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Management Accounting Practices, Quality, and Performance in the Context of a Natural Monopoly

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Abstract

Objective: This paper aims to analyze the relationship between the use of management accounting artefacts and size, performance, and perceived service quality provided by Brazilian electric power distribution public utility concessionaires, a sector configured as a natural monopoly, marked by a large number of regulations and restricted to a limited number of performance strategies.

Method: The research involved 22 concessionaires from a universe of 63; for the relationship analyses, the non-parametric chi-squared, Kruskal-Wallis, Mann-Whitney U, and Kendall's τ tests were used.

Results: Results show a higher frequency in the use of traditional artifacts and suggest that the use of artifacts is related with the company size. No relationship could be verified though between the use of these artifacts and performance, nor with service quality. It may be concluded that in this context of natural monopoly, information obtained through artifacts do not lend themselves to the improvement of operations, even if a small number of organizations have taken initiatives in this sense.

Contribution: Various studies have investigated the relationship between management accounting practice (artifacts) and organizational performance in different contexts, however, very little is known about this relationship in highly regulated sectors.

Keywords: Management accounting. Management accounting artifacts. Electric utility companies.

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1. Introduction

The electricity sector is a natural monopoly, that is, its structure is based on the fact that the maximization of results and full efficiency in the use of resources in this economic activity are only possible when performed in conditions of exclusivity (Figueiredo, 2016). In this context, based on Law 8.987 of February 13th, 1995, which deals with the concessions and permissions for rendering public services, the adoption of differentiated tariffs was established, thus opening up a new phase for the services related to the distribution of electricity in the country: the State took on the role of regulator and supervisor of infrastructural services, aiming to reduce costs and charges and, at the same time, aiming for the quality of the services provided to society.

Based on this new institutional configuration, the National Electric Energy Agency (Aneel) would intend to align the companies' management with the provision of qualified and efficient services at competitive prices. Thus, among the main aspects of the new regulatory framework, the agency was concerned with determining the quality standards of the energy distribution services, monitoring the concessionaires' operations and fixing tariffs, considering that the determination of a ceiling price would encourage concessionaires to seek productivity through cost reduction (Pessanha, Souza, & Laurencel, 2007). For the concessionaires, the financial performance would tend to improve as operational efficiency increases, the levels of losses drop, default decreases, the transmission and distribution systems are improved and the number of regular consumers increases (Silvestre, Matos, & Filgueira, 2010). In view of this scenario, it is argued that the management accounting practices (or artifacts) – a comprehensive description of artifacts, activities, tools, management philosophies, tools, costing methods, management models, assessment methods, or costing systems management accounting professionals use in their activities (i.e., variable and standard absorption costing; present value and simulation, Benchmarking, Kaizen, Just-in-Time, etc.) (Soutes & Guerreiro, 2007) - would offer essential support to the decision-making process at the level of the concessionaires, mainly because it permits a detailed examination about the performance of activities, projects, products and the general economic-financial performance (Atkinson, Kaplan, Matsumura, & Young, 2015; Crepaldi & Crepaldi, 2014).

Based on the profitability and growth challenges of the electricity distribution companies, it can be assumed that a direct association exists between their economic-financial performance (in addition to size and perceived quality) and the use of artifacts, especially the so-called "modern" artifacts, as those artifacts are able to grant further grounds and security to decision makers regarding the reduction of losses in operations and the generation of value than the so-called traditional artifacts, these being more related to the determination of costs and the collection of information for financial control and planning.

Thus, this research starts from the following question: **Is there an association between the use of modern accounting artifacts and the size, quality of services provided and economic-financial performance in these companies?** The objective is to investigate the relationship between the use of these artifacts and the variables "size", "perceived quality", and" performance " in the scope of the power distribution concession companies.

Amidst the studies that investigate the relationship between management accounting practices and the organizational performance in various contexts, including Milk, Diehl, & Manvailer, 2015; Gonzaga, Luz, Guimarães, & Valerio, Junior, 2010; Espejo, Portulhak, & Martinez, 2015; Klein & Anderson, 2017; Soutes & Guerrero, 2007; Sulaiman, Ahmad, & Alwi, 2004), little is known about this relationship in the context of highly regulated sectors, i.e., natural monopolies. Moreover, there are no studies yet that explore how those practices influence the quality perceived by customers, a measure of value generation from the perspective of the strategy. Finally, this research contributes with *insights* to company managers in the sector, specifically on possible complementarities between financial and quality measures - thus contributing to the verification of the financial impact based on the generation of value - and on how the use of modern artifacts can help in the identification of low-cost initiatives that can contribute to the increase of perceived quality, which can bring intangible returns via reputation.

