knowledge of environmental accounting. The management of environmental costs in the surveyed hospitals is not handled strategically, being limited to regulatory compliance. It was not possible to identify the existence of a relationship between environmental cost control and the hospitals' economic performance. Statistically, the largest hospitals are those with the highest investment volume in environmental issues and greater control of environmental costs. It was found that this is still an emerging issue in the surveyed hospitals.

Keywords: Environmental Accounting. Environmental Cost Management. Environment. Private Hospitals.

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GESTÃO DE CUSTOS AMBIENTAIS EM HOSPITAIS PRIVADOS BRASILEIROS

RESUMO

O objetivo do estudo é identificar os procedimentos utilizados por hospitais privados brasileiros na gestão de custos ambientais. Aplicou-se uma pesquisa do tipo *survey,* composta por assertivas com escalas do tipo *Likert* de cinco pontos, cujo instrumento foi encaminhado aos respectivos contadores e gerentes da área ambiental de 1.188 hospitais. Os dados de 101 hospitais (8,5% da população) foram coletados em outubro/2017 e foram analisados por meio de estatística descritiva e as hipóteses oriundas da literatura foram testadas pelo modelo de *Mann-Whitney*, pelo coeficiente de *Spearman* e pelo modelo de regressão linear múltipla. Os resultados apontam que, em geral, nos hospitais há pouca contabilização e utilização de práticas de gestão de custos ambientais. Os contadores evidenciam pouco conhecimento em contabilidade ambiental. Nos hospitais pesquisados a gestão dos custos ambientais não é tratada de forma estratégica, limitando-se apenas a cumprir a legislação. Não foi possível identificar a existência de relacionamento entre o controle de custos ambientais e o desempenho econômico dos hospitais. Verificou-se, estatisticamente, que os hospitais de maior porte são aqueles que apresentam maior volume de investimentos nas questões ambientais e maior controle dos custos ambientais. Constatou-se que o tema é ainda incipiente nos hospitais pesquisados.

Palavras-chave: Contabilidade Ambiental. Gestão de Custos Ambientais. Meio Ambiente. Hospitais Privados.

1 INTRODUCTION

The scarcity of natural resources, occasioned mainly by their growing consumption brought by the intensity of business activities, especially those environmentally harmful, caused the paradigm of environmental sustainability of economic systems to gain notoriety in recent discussions (Pereira, Melo, Slomski & Weffort, 2013). In this regard, the growing concern with issues related to environmental preservation, especially in the most recent decades, highlights the need for clarification as to the factors that negatively impact the environment. This concern is not isolated in a specific region or culture, but a global awareness (Viviani, Moura, Macêdo & Silva, 2014).

The challenge that arises from this situation is to reconcile economic growth and profit generation with environmental preservation. Tinoco and Kraemer (2011) understand that organizations need to incorporate sustainability and conscious consumption of natural resources in their strategic plans. On this subject, Ahmad and Schroeder (2003) argue the need to implement an environmental management system (EMS) to reduce the consumption of natural resources and gain process efficiency. Different organizational segments present distinct environmental risks. Among them, Doiphode, Hinduja, and Ahuja (2016) highlight those in the health field, mainly from the generation of health care waste (HCW). These are characterized by the high risk of environmental contamination and professionals and the general population's health.

Regarding health care organizations, environmental concerns arise mainly from HCW generation. According to Oliveira, Pandolfo, Martins, Gomes, and Moro (2013), in addition to the significant quantities generated, HCW represents a risk to public health and the environment due to the presence of pathogens.

As highlighted by Silva (2003) and Schneider, Rech, Bigoline, and Paiz (2013), effective environmental management takes into account the economic impact that the costs arising from these environmental actions can cause to organizations. As such, the authors note the need to identify, classify, record, and analyze environmental costs as a way to support the analysis of environmental performance and prioritize the best decisions. They also note that this applies to organizations in general—in particular, to hospitals.

Brazil has a total of 6.805 registered hospitals. Private hospitals account for 70% of this total (CNS, 2018). These institutions have been the subject of studies in Brazil by Pizzomo, Uhlmann, and Pfitscher (2013) on environmental sustainability; Schneider et al. (2013) on HCW monitoring and managing; Rosa, Mathias, and Komata (2015) on HCW management costs; Martins, Portulhak, and Voese (2015) on cost management practices in university hospitals and Lucchese (2015) on environmental costs in hospitals in the southern region of Brazil, among others.

Such studies examined the implementation of environmental cost management practices, increasing academic interest in investigating this topic. This leads to the proposition of the following research problem: What environmental cost management procedures and practices are adopted by Brazilian private hospitals? To answer this question, the aim of this study is to analyze the procedures used in the management of environmental costs by Brazilian private hospitals.

The research question and its objective meet Segatto's musings (2012), for whom environmental issues have been gaining ground both in scientific literature and in social discussions on account of the increased environmental degradation. Besides Segatto (2012), Schneider's research (2004) adds that environmental cost management must be aligned with the organization's overall management.

Lucchese's research (2015) identified that there is no management of environmental costs in the hospitals surveyed in southern Brazil, given that their accounting takes place jointly with other factors and thus, removing the possibility of a specific analysis. Nichols, Grose and Mukonoweshuro (2016), through a review of international literature, identified a gap in studies addressing the issue of costs arising from HCW management in health institutions. Therefore, these authors recommend carrying out empirical studies focusing on the management and reduction of environmental costs and assert that a possible alternative is to address the reduction in waste generation.

Past studies show that this issue is relevant given the effort aimed at protecting the environment and its cost-efficiency. It is also worth noting that new studies are becoming increasingly relevant. This research is exceptional in its scope at a national level. Thus, it allows for a deeper understanding of the control and management of environmental costs in Brazilian private hospitals. In addition, it proposes a discussion on the generation and operational management of environmental waste regarding structural aspects of the economic management of arising costs.

The paper is structured in five sections, the first of which being this introduction. The second section deals with the literature review on environmental cost management in hospitals, presenting noteworthy national and international studies. The third section introduces the methodological aspects of the research, including the study's hypotheses. The fourth section is dedicated to presenting the data and analysis results. Finally, the study's conclusion, its limitations, and suggestions for further studies are contemplated in the fifth section. The bibliography consulted for the study development is present at the end of the paper.