In the next section, we present a review of the literature, together with the respective hypotheses; followed by the method and the description of each analyzed variable, sampling procedure, data collection, and analysis procedures; the analysis of results, including further studies of the data obtained, and the conclusion, where mainly the findings are emphasized, which take the form of theoretical contributions, as well as suggestions for further research and fundamental references (mostly scientific papers and documents) for the research.

2. Literature Review

The set of artifacts and the verification of their use in this research context was based on the work of Soutes (2006) and the document *International Management Accounting Practice Statement* (IMAP #1): Mana*gement Accounting Concepts* cited by the same author(*International Federation of Accountants*, 1998). The classification of the artifacts into traditional and modern was also adopted based on the contributions of Sulaiman et al. (2004) and Soutes and Guerreiro (2007); this classification is legitimized by previous studies, such as Bjoornenak and Olson (1999), but it is also widely accepted in other research on the subject as verified through various citations.

Regarding the classification, this rests on the evolutionary stages of management accounting practices, in which are classified in traditional artifacts those present in the 1st and 2nd stages are classified under traditional artifacts, while those in the 3rd and 4th stages of the evolution are considered modern artifacts.

- **1st stage:** artifacts aimed at determining the cost and financial control, i.e., absorption costing, variable costing, standard costing, return on investment.
- **2nd stage:** artifacts focused on information for control and management planning, i.e., transfer price, constant currency, present value, budget, and decentralization.
- **3rd stage:** artifacts aimed at reducing resource losses in the operational process, i.e., activity-based costing, target costing, benchmarking, kaizen, just in time (JIT), theory of constraints, strategic planning, activity-based management (ABM).
- **4th stage:** artifacts aimed at creating value through the effective use of resources: economic value added (EVA), simulation, GECON, balanced scorecard, value-based management (VBM) (Soutes, 2006; International Federation of Accountants, 1998).

2.1 Use of modern artifacts and growth/company size

In relation to studies on the relationship between the use of modern artifacts and organizational size or growth, a significant convergence of results cannot be verified yet.

In a comprehensive review of the literature on the practice of managerial accounting in companies from China, India, Malaysia and Singapore, Sulaiman *et al.* (2004) found the predominant use of traditional artifacts to the detriment of modern artifacts. Although the authors argue about the insufficient information resulting from traditional artifacts like standard costing, budget, and break-even point in a sectoral context of high competition, they also recognize the potential costs of implementation of so-called modern artifacts in the sample, specifically in traditional manufacturing companies operating in hardly innovative sectors. Thus, considering the competitive dynamics as a factor that stimulates the use of modern artifacts, the authors draw attention to the need for awareness-raising about the existence of these artifacts, in addition to the lack of expertise and support from high management for their effective implementation. Based on these results, one can argue that the use of modern artifacts can take place according to the requirements of the business environment, i.e., in more dynamic sectors.

The study by Teixeira, Gonzaga, Santos, and Nossa (2011), based on the two hundred largest companies in the state of Espírito Santo and the use of artifacts, does not show a significant association between the use of modern artifacts and size; however, there are indications that the amount of assets is positively associated with a greater number of artifacts used and the intensity of this use. This conclusion complements the findings of Sulaiman et al. (2004) that the use of modern artifacts would be more related to the growth potential of the organization (based on the dynamics of the sector), rather than the size itself.

In an exploratory study involving nine publicly traded family companies in Brazil, Grande and Beuren (2011) sought to identify variations in management accounting practices from the management reports in the period between 1998 and 2007. Throughout this period, the authors identified the predominance of practices more focused on determining financial costs and control and reducing waste, stages 1 and 3 of the IMAP report #1, (*International Federation of Accountants*, 1998). Practices more related to the provision of information for planning and management control, as well as for the creation of value through effective resource use, that is, more complex practices that are more linked to strategic aspects, were partially verified, although not consolidated. Based on this study, it is verified that, even in a sample of large companies, the influence of family standards hardly matters in a professional organizational structure. Moreover, given the size of the analyzed companies, there is no direct relationship between the use of more modern practices and growth, suggesting that there is no direct relationship between size and the use of practices in this category.

Espejo, Portulhak and Martins (2015) investigated the management control practices in 45 federal university hospitals and showed that, in thirteen of the hospitals analyzed, there is a "low adherence" to artifacts. Among the most used practices, strategic planning and isolated analysis of revenues, costs and expenses, cost centers and service groups were identified. More advanced practices were identified in only two of the large hospitals. Thus, even when considering different samples of companies in different sectors, it can be verified that these results corroborate the developments pointed out in Grande and Beuren (2011).

By means of an organizational life-cycle approach, Paulo and Cintra (2018) noted how the use of these practices changes over the life-cycle of a firm in a sector marked by strong competitive dynamics, identifying that the company, in each of the life cycles, used management artifacts as the basis of its growth, but in a reactive and *ad hoc* manner, that is to say, in response to the problems that emerged with the growth of the company and the complexity of its operations. These results illustrate a partial relationship between size/growth and the use of modern artifacts.

Based on the contributions presented here, it can be concluded that there is no clearly direct relationship yet between the organizational size and the use of modern management accounting artifacts. Nevertheless, they shed light on the aspect of competitive dynamics and the complexity of problems and issues experienced based on the growth as factors that certainly influence the use of modern artifacts. Considering the activity limits of distribution companies within the new regulatory framework, i.e., delimitation of tariffs, requirement of quality standards, it can be inferred that the use of modern artifacts is much more preponderant for the growth strategies of these companies. Thus, the following hypothesis can be derived for the research in question:

H1: A positive association exists between the use of modern management accounting artifacts and the size in electric energy concessionaires.

2.2 Use of modern artifacts and company performance

Discussing the relationship between the use of modern artifacts in companies and organizational performance, Ittner and Larcker (1995) point out that the use of accounting practices cannot be linked to a competitive advantage, that is, to superior performance in relation to competitors. In a subsequent study (Ittner & Larcker, 1997), the authors showed, from a sample of companies from different countries, that the performance obtained from accounting practices or strategic control mechanisms varies from sector to sector; by arguing the companies' need for creative and flexible responses, the authors also showed that, in various contexts, the use of strategic controls can reduce the company's performance.

In Brazil, the study by Soutes and Guerreiro (2007) similarly pointed out that companies that used modern artifacts also displayed distinguished performance indices. No relationships were identified though between the use of artifacts and variables such as size, activity sector and shareholder control. In another sample of companies, Guerreiro and Soutes (2013), analyzing the relationship between *time-based management* techniques and organizational performance, did not identify an association between the use of these more complex techniques and the return on assets, a key indicator of productivity. This result leads us to believe that, despite the use of such practices, there are restrictions or bottlenecks beyond the organizational environment.

Gonzaga, Luz, Guimarães and Valerio Júnior (2010), when relating the size of the companies and the use of artifacts (i.e., *benchmarking*, budget, *balanced scorecard*, standard costing, strategic planning, absorption costing, transfer price, and variable costing) showed a positive relationship between the quantity and intensity of artifact usage and the value of the companies' assets, that is, a direct relationship was identified between the use of artifacts and performance.

In a study in Minas Gerais involving 68 agricultural cooperatives, Reis and Teixeira (2013) found that 19 of them, which used modern artifacts, presented average revenues and assets about 2 to 3.4 times higher than those using more traditional artifacts; these results lead us to believe that the use of modern artifacts contributes to organizational performance, although the reasons and underlying aspects need to be better investigated. In this same line, Morais, Coelho and Holland (2014), when examining the association between the use of artifacts and the goal of maximizing value in publicly traded companies in Brazil, illustrate that the amount of artifacts implemented does not contribute to maximizing the company's performance, but rather to its continuous modernization. Therefore, a more detailed discussion of this relationship is needed, involving the context of analysis of these artifacts, the speed of effective implementation (and institutionalization of these artifacts), as well as the main factors that influence their implementation in view of the competitive context.

From the above studies, a clear relationship between the use of modern artifacts and performance cannot yet be verified, a fact that entails the need for further verifications, in addition to greater consideration of the competitive context. In this case, due to regulatory limitations regarding tariffs and quality standards required of energy distribution companies, it can be argued that they can increase their performance through the use of modern management accounting practices, especially by means of decisions that influence the operational and financial efficiency. Thus, the following hypothesis was established:

H2: there is a positive relationship between the use of modern artifacts of management accounting and the economic-financial performance of electric energy concession companies.