2 LITERATURE REVIEW

2.1 Environmental Cost Management in Hospitals

The generation of potential pollutants is ingrained in health care institutions. According to Camacho (2008), such waste was known as health care or hospital waste until the establishment of the Brazilian National Standards Organization standard ABNT NBR 12.807/93, which defined its classification according to the potential environmental risk, naming it Health Care Waste (HCW).

Regarding HCW management, this standard represents a set of technical and legal procedures for waste management in any kind of health care establishment. For Rosa et al. (2015), as existing resources are finite, the reduction of environmental costs can contribute to the overall cost management of hospitals. According to Schneider et al. (2013), the expenditure on personnel training of those involved in HCW management contributes to the reduction of its processing costs. Mmereki, Baldwin, Li, and Liu (2015) highlight this issue by stating that failures usually occur in the storage, transport, and final disposal of waste. These are caused by the professionals' lack of information and inadequate structure.

Knowing the activity cost allows one to analyze service price negotiation strategies. For instance, HCW management is hardly considered when pricing the daily rate of a hospital bed. The reason for this is that many managers deem it as an irrelevant cost. However, its correct measurement is necessary as it can potentially cause the institution financial losses. Rosa et al. (2015) support this understanding by highlighting that monitoring HCW management costs is an important practice to avoid losses and assist in reducing them.

2.2 Classification of Hospital Environmental Costs

The need for efficient cost management is emphasized in hospitals due to the positive impact this practice can bring in the services offered—particularly due to lower prices. To ensure this occurs, it is essential to clarify its identification.

The general classification of health care or hospital waste, whose treatment generates environmental costs, is related to biological materials contaminated with blood or pathogens, anatomical parts, syringes and other plastic materials, in addition to a wide variety of toxic, flammable, and even radioactive substances. Resolution 306/04 from Brazilian Health Regulatory Agency (ANVISA, 2004) establishes five groups of HCW: (a) potentially infectious, (b) chemicals, (c) radioactive waste, (d) common waste, (e) sharps and those which give rise to specific environmental costs for their treatment.

Schneider, Ben, and Carvalho (2008) confirm that the identification and classification of environmental costs can help administrators to manage available resources more efficiently. Schneider (2004) lists the following characteristics of hospital environmental costs (Table 1).

Table 1

Characteristics of hospital environmental costs

Type	Details
Amortization and depreciation of equipment and buildings	HCW storage, transport carts for handling, equipment used in the treatment of infected waste.
Acquisition of goods	HCW containers, personal protective equipment (PPE).
Waste treatment	Chemical materials. HCW handling costs until final disposal, wastewater treatment.
Water consumption	Material used in equipment disinfection, waste sterilization, cleaning of transport carts, and external HCW storage.
Labor	Personnel costs related to the HCW management process, environmental education.

Source: Based on Schneider (2004).

Rooted in the classification presented by Schneider (2004), the origin and nature of hospital environmental costs can be clarified and classified into five characteristics. The first category includes costs derived from equipment used to treat waste in order to protect against infection. In this category, there is a predominance of depreciation costs for machinery, equipment, and buildings. In the second category, there is the consumption of auxiliary materials used. These are both the packaging of waste, as well as the protective materials and equipment used by the operation agents.

In the third category, there are the various types of chemical materials used in effluents treatment, from waste management to final disposal in particular storage locations or the environment, provided that they are completely purified. The fourth section comprises basic materials, water used for washing and disinfecting materials, and equipment used in the waste treatment process. Finally, the fifth section presents the cost related to professional labor working directly in the process of handling, conditioning, and disposing of HCW.

Salamoni, Gallon, and Machado (2015) add that there are environmental costs related to control, correction, and failures, which can be reduced by adopting effective management measures. The authors emphasize that the costs related to environmental prevention should be prioritized since these minimize the occurrence of failures related to the production process and the environment.

It is also worth noting that, in hospital environments, there is the imminent risk of continually exposed negative impacts, such as the generation of environmental liabilities due to environmental contamination or due to failures in the HCW management process. (Mmereki et al., 2015). Kumar and Nagpal (2011) support the importance of efficient cost management in these institutions, acknowledging management not as a synonym for cost reduction, but as the correct allocation of costs with a focus on long-term sustainability.

2.3 Accounting Structure for Registration and Control of Environmental Costs

Concerns about the economic effect of environmental costs and the need for its planning and control gave rise to a new area in Accounting Sciences - Environmental Accounting.

Conceição, Finhani, Alonso Jr, and Alonso (2014) stress that learning strategies to enable economic growth with no detriment to future generations is the responsibility and contribution of science as a whole. Still, the authors argue that Accounting contributes by offering ways to measure and demonstrate the effects on a company's financial and economic standing due to the environmental impacts caused by it. This accounting performance provides companies with information that can both reduce their liabilities and increase their environmental assets.

Despite these initiatives, the authors note that the main difficulty faced in Environmental Accounting is the clear and complete registration of environmental resources since this is not yet a widespread practice. According to the same authors, another point of resistance is that many companies restrict themselves to operating within the narrow limits of legal requirements, with little spontaneous action. This is reflected, in addition to the accounting aspects, in the absence of environmental planning and control procedures from an economic perspective.

The usefulness of Environmental Accounting as an internal management tool for organizations is also addressed by Sgarabotto, Verona, and Silva (2017). For these authors, knowledge of environmental events in a company is fundamental for improving internal processes and strengthening the commitment to both the environment and society. There are also the benefits of environmental management, given that Environmental Accounting aids managers in decision-making that guarantee the organization's sustainability.

For Conceição et al. (2014) the innovations brought by Environmental Accounting are associated with at least three topics: (I) the definition of the environmental cost; (II) how to measure the environmental liabilities of long-lived environmental assets; and (III) the use of comprehensive explanatory notes and the employment of environmental performance indicators, standardized in the process of providing information to the public.

However, for Management Accounting to be an effective management tool, it needs a few basic preconditions, such as a chart of accounts that structures the necessary foundation for the appropriate environmental records of expenses, assets, and liabilities. In this regard, a study by Souza, Heinen, and Mezzomo (2012) identified that the accounting and systematic recording of environmental assets, liabilities, and costs—the basis for a reliable and secure planning and control system of environmental costs—is not yet part of the reality of business management. What has been observed is restricted to the use of specific and alternative measurements to the general accounting practice, which generates a set of reports used in the environmental management routines in companies.