2.3 Use of modern artifacts and quality

Despite the relationship of complementarity between quality management and management accounting, considering its effects on the performance of companies (Sedevich-Fons, 2018), in general, no studies were identified that analyze the relationship between companies' use of modern accounting artifacts and the perception of product and service quality. Nevertheless, some studies identified in this line served as support to ground the relationship between the use of artifacts and perceived quality, that is, the evaluation of product and service quality by the end customer.

One of the first studies to relate management accounting practices and quality is also Ittner and Larcker (1995) who, through extensive research involving companies in the automotive and computer sectors, showed that quality, as a management philosophy, is directly associated with the informational support of modern management accounting practices. Similarly, Ittner and Larcker (1997) showed, based on a sample of companies from different countries, the relevance of accounting information support to management actions focused on quality and that this information or necessary controls vary among sectors.

More recently, in a research conducted in the Brazilian context, specifically in the hotel sector, Lunkes et al. (2018) pointed to a trend to use non-financial measures, more focused on innovation and activity-based management, despite the predominance of the use of traditional management accounting practices. Considering the operational context of the hotel sector, marked by seasonality, demand volatility, perishability, reduced service time, high levels of investment in fixed assets and fixed costs, in addition to diverse and intensive labor, it can be concluded that quality is a key measure to guide and evaluate the multiplicity of operations as a means of differentiation or loyalty. This aspect illustrates a natural inclination to adopt accounting practices that adhere to the need of customers, as there are few possible strategies to increase revenues, to the detriment of optimization strategies. This same logic can be extrapolated to sectors such as energy, in which the setting of price limits (Pessanha et al., 2007) ends up limiting strategies to increase revenues. Thus, assuming that companies in the energy sector would tend to use informational subsidies through modern artifacts to ensure better controls and quality actions in their services in line with regulatory standards, the following hypothesis is suggested:

H3: A positive relationship exists between the use of modern management accounting artifacts and the consumer's perception of the service quality provided by electric energy concessionaires.

Based on this literature review, the next section presents the methodological aspects of the research, including descriptions of the approach, description and process of data collection and analytical procedures.

3. Method

In view of the research objective, a quantitative approach was adopted, using both secondary and primary data. The secondary data included sectoral documents obtained from the websites of the National Electric Energy Agency (Aneel), the Brazilian Association of Electric Energy Distributors (Abradee), and the reports are published on the websites of the companies, the concessionaires, while the primary data were obtained through a questionnaire sent to professionals working in the accounting, administrative and financial areas, who were knowledgeable on the management accounting routines and practices of the respective companies where they worked.

Regarding the sample, it should be highlighted that Brazil has 101 electricity distributors, 63 of them holding concessions and 38 licenses, in addition to 13 rural electrification cooperatives whose operation is governed by precarious authorization and going through regularization to receive a concession or license (Aneel, 2016a). Initially, the 101 distributors were considered, however, due to the low response rate, it was decided to work with the 63 concessionaires. Of these, 73% are private equity firms. As for size, 59% are large (>1 TWh) and 41% small. Thus, for procedural purposes, non-probabilistic sampling was considered, a situation in which the elements are chosen deliberately, but whose results are not representative of the population (Fonseca & Martins, 2012). In this line of reasoning, we adopted the quota sampling technique to maintain the proportionality of fundamental characteristics present in the population in the final sample (Curwin & Slater, 2007; Cochran, 2007). Quota sampling is a sample deliberately selected based on the judgment of the researcher, restricted to two stages: the generation of categories or quotas of control elements of the population and the selection of sample elements, based on convenience or judgment (Malhotra, 2012). Thus, 22 concessionaires were selected from a universe of 63 companies (35% of the population), observing their size (small or large) and the origin of capital (public or private), as shown in Table 1.

Table 1
Dimensions of the research universe and sample

Size	Private				Public			
	Universe	%	Sample	%	Universe	%	Sample	%
Large	25	54%	8	53%	12	71%	5	71%
Small	21	46%	7	47%	5	29%	2	29%
Total	**46**	**100%**	**15**	**100%**	**17**	**100%**	**7**	**100%**

Regarding the subjects' profile, it should be emphasized that three of them each answer for two companies. Thus, there are 19 respondents, 16 of whom work in the accounting area and the others in planning and/or control. Thirteen of them have been working in the current company for more than ten years, and the average time of experience after obtaining the undergraduate degree is 12 years. As for the degree of knowledge about the artifacts, 73% affirmed they had knowledge and 27% said they had little knowledge about the artifacts. Only the respondent from the concessionaire CPFL claimed to have in-depth knowledge on the subject. A brief characterization of the respondents is shown in Table 2.

Table 2
Profile of research subjects

Respondent	Concessionaire	Position	Educational background	Experience in the company (years)
1	COELCE / AMPLA	Planning and Control Manager	Accountancy	2
2	CELG Distribuição S/A	Economic and Financial Planning Superintendent	Economic Sciences	13
3	CEMIG	Controllership Superintendent	Accountancy	30
4	COPEL	Accounting Manager	Accountancy	13
5	LIGHT	Accounting Manager	Accountancy	7
6	CEEE D	Accountant	Accountancy	11
7	CEMAR / CELPA	Budget coordinator	Accountancy	1
8	CEB Distribuição	Accountant	Accountancy	6
9	ELETROCAR	Accounting Manager	Accountancy	37
10	BANDEIRANTE / ESCELSA	Accounting Manager	Accountancy	9
11	Muxfeldt, Marin e Cia. Ltda.	Accounting Supervisor	Accountancy	20
12	Força e Luz Coronel Vivida Ltda.	Administrative Adviser	Administration	30
13	CHESP	Accounting department manager	Accountancy	40
14	Nova Palma Energia Ltda.	Accountant	Accountancy	2
15	DME Distribuição S/A	Accounting Manager	Accountancy	27
16	Iguaçu Distribuidora de Energia Elétrica Ltda.	Accountant	Accountancy	30
17	COCEL	Accountant	Accountancy	16
18	Hidroelétrica Panambi S/A	Accounting Supervisor	Accountancy	15
19	CPFL Energia	Accounting Coordinator	Accountancy	19

The questionnaire, prepared based on the list of artifacts presented in Soutes (2006), aimed to gather information about the companies' knowledge and use of the artifacts. It was applied throughout the second semester of 2017.

Combining the primary and secondary data for analysis, Table 3 below describes the respective data sources, analysis variables and their breakdown.

Table 3

Variables used in the research

Variables	Specification of the variables	Source
Accounting artifacts	Activities, tools, instruments, philosophies and management models used by management accounting professionals in the practice of their functions (Soutes, 2006).	Data obtained from a questionnaire based on Soutes (2006) and *International Federation of Accountants* (1998)[1]
Performance	$Efficiency = \frac{PMSO_{A}{}^{2}}{PMSO_{R}{}^{3}} - 1$	ANEEL (2016a; 2016b; 2017)
	$Profitability = \frac{EBIT_{A}{}^{4} - EBIT_{R}{}^{5}}{BRL^{6}}$	ANEEL (2016a; 2016b; 2017)
	Overall performance continuity indicator (DGC): examines the level of continuity of the service the distributor provided in relation to the limits set by ANEEL for its concession area and in comparison to the other distributors. For the calculation, the following indicators are considered: *DEC*[7] and *FEC*[8].	ANEEL (2013; 2016a; 2016b; 2017)
Aneel Consumer Satisfaction Index (Iasc)	Residential consumer satisfaction indicator regarding the services provided, consisting of five variables: perceived quality, perceived value, overall satisfaction, trust in the supplier and fidelity.	ANEEL (2016b; 2017)
Size of the concessionaire	Companies are considered large when the billing exceeds 1 TWh (terawatt hour), and small when equal to or lower than 1 TWh.	ANEEL (2016a)
Origin of capital	Stock control can be public or private.	ABDEE

Obs.: [1]A non-updated list of these artifacts was chosen due to the possibility to compare the results with other studies that used the inventory based on Soutes (2006), departing from IFAC (1998). [2]$PMSO_{A}$ = Adjusted indicator of personnel, material, services, and others for the past 12 months. [3]$PMSO_{R}$ = Regulatory indicator of personnel, material, services, and others for the past 12 months. [4]$EBIT_{A}$ = adjusted earnings before interests and taxes for the past 12 months. [5]$EBIT_{R}$ = regulated earnings before interests and taxes for the past 12 months. [6]*BRL* = Net remuneration base. [7]*DEC* = Equivalent Duration of Interruption per Consumer Unit: number of hours a consumer had no electric energy during a certain period. [8]*FEC* = Equivalent Interruption Frequency per Consumption Unit: identifies how many times, on average, electric energy was interrupted at the consumer unit.