Despite the still partial measurement of economic events derived from environmental systems, several authors have dedicated themselves to providing Environmental Accounting the structure it needs for its more traditional performance. Such involves environmental assets and liabilities, expenses,

environmental costs and revenues, and environmental balance (Braga, 2007; Silva, 2009; Ferreira, 2009; Tinoco & Kraemer, 2011).

2.4 Related Works

The search for related works took place in the Scopus, EBSCOhost, and Google Scholar platforms. The terms used were: "Health Service Waste", "Hospital Environmental Costs", "Hospital Environmental Cost Management", both in Portuguese and English. In the first step, we identified and selected the four studies presented below in Table 2.

Table 2

National Related Works

Author/year	Objective	Findings
Pizzorno, Uhlmann, Pfitscher (2013)	To verify the environmental sustainability of a hospital in southern Brazil.	Weak overall sustainability index (30.6%), indicating negative environmental impacts. The key group "Provision of Services" ranged only 35.6%. The key group "Finance and Accounting" was the worst (12.8%). The hospital does not have an EMS or environmental quality plan.
Schneider et al. (2013)	To evaluate the total cost per HCW category/day and occupied bed/day in a teaching hospital in southern Brazil.	The results show that if this particular hospital's management system was completely adequate, there would be a monthly saving of 18.4% for the treatment of infectious waste and 5.83% for chemical waste
Rosa et al. (2015)	To estimate the cost of HCW management phases in the intensive care unit (ICU) for the public sector.	Packaging (40.7%) and segregation (40.2%) are the costliest since these include health professionals' compensations. The daily cost of management in the ICU, from segregation to disposal, is R$4.3 thousand or R$314.9/patient-bed/day.
Martins, Portulhak, Voese (2015)	To investigate the cost management practices employed by federal university hospitals (FUH).	Of the 11 FUH surveyed, four employ a costing system. Three clusters can be identified: (I) those that do not use a costing method; (II) those who implemented at least one method; (III) a single hospital that employs RKW and Absorption Costing. There are no other cost management tools. Legal compliance is not widespread in the sample.

Source: Cited authors.

Of the four works identified, that of Martins, Portulhak, and Voese (2015) is the one that most resembles the present research. Such is evident by the objective of investigating the cost management practices used in federal university hospitals. The findings point that, despite the legal responsibility, these practices still have restricted application since only one hospital among the sample of 11 employs them more severely.

The work of Pizzorno et al. (2013), despite posing fewer similarities with the current research's objective, also highlights the deficiency in the adoption of environmental management practices, including the key group "Finance and Accounting" presenting the worst performance.

The remaining two studies (Schneider et al., 2013; Rosa et al. 2015) are focused on measuring the costs incurred by the researched institutions. While the

first study identifies that the management system is not adequate and indicates potential savings, the second one estimates (since there is no costing system in place) possible activities and savings.

In a continuous process, we also identified four works developed on the same research topic, which are presented in Table 3.

Table 3
International Related Works

Author/year	Objective	Findings
Özkan (2013)	To analyze HCW management in Turkey. Investigate the most appropriate treatment/disposal employing different decision-making techniques	Five HCW treatment/disposal alternatives were evaluated according to two decision-making techniques with several criteria: the analytic network process (ANP) and ELECTRE. The alternative ranking was compared for the two methods. The off-site sterilization technique was considered the most appropriate solution in both cases.
Mosquera, Andrés-Prado, Caravaca, Latasa and Mosquera (2014)	To evaluate an education and training system for HCW reduction in a tertiary hospital in Spain	There was a significant reduction (6.2%) in the average monthly volume of waste. There were statistically significant differences in the weight of infectious waste and genotoxic waste. With the reduction of HCW weight and improved classification, there was a saving of €125.205.
Wyssusek, Foong, Steel, and Gillespie (2016)	To implement a waste segregation and recycling system in an Australian hospital.	Processes that segregate general waste from the clinical waste in ORs were implemented. There was a 60% reduction in waste disposal costs. Overall, there was an 82% reduction in clinical waste from the operating room. Total OR waste has been reduced by 50%.
Doiphose, Hinduja, and Ahuja (2016)	To develop a sustainable system for systematic management of non-hazardous health care wastes (NHHWs) in an Indian hospital.	The HCW management system at the hospital was considered efficient, offering vital information on the development of the new system. The study was successfully completed. It generated significant revenue from the hospital's NHHW and managed it in an environmentally friendly manner.

Source: Cited authors.

As for international works, another four studies were selected. Three of them (Ozken, 2013; Wyssesek et al., 2016; Doiphose, Hinduja & Ahuja, 2016) are aimed at researching operational processing techniques of HCW handling. Only the work of Mosquera et al. (2014) focuses on measuring the financial savings f the processes, in addition to issues of handling.

In summary, it can be observed in the literature that despite the social appeal regarding the environmental impacts resulting from business activities, the use of effective Environmental Accounting in companies still lacks more significant strides. The researched material suggests that companies are more compelled, albeit partially, to comply with legal requirements and environmental standards that regulate the issue.

Regarding Environmental Accounting, it appears that there are already in-depth studies aimed at conceptualizing it, positioning its relevance for organization management, and for organizing the information flow to society. We

note there are also important outlines of the structure required for Management Accounting to be developed in the organizational management environment.

3 METHODOLOGICAL ASPECTS

This is a quantitative and qualitative descriptive research that employed a survey as a research instrument. The classifications made are based on the descriptions of Gil (2010).

According to CNS data (2018), there are 4.765 private hospitals in Brazil. Through direct electronic consultation and hospital associations information portals, it was possible to contact 1.188 hospitals duly registered and located in different regions of Brazil, after duplication exclusion. During Oct/2017 and after 2.206 telephone contacts, the research instruments were sent in two stages of collection.

The final sample corresponds to 8.5% of the total population. There is a predominance of hospitals in Brazil's southeast region - 51.5% of the total, slightly higher than the sample's 45.5%. Following, the hospitals are located in the southern (27.7% of the sample) and the northeast regions (12.9% of the sample). The northern region is the one with the lowest representation, equivalent to 5.0% of the sample. The research instrument was structured with binary questions related to the use of particular practices. It includes assertions with five-point Likert scales, adjusted accordingly.

Based on the literature, the questions and assertions are presented in two groups. Group A holds the questions and assertions related to the environmental issue, and Group B those regarding accounting. Group A was based on the studies of Oliveira et al. (2013), Scheineider et al. (2013) and Mosquera et al. (2014), while Group B was based on Ahmad and Schroeder (2003), Salamoni et al. (2007), Tinoco and Kraemer (2011), Schneider et al. (2013), Rosa et al. (2015) and Oleiro and Schmidt (2016).

The instrument was pre-tested in three hospitals, excluded from the sample. Some adjustments were made in the scale nomenclature and the assertions, making them clearer and more objective. The research instrument was preceded by a telephone call to each hospital directed at the accountant, controller manager, or similar position, and environmental managers or similar position. The former would reply to the assertions related to accounting, while the latter was responsible for the environmental management inquiries. Respondents had access to the instrument's digital link through the Google Docs platform. An exception occurred in specific situations, with answers obtained directly by phone.

Regarding data analysis, the first stage was performed based on descriptive statistics of the sample profile. Following that, Cronbach's alpha was used to attest to the reliability of the answers (Hair Junior, Black, Babin, Anderson & Tatham, 2005). The possibility of adhering to a normal distribution of responses was ruled out due to the research instrument being developed with Likert-type scales, presenting only 5 predefined options. Given this structure, it became appropriate to use nonparametric tests for this particular set of data, as is the case with the Mann-Whitney U test and the Spearman's coefficient (Siegel & Castellan Junior, 2006). The Mann-Whitney U test and Student's t-test were also used (Siegel & Castellan Junior, 2006). In the Mann-Whitney test, the null hypothesis (H_0) affirms that the

median of the analyzed variable is the same in both populations, while the alternative hypothesis (H_1) indicates that the median of the variable is different between populations. Spearman's coefficient was used to statistically test correlations (Martins, 2006). The multiple linear regression model was used to identify the influence of factors on the institutions' environmental and financial performance. The model investigates whether independent variables are capable of predicting a dependent variable, extracting a mathematical model that describes the relationship (Duarte, Lamounier & Takamatsu, 2007). The Statistical Package for the Social Sciences (IBM SPSS) software, version 21.0, was used for all tests and statistical analyzes described in this section.

Based on the theories and empirical studies found in the literature, we sought to verify possible converges with our findings. Thus, we developed hypotheses to be later tested. Hypothesis tests were used to determine which results could lead to the study's conclusion.

This research is based on the idea that the efficiency of environmental cost management contributes positively to the financial performance of institutions, as observed in studies by Schneider et al. (2013) and Wyssusek et al. (2016) Therefore, the first developed hypothesis was the following:

H_1: Companies with greater control of environmental costs present better financial performance.

Based on the same idea as the previous hypothesis, it is natural to assume and, therefore, test whether the environmental and financial performances of Brazilian private hospitals are indeed positively related. Thus, the second hypothesis emerges:

H_2: The environmental and financial performance of hospitals present a positive relationship.

ISO 14001 is an environmental quality management standard. It asserts the commitment of its signatories in the search for continuous improvement in environmental protection (VALLE, 2002). As such, the third hypothesis is defined:

H_3: Companies employing ISO 14001 present superior environmental performance.

Studies such as those of Mosquera et al. (2014) and Doiphode et al. (2016) present overwhelming results regarding HCW management. The well-executed management process provides financial gain to the institution. This is especially significant in the segregation phase, which is contingent on the professionals' level of knowledge. It is then tested:

H_4: Hospitals that employ higher level-knowledge professionals on HCW segregation and treatment present better financial performance.

The legitimacy theory summarizes organizations' needs to integrate into society and be accepted and legitimized by it (Islam & Deegan, 2008). In this interrelation, the larger the organization, the greater the responsibility to account for its activities and provide counterparts in the social, environmental, and economic spheres (Elkington, 1998). Furthermore, it is known that considerable investments are needed both in personnel training and hospital structure in order to achieve a higher level of environmental management and its costs. Based on this, the last hypothesis is reached:

H_5: The level of environmental management and environmental costs present a positive relationship with the size of the institution.

4 DATA PRESENTATION AND ANALYSIS

4.1 General Characterization of the Sample

The research instrument included questions that aim to support analyses and comparisons, especially when dealing with differences and correlations between them. The first variable analyzed was the hospitals' lifetime. Table 4 summarizes the results.

Table 4
Profile of Sample Lifetime

Lifetime	Amount	Participation %
0 to 19 years	16	15.7
20 to 39 years	16	15.7
40 to 59 years	21	20.6
60 to 79 years	21	20.6
80 to 99 years	13	12.7
100 years or more	14	14.7
Total	**101**	**100.0**

Source: Research data.

As shown in Table 4, the sample is composed of hospitals with varying lifetimes, prevailing those aged 40 to 79 years (41.2%). Those with up to 39 years since their foundation correspond to the second largest group (21.4%). Hospitals whose lifetime are over 80 years are also present, corresponding to 27.4%.

Regarding the size of hospitals, the Brazilian Ministry of Health's criterion was followed. Ordinance 30/77 establishes the number of beds as the principal reference for their size (Table 5).

Table 5
Size of hospitals

Size & Beds	No. of hospitals	%
Average (51 to 150)	67	66.3
Large (151 to 500)	28	27.7
Small (up to 50)	3	3.0
Extra (more than 500)	3	3.0
Total	**101**	**100.00**

Source: Research data.

The sample is predominantly composed of average sized hospitals (66.3%). Grouped with large hospitals (27.7%), both categories add up to a total of 75 hospitals, totaling 94% of the sample. This is noteworthy since research has shown that the hospitals' sizes influence the amount of waste generation in health care services (André, Veiga & Takanagui, 2016, Lucchese, Souza & Machado, 2018).

4.1.1 ISO 14001 Certified Hospitals

Another sample characteristic refers to the international accreditation of the ISO 14001 standard, which focuses on environmental issues. This standard focuses on reducing the amount of waste generated and continuously improving environmental management processes.

We identified that only 9.9% of the sample, equivalent to 10 hospitals, are certified by this standard. The remaining hospitals (90.1% = 91 hospitals) hold only mandatory licenses. The low number of hospitals that adhere to ISO 14001 shows a tendency of Brazilian private hospitals to ally themselves with the model of corporate conformity, according to Miles and Covin (2000). This occurs since they are limited to comply with legal requirements and do not address the environmental issues with a strategic focus for the business as established by the ISO standard.