In relation to sector-specific performance measures, profitability is obtained by the quotient of the difference between the realized operating profit (Ebit) and regulatory operating profit (realized less regulatory) by the net remuneration base (amount of investments made by companies in the provision of services to be covered by tariffs charged to consumers). Thus, the higher the index, the more profitable the enterprise. Efficiency, in turn, is obtained through the quotient between the efficiency of personnel, material, services, and other expenses (realized PMSO) and the regulatory PMSO, a level considered as a *benchmark* for energy distribution companies. Thus, the higher the value obtained from this quotient, the lower the company's efficiency in cost management. On the other hand, the overall performance continuity indicator, an operational indicator, is calculated by means of the simple arithmetic mean of the ratios between the values realized and the annual regulatory limits of the indicators equivalent duration of interruption per consumer (DEC) and equivalent frequency of interruption per consumer unit (FEC). Thus, DGC indices lower than 1 are desirable, as this is a regulatory limit for interruptions in power transmission.

The perceived quality of energy distribution services is measured by a general residential consumer satisfaction indicator composed of five variables: perceived quality, perceived value, overall satisfaction, trust in the supplier and fidelity. Perceived quality consists of 17 items, grouped into three dimensions: information to the client, access to the company and reliability of the services; perceived value evaluates the user's perception in the economic dimension (3 items); overall satisfaction, broad satisfaction with the company and distance between the company under analysis and a company that is perceived as the ideal (3 items), trust in the provider from the point of view of the consumer (4 items), and loyalty, as measured from the analysis of the intent to exchange (3 items). Each of these five variables uses a distinct evaluation scale and each indicator is calculated using Partial Least Squares (PLS) modeling and then weighted in the Aneel Consumer Satisfaction Index (Iasc). The data to calculate these indicators are collected each year through interviews in randomly selected households.

For the statistical analysis of the hypotheses, the nonparametric tests highlighted in Table 4 were used.

Table 4
Tests used to treat the hypotheses

	Treatment	
H1	A positive association exists between the use of modern management accounting artifacts and the size in electric energy concessionaires.	Chi-squared test (χ^2)
H2	A positive relationship exists between the use of modern management accounting artifacts and the economic-financial performance of electric energy concessionaires.	Mann-Whitney test (U)
H3	A positive relationship exists between the use of modern management accounting artifacts and the consumer's perception of the service quality provided by electric energy concessionaires.	Mann-Whitney test (U)

Nonparametric tests are applicable to the analysis of small samples (N<30) and do not depend on population parameters such as mean, variance, standard deviation etc., derived from their respective sample estimates (Fonseca & Martins, 2012; Bruni, 2012). To obtain group profiles among the associated variables, the Kendall test was used (Field, 2009). To develop the analyses, IBM *softwareStatistical Package for the Social Sciences* (SPSS) version 18 was used.

In the next section, the data analysis is presented based on a documentary survey and a questionnaire in the energy companies' planning and controllership areas.

4. Analysis of Results

Based on an initial descriptive analysis of the use of the management accounting artifacts in the selected sample, among the modern artifacts, the predominance of strategic planning (19 companies), *benchmarking* (18 firms), and the *Balanced Scorecard* (19 companies) was verified; with regard to the use of traditional artifacts, these being used more than the modern ones, the budget (20 companies), variable costing (18 companies), return-on-investment (16 companies) and value-based management (VBM) (15 companies) stand out; the least used artifacts, all of which are classified as modern, are: *kaizen* (2 companies), Gecon (2 companies) and Just-in-Time (3 companies). The predominant use of traditional over modern artifacts is noticed, as 16 companies (73% of the sample) use mostly traditional artifacts, differently from results like Soutes and Guerreiro (2007), in which 66% of the companies under analysis used modern artifacts. This is a relevant finding as, assuming that the regulatory influence described by Pessanha et al. (2007) and Silvestre et al. (2010) required the use of modern artifacts, more directed to reducing resource losses in the operational process and value creation through operations (Soutes, 2006; *International Federation of Accountants*, 1998), it was expected that most of the companies investigated would make use of these artifacts rather than of more traditional ones. In addition, the variables previously defined for the study are more directly associated with the purpose of the so-called modern artifacts.