4.2 Cronbach's Alpha Test

Before analyzing Likert scale results, it is advisable to certify the constructs' internal consistency. Table 6 presents the results of the question groups introduced in the research instrument.

Table 6
Initial results model 01

Group	Cronbach's alpha
A - Environmental area	0.741
B - Accounting area	0.792

Source: Research data.

The indicator stands at 0.741 for the environmental sector group. It attests to the construct's consistency since values above 0.70 are considered as such. Likewise, the internal consistency of the accounting assessment group is also confirmed, presenting Cronbach's alpha at 0.792.

4.3 Environmental Management

4.3.1 Generated Waste Control

Respondents were asked about the frequency with which the amount of waste generated per bed is measured, as well as the start of their internal treatment of the material (Table 7).

Table 7
Frequency of waste treatment control

	Scale	Mean	Median	Mode	Standard Deviation
		$\bar{x}$	$\tilde{x}$	M	σ
Answer the frequency with which the amount of waste/bed (HCW) generated is controlled.	Frequency	4.20	5.00	5.00	1.08
Answer about the percentage of waste (HCW) that is already being treated at the institution	Percent	2.17	2.00	1.00	1.27

Source: Research data.

The mean value of 4.20 and the median and mode equivalent to 5.00 indicate that there is frequent control over the waste generated in most hospitals. Such is consistent with health institutions' obligation to maintain a Management Plan for Health Care Waste (PGRSS) as prescribed by the Brazilian Health Regulatory Agency ANVISA, which obliges hospitals to periodically manage this waste.

Regarding treatment, the data in Table 4 indicates that the majority of hospitals treat only between 0% and 20% of the generated HCW internally. The mode represents only 1%, demonstrating a preference for external waste treatment. The lack of information about the physical structure of each hospital prevents further analysis on this issue, as this information is necessary for a proper on-site treatment system. The results of Schneider et al. (2013) highlight the benefit that environmental risks are reduced when waste begins to be treated within the institution.

4.3.2 Environmental Risks

According to Resolution 358/05 of the Brazilian National Environment Council, CONAMA, waste generated by health care institutions poses different risk levels to human health and the environment. As such, respondents were asked about the perception of risks to the environment and society that a possible failure in HCW management could cause. The data obtained are shown in Table 8.

Table 8
Level of damage to the environment and society

	Scale	Mean	Median	Mode	Standard Deviation
		$\bar{x}$	$\tilde{x}$	M	σ
Answer about the level of damage to the environment and society that failure in waste management (HCW) can cause.	Level	3.50	4.00	5.00	1.53

Source: Research data.

Regarding the existence of a high risk of contamination with inappropriate handling of HCW, the alternative 5.00 (Very high) was the most prominent one, representing 38% of total responses. However, the standard deviation value of 1.53 also indicates that some professionals understand that the risk caused by a failure is considered low or moderate. One of the possible explanations can be found in the study by Ciplak and Barton (2012), who estimate that 20% to 25% of hospital generated HCW are classified among those that represent considerable risks to the environment and human health.

4.3.3 Staff Qualification and Waste Treatment Costs

The segregation stage, which consists of the sorting of waste at the time and place of its generation, is considered to be one of the most important in the HCW management process (Mmereki et al., 2015). Regarding this issue, respondents were asked about the level of preparation of hospital staff and the frequency of relevant training (Table 9).

Table 9
Knowledge and training of personnel on waste sorting

	Scale	Mean	Median	Mode	Standard Deviation
		$\bar{x}$	$\tilde{x}$	M	σ
Answer about the staff level of knowledge on waste sorting (HCW) according to their risk rating.	Level	3.93	4.00	4.00	1.04
Answer about the frequency with which staff training on segregation, disposal, and treatment of waste occurs (HCW).	Frequency	3.92	4.00	5.00	1.08
Investments in staff training on waste sorting and disposal (HCW) can reduce treatment costs.	Agreement	4.80	5.00	5.00	0.63

Source: Research data.

The mean value of responses indicates that the staff has a high level of knowledge in this regard, presenting a mode equivalent to 4.00 (Table 9). The standard deviation value of 1.04 indicates that the responses have generally not differed from this average. This result corroborates the highlight of Mosquera et al. (2014) in a research carried out with staff from a hospital in Spain.

We also sought information regarding how often staff receives training focused on HCW correct sorting techniques. The results in Table 9 show a mode value of 5.00, 4.00 median, and standard deviation of 1.08. It demonstrates that training is frequent in the surveyed hospitals, which explains the high level of staff knowledge.

Table 9 also contains data that reflects the environmental area respondents' understanding that training on the waste segregation process can reduce the institutions' environmental costs. Almost complete agreement and low standard deviation value both reflect unanimous acceptance. Such understanding is in line with the study by Schneider et al. (2013), who state that an error at the beginning of the disposal process generates unnecessary costs for the institution, citing as an example the mixing of food waste with infectious waste. This result also corroborates the studies by Wyssusek et al. (2016) and Doiphode et al. (2016), which argue that correct segregation processes allow health institutions to reduce waste generation, reduce the proportion of infectious waste due to poor segregation, and, consequently, reduce total treatment costs.

4.4 Accounting

The questions and assertions in the second group were directed to respondents in the accounting sector of each hospital.

4.4.1 Environmental Accounting

The objective of this step is to investigate the level of knowledge in environmental accounting and identify possible difficulties in measuring and classifying costs (Table 10). The questions about these issues, as stated by Oleiro and Schmidt (2016), seek to identify the professionals' knowledge about the environmental area.

Table 10
Knowledge and treatment of environmental costs

	Scale	Mean	Median	Mode	Standard Deviation
		$\bar{x}$	$\tilde{x}$	M	σ
Answer about the institution's accounting professionals' level of knowledge in environmental accounting.	Level	2.64	3.00	3.00	1.13
Answer the degree of difficulty in identifying, measuring, and classifying environmental costs.	Level	3.96	3.00	4.00	1.32

Source: Research data.

Regarding the level of knowledge in environmental accounting, the mean value of 2.64 demonstrates a level between reasonable and low, with most of the answers at only a reasonable level. This may reflect the inception of the issue, as well as the lack of regulation and mandatory obligations in this accounting aspect.

We identify the significant difficulty of accounting professionals in effectively carrying out the accounting process and identifying, classifying, and measuring events, particularly those regarding environmental costs. The mean value of 3.96, approximate to the mode (4.0), evidences this statement. This signal, for instance, the difficulty in measuring the economic impact of a given failure in the environmental management system. Quantifying this type of occurrence - obtaining representative data and transforming it into comparable information - is a great challenge, as highlighted by Oleiro and Schmidt (2016).

4.4.2 Environmental Cost Management

To identify whether hospital accountants' viewpoints are aligned with those present in the literature, we questioned their agreement over the statement that the management of environmental costs in specific accounts can contribute economically to the institution. The result was nearly unanimous as to the contribution of these accounts to the accounting planning and the consequent generation of economic information to the institution. The proximity of the measures (mean, median, and mode) to the scale limit, 5, and the low standard deviation level (1.14) confirms this interpretation. These results corroborate those found by Salamoni et al. (2015).

Afterward, respondents were asked about the usefulness of specific groups of G/L accounts, which should be included in the institution's chart of accounts and record base, and preparation of statements. Tinoco and Kraemer (2011) reaffirm the usefulness of this structural organization of environmental accounting (Table 11).

Table 11
Specific environmental accounts

Are there specifically environmental accounts in the institution's chart of accounts?	Yes	%	No	%
Environmental costs	30	29.7	71	70.3
Environmental expenses	39	38.6	62	61.4
Environmental revenue	12	11.9	89	88
Environmental assets	20	19.8	81	80.2
Environmental liabilities	19	18.8	82	81.2
Total	**114**	**22.6**	**391**	**77.43**

Source: Research data.

Overall, we observed a low number of hospitals that include specific environmental accounts in their chart of accounts. Environmental expenses were those that most appeared segregated (38.6%), followed by environmental costs (29.7%). Environmental revenue, assets, and liabilities accounts appear in less than 20% of responses. In total, of the possible classifications of environmental accounts, only 22.6% of them are segregated.

Lucchese (2015) found a similar result in their study, which did not identify the adoption of a more structured environmental accounting when analyzing four private hospitals in southern Brazil. The study by Souza (2012) also corroborates the results regarding the absence of a specific chart of accounts for environmental events in the institutions.

As a result, there is no preparation of the balance sheet nor the environmental impact statement in the surveyed hospitals. This fact is also emphasized by Tinoco and Kraemer (2011). This absence explains the results regarding the analysis of environmental financial reports according to the low levels of the scales presented in Table 12.

Table 12
Analysis of environmental financial reports

	Scale	Mean	Median	Mode	Standard Deviation
		$\bar{x}$	$\tilde{x}$	M	σ
Answer about the frequency with which financial reports related to environmental management are analyzed.	Frequency	2.20	2.00	1.00	1.52

Source: Research data.

4.4.3 Hospital Environmental Costs

More objectively addressing issues related to environmental costs, this section seeks to identify the relevance of HCW treatment costs, its analysis, and its

usefulness. Such questioning is justified, as according to Rosa et al. (2015) these environmental costs in health care organizations are high (Table 13).

Table 13
HCW costs: treatment, management, and utility

	Scale	Mean	Median	Mode	Standard Deviation
		$\bar{x}$	$\tilde{x}$	M	σ
The costs of treating health care waste (HCW) correspond to a significant portion of the institution's total costs.	Agreement	3.80	4.00	5.00	1.39
Answer about how often HCW management costs are analyzed.	Frequency	3.39	4.00	4.00	1.51
Environmental costs are taken into account when formulating prices for the institution's services.	Frequency	3.17	3.00	3.00	1.01

Source: Research data.

On average (3.80), respondents agreed with the literature statement regarding the relevance of HCW treatment costs. The median and mode values are even more expressive; the "I completely agree" scale is the most prevalent.

A virtually identical result is found regarding the frequency with which data related to management costs are analyzed. The median and mode values of 4.0 are expressive. The mean value is lower (3.39), justifying the standard deviation value of 1.51, higher than that of the relevance of treatment costs.

Finally, regarding the use of information related to environmental costs in the formulation of service prices, the results are merely average (scale 3.0), with a standard deviation value of 1.0. Therefore, hospital managers consider of low usefulness the use of cost information in the formulation of their revenue.

From these results, it can be observed that hospital management employs, albeit precariously, reports to monitor environmental costs (treatment and management). However, hardly any attention is devoted to the managerial utility of such information, as in the formulation of service prices, for instance. Again, these results corroborate those found by Souza et al. (2012) and Lucchese (2015).

4.5 Statistical Analysis

In addition to the questions related to environmental accounting practices adopted in each hospital, respondents were asked about their satisfaction with the institution's performance. The question was addressed to environmental managers regarding performance in the environmental area, and to accountants regarding the institution's global financial performance (Table 14).

Table 14
Satisfaction with environmental and financial performance

	Scale	Mean	Median	Mode	Standard Deviation
		$\bar{x}$	$\tilde{x}$	M	σ
Answer about your satisfaction with the institution's environmental management performance.	Satisfaction	3.58	4.00	4.00	1.18
Answer about your satisfaction with the institution's financial result.	Satisfaction	3.66	4.00	4.00	1.23

Source: Research data.

The satisfaction of professionals in the accounting and environmental areas is aligned and positive according to the mean and median values, although the mean is slightly higher than the central scale value (approximately 3.6). The low standard deviation value demonstrates low dispersion in the answers. Overall, the staff is partially satisfied with their areas' performance despite the low adherence to management accounting procedures. We highlight that staff satisfaction with environmental and financial performance is used in the following sections as a proxy for measuring actual performance. This is in view of the difficulty of obtaining concrete numbers for such measures.

4.5.1 Hypothesis Testing

To test Hypothesis H_1, we used as a parameter of environmental cost control the responses compiled in Table 11 regarding the presence of specific accounts in the institution's chart of accounts. The values 1 and 0 were was assigned for presence and absence, respectively; 5 represented the highest level of environmental cost control. Spearman's correlation test was applied to the parameter of environmental cost control and the respondents' perception of financial performance. This correlation coefficient presented a p-value of 0.083, significant at the level of 0.05. It indicates a nearly null positive correlation between the variables, thus refuting Hypothesis H_1—that companies with greater control over environmental costs present greater financial performance.