When verifying the respondents' knowledge about the management accounting artifacts, it was observed that 73% of them have knowledge; the other respondents revealed either little or no knowledge.

Regarding the reliability of the responses regarding the use of artifacts, identified by the Cronbach's alpha test, a value of 0.9 was obtained, thus indicating an excellent level for statistical inferences with 90%, higher than what is generally accepted, that is, 0.7 (HAIR et al., 2009).

4.1 Use of modern artifacts and company size

To test hypothesis H1, we used the Chi-Squared test (χ^2), aiming to detect a significant association between two categorical variables (Field, 2009). As the χ^2 coefficients in the table of critical values depend on the level of significance adopted and the number of degrees of freedom, a 5% significance level (α) was used. For the sake of analysis, the responses favorable to the use of modern artifacts were restricted to grades 4 and 5 on a scale from 1 to 5 (Table 5).

Table 5
Calculation of contingency and Chi-squared test of association between use of modern artifacts and the size of the enterprise

Size	Yes (grades 4 and 5)		No (grades 1, 2 and 3)		Total
	Answers	Chi-squared	Answers	Chi-squared	
Large	90	1.85	79	1.58	
Small	42	2.67	75	2.29	
Total	**132**	-	**154**	-	**286**

4.2 Use of modern artifacts and performance

To test H2, we considered the cross-analysis of the companies' financial indicators for the year 2016 (efficiency, profitability and DGC) with the use or not of modern artifacts. The following rule was adopted for a proper assessment: grade 1 (yes) if the average response on the use of modern artifacts is higher than 3, and 0 (no) if not. To test this hypothesis, the Mann-Whitney test (*U*) was used. According to Bruni (2012), this test is the nonparametric version equivalent to the parametric *t*-test (Student), and should be used in the analysis on two samples, regardless of whether they were extracted based on equal means. The *U* values, calculated from that test, evaluate the degree of interlacing of the data for the two groups after sorting.

The p-value test indicates the probability that more extreme statistical values than what was observed will occur, under the premise that the null hypothesis is true. To examine the null hypothesis against the alternative hypothesis, the scale of evidence suggested by Fisher was used, in which this null hypothesis is rejected for those cases in which the p-value is inferior to 0.05 (Morettin, 2009).

4.2.1 Efficiency indicator

The statistical comparison of the modern artifacts and efficiency indicator variables revealed that the result for the p-value was higher than the significance level (0.8212 > 0.05 with U = 56), concluding that there are no significant differences between the values of the efficiency indicator and the companies that use modern artifacts or not (Figure 1).

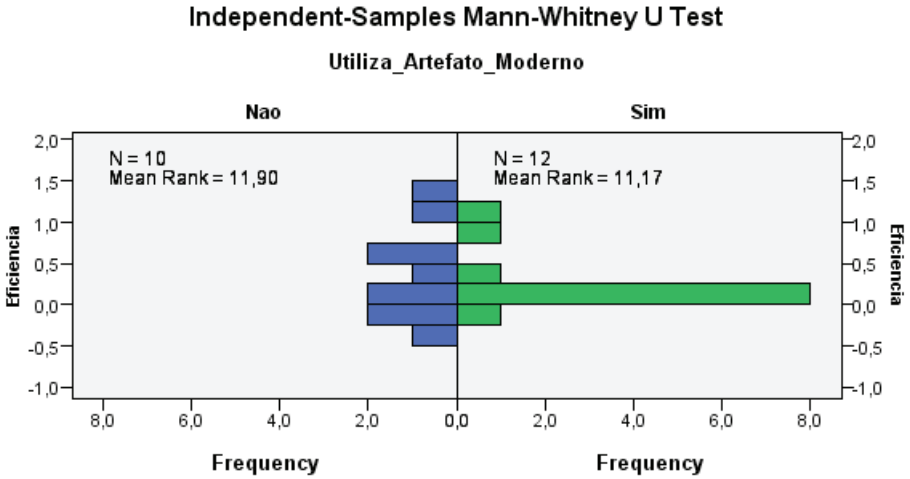

Figure 1. Mann-Whitney efficiency test for independent

4.2.2 Profitability indicator

The evaluation of the variables modern artifacts and profitability indicator revealed that the result obtained for the p-value was higher than the level of significance (0.2030 > 0.05 with u = 79.5), indicating, therefore, no significant differences between the values of the profitability indicator and the companies that use or not modern artifacts (Figure 2).