Spearman's test was used to analyze the correlation between the hospitals' financial and environmental performance measures to validate or discredit Hypothesis H_2. The coefficient indicated $\rho = 0.580$ with a significance value of $\alpha = 0.05$, a moderate to strong positive correlation, indicating partial acceptance of Hypothesis H_2—that the hospitals' environmental and financial performances are positively related. Spearman's test attests to the variables' correlation but does not ensure a causal relationship between them.

Hypothesis H_3 was tested, that hospitals with the ISO 14001 certification display superior environmental performance. We used the Mann-Whitney test to compare the differences between the environmental performance of hospitals with and without the ISO 14001 certification. For a medians' comparison test, the null hypothesis H0 is defined as the equality between the groups, and H1 is the alternative hypothesis of statistical difference between the groups. The result

showed a p-value = 0.768, higher than the significance level (a = 0,05) stipulated for the test. Therefore, the null hypothesis that the samples come from a population exhibiting similar medians cannot be rejected. Thus, Hypothesis H_3 is not confirmed.

Spearman's correlation test was again used to test Hypothesis H_4, which showed ρ = 0.267, with a significance of a = 0.01. Although the index is positive, it is significantly low, indicating that Hypothesis H_4 is not confirmed—that hospitals employing higher level-knowledge professionals in HCW treatment and segregation display better financial performance. However, this result does not rule out a possible positive effect in financial terms due to the staff's high-level knowledge, since the institution's financial outcome depends on additional factors not addressed in the research.

Hypothesis H_5 was tested in two simultaneous tests. The Mann-Whitney test was used to verify if a statistical difference exists between the hospitals' size and the level of environmental cost control and environmental management. We used the number of beds as a proxy for the size. The control of environmental accounts was used for the level of environmental cost control (hypothesis H_1 test). To symbolize environmental management, the ISO 14001 certification was used. Regarding the control of environmental costs, there is a p-value = 0.041 with a significance of a = 0,05. Concerning environmental management, the result was a p-value = 0.002 and a significance value of a = 0.01. In both tests, the null hypothesis of equality between samples is rejected, and the alternative hypothesis is accepted. Therefore, larger hospitals present both higher levels of environmental cost control as possibilities for implementing ISO 14001. This result confirms Hypothesis H_5.

4.5.2 Regression Analysis

In this stage of the study, we sought to analyze possible predictive factors of the institutions' environmental and financial performances through multiple linear regression. To analyze the determinants of the dependent variable environmental performance (DESAMB), we used as independent variables the staff's level of environmental management knowledge (QUALIFAMB), the time since the hospital's foundation (TFUNDACAO), the hospital's size (PORTE), the presence or absence of ISO 14001 certification (ISO), and the hospital's financial performance (DESFIN).

The variables selected for the financial performance prediction analysis (DESFIN) were the staff's level of environmental accounting knowledge (QUALIFCONT), the hospital's time of foundation (TFUNDACAO), the hospital' size (PORTE), the level of control and management of environmental costs (CUSTOAMB), and the hospital's environmental performance (DESAMB). Note the names of the variables are based on their original designation in Portuguese. Some prerequisites must be considered in the elaboration of a regression model. Table 15 shows the correlation matrix of the environmental model.

Table 15
Correlation matrix of the environmental model

	DESAMB	QUALIFAMB	PORTE	TFUNDACAO	ISO	DESFIN
DESAMB	1.000					
QUALIFAMB	0.457	1.000				
PORTE	0.024	0.016	1.000			
TFUNDACAO	0.024	-0.138	0.574	1.000		
ISO	0.061	-0.010	0.643	0.068	1.000	
DESFIN	0.442	0.240	-0.011	0.060	0.010	1.000

Source: Research data.

To complete the analysis, Table 16 presents the correlation matrix of the financial model.

Table 16
Correlation matrix of the environmental model

	DESFIN	QUALIFCONT	PORTE	TFUNDACAO	CUSTOAMB	DESAMB
DESFIN	1.000					
QUALIFCONT	0.093	1.000				
PORTE	-0.011	0.075	1.000			
TFUNDACAO	-0.161	0.000	0.574	1.000		
CUSTOAMB	0.075	0.364	0.090	-0.072	1.000	
DESAMB	0.442	0.264	0.024	0.024	0.228	1.000

Source: Research data.

One of the prerequisites for a multiple regression model is confirmed from the data in Tables 15 and 16; the absence of multicollinearity between the independent variables. Correlations values from 0.8 up are considered a strong relationship, consequently impeding the model (Hair Jr. et al., 2009). There is no correlation between the variables that compromise the analysis in neither the environmental or financial models.

Tables 17 and 18 show the residual statistics of the environmental and financial models. Likewise, the tables verify the absence of outliers in both models' sample, since the predicted values, as well as the residues, are within the range of -3.00 and 3.00 standard deviations. The absence of outliers is also a prerequisite for the multiple regression model.

Table 17
Residual statistics of the environmental model

	Minimum	Maximum	Mean	Standard Deviation	N
Expected standard value	-2.304	2.147	0.000	1.000	101
Standardized residual	-2.815	2.466	0.000	0.995	101

Source: Research data.

Table 18
Residual statistics of the financial model

	Minimum	Maximum	Mean	Standard Deviation	N
Expected standard value	-2.338	1.726	0.000	1.000	101
Standardized residual	-2.883	2.410	0.000	0.975	101

Source: Research data.

The results of the environmental and financial regression models are shown in Tables 19 and 20, respectively.

Table 19
Results of the environmental regression model

Environmental Model	Unstandardized coefficient		Standardized coefficients	t	Sig
	B	Standard Model	Beta		
Constant	0.417	0.475		0.879	0.381
QUALIFAMB	0.448	0.097	0.397	4.621	0.000
PORTE	-0.001	0.001	-0.143	-1.152	0.252
TFUNDACAO	0.004	0.002	0.191	1.838	0.069
ISO	0.340	0.423	0.087	0.804	0.424
DESFIN	0.360	0.082	0.375	4.364	0.000
R-squared		0.354	Durbin-Watson		2.080
Adjusted R-squared		0.320	F-test		10.404

Source: Research data.

Table 20
Results of the financial regression model

Financial Model	Unstandardized coefficient		Standardized coefficients	t	Sig
	B	Standard Model	Beta		
Constant	2.198	0.417		5.266	0.000
QUALIFCONT	-0.021	0.107	-0.019	-0.196	0.845
PORTE	0.001	0.001	0.127	1.140	0.257
TFUNDACAO	0.005	0.002	0.248	2.240	0.027
CUSTOAMB	-0.044	0.083	-0.052	-0.531	0.596
DESAMB	0.482	0.098	0.462	4.913	0.000
R-squared		0.237	Durbin-Watson		1.676
Adjusted R-squared		0.197	F-test		5.906

Source: Research data.

The independence of residues is another key consideration for regression models, here conceptualizing residues as the difference between the predicted and realized values. This independence was measured by the Durbin-Watson test, which measures the correlation between each error term and that of the immediately previous observation. The environmental and financial models (Table 19 and 20) present Durbin-Watson test values of 2.080 and 1.676, respectively. Both

are within the test's expected acceptance parameters, which are values between 1.5 and 2.5.

Table 19 shows the regression model results for the institutions' environmental performance. Three of the variables added to the model were refuted. The variables related to size (PORTE), time of foundation (TFUNDACAO), and ISO 14001 certification (ISO) were not significant, presenting a significance value of 0.05. This allowed us to infer that these variables do not influence environmental performance since it is not possible to statistically confirm that these variables' coefficient is different from zero.

In turn, the variables related to the environmental staff qualification (QUALIFAMB) and financial performance (DESFIN) were significant, presenting a significance value of 0.05. Such finding implies these variables influence environmental performance. The standardized coefficient (beta) allows comparing the relevance of each variable to the model. The beta value of the QUALIFAMB and DESFIN variables are close to —0.397 and 0.375, respectively— indicating that they have a similar influence as predictors of the dependent variable. The fact that both values are positive indicates a positive correlation with environmental performance. Thus, it infers that better qualified environmental staff and improved financial performance are related to improved environmental performance.

The analysis resulted in a statistically significant model validated by the F-test value of 10.404 and 0.05 significance. Such findings attest that the model is a better predictor than chance. The adjusted R-squared value of 0.320 signifies that the dependent variable DESAMB is explained in 32% by the model. Despite being statistically significant, the model has low predictive power. Thus, it is understood that other variables not present in the model influence the environmental performance of the analyzed hospitals.

Table 20 shows the regression model results for the institutions' financial performance. The variables related to the staff's knowledge in environmental accounting (QUALIFCONT), hospital size (PORTE), and the level of control and management of environmental costs (CUSTOAMB) were refuted due to statistical non-significance presented by Student's t-test.

As in the environmental model, only two variables were statistically significant as predictors of the dependent variable in the financial model. These are the institution's time of foundation (TFUNDACAO), presenting a standardized coefficient value of 0.248, and environmental performance (DESAMB), with a standardized coefficient of 0.462. Both variables present a positive influence on environmental performance. The DESAMB variable's influence is nearly double that of the TFUNDACAO variable.

Although the financial model presents statistical significance (5.906 significance F value to a significance index of 0.05), the value of adjusted R-squared is significantly low (0.197). The dependent variable DESFIN is explained in only about 20% by the proposed model. Therefore, as mentioned in the environmental model, it is assumed that other variables not present in the proposed model influence the institutions' financial performance.

5 CONCLUSION

This study presented the still incipient issue of environmental cost management in hospitals. The subject has yet to be developed further, particularly in the Brazilian literature. The aim was to analyze the procedures used in the management of environmental costs by Brazilian private hospitals.

The research's specific objectives were identifying the environmental cost management procedures used in the researched hospital institutions, verify the use of environmental costs in the institutions' management, and identify the influence of factors linked to environmental cost management in the environmental and financial performance of the institutions.

The results prompt reflections on the issue of environmental accounting. We perceived a low level of knowledge regarding environmental accounting by the accountants of the analyzed institutions. This was perhaps motivated by the incipience of the issue, or even by the lack of more stringent regulations in this regard. Nevertheless, this helps to explain the low adherence to environmental cost management practices reported by the research.

This is not the case regarding environmental professionals. We identified a higher level of knowledge in this population, particularly regarding HCW management. It is widely evidenced in the literature that this issue is especially responsible for generating high costs for institutions and significant risks to environmental and human health. Such finding can be explained by the significant frequency with which staff receives training in environmental issues. This is not verified regarding the accounting personnel.

The accounting professionals' responses were nearly unanimous. They recognize that efficient environmental cost management segregated from traditional accounting financially benefits the institution; however, they do not employ this practice.

Regarding private institutions, in which profit is one of the main objectives, this non-adoption is, at least, contradictory. Possible explanations may be based on the staff's lack of knowledge or the evidence that smaller hospitals (characteristic of the sample) have limited resources and, therefore, more significant restrictions on investments in this regard.

From the institutions' viewpoint, it is clear they aim solely to comply with current legislation concerning environmental issues. There is no evidence of a strategic vision of hospitals in this issue. This fact is based on the low index of entities that present the ISO 14001 certification, even though it is recognized worldwide as the main environmental management tool in the business area.

A natural occurrence in studies of this nature is the identification of its main limitations, which emerges from the development of the research. The first limitation refers to the sample reached, equivalent to 8.5% of the population. Despite other studies possessing an even less significant sample, it is understood that a more representative sample may allow for greater objectivity concerning the study's population. In addition, a more significant sample may allow for more appropriate statistical techniques. We note that the results found are valid for the analyzed sample, thus, not allowing generalization for the study population.

There is also a significant concentration of hospitals from southeastern Brazil (51.5%), which may represent a limitation in the range of results. Another concentration of the sample regarding medium and large hospitals (94.6%) can also compromise the analysis and meanings concerning this variable.

From the obtained results, we highlight the need for further research on this issue. Including, but not limited to: (a) carry out multiple case studies in hospitals with the ISO 14001 certification in order to verify the implementation costs and economic benefits that the certification provides; (b) develop case studies in hospitals to financially measure all the environmental costs involved in the HCW management process and to thoroughly analyze all other institutional costs to obtain an overview of the cost structure and the actual relevance of environmental costs; (c) develop an accounting system model structured in a chart of accounts and specific cost centers for correct segregation of costs, expenses, environmental assets and liabilities, and preparation of management reports.

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