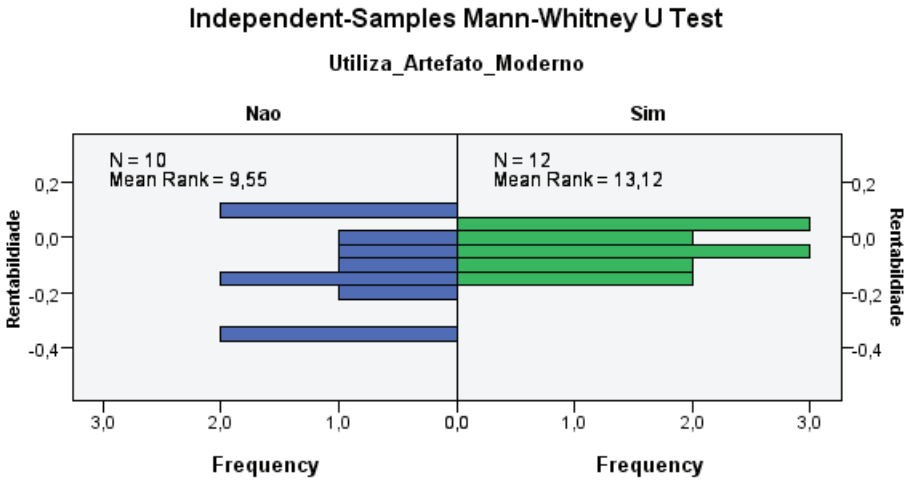

Figure 2. Mann-Whitney profitability test for independent samples

4.2.3 Overall Performance Continuity Indicator (DGC)

When applying the statistical test to the variables modern artifacts and DGC, a p-value higher than the level of significance (0.8212 > 0.05 with u=63.5) was evidenced, thus deducing that there were no relevant differences between the values of the DGC indicator and the companies that use or not modern artifacts (Figure 3).

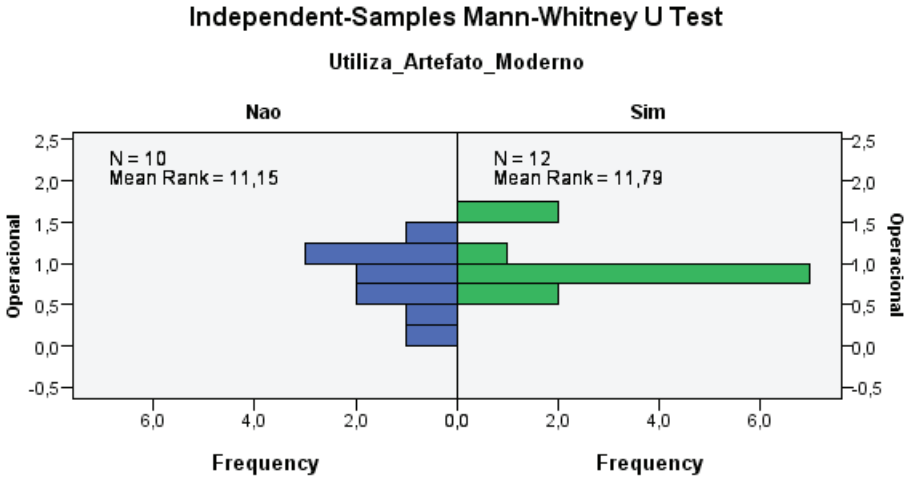

Figure 3. Mann-Whitney operationality test for independent samples (DGC)

The results of this item demonstrate that the use of modern artifacts does not imply better economic-financial performance, converging with the results found by Reis and Teixeira (2013), according to which there is no relationship between the use of modern artifacts and differentiated financial performance, that is, the group classified as traditional presented the same performance averages as the group classified as modern. On the other hand, the results presented here diverge from those found in Soutes and Guerreiro's research (2007), in which the Brazilian companies included in the studied sample used artifacts classified as modern and presented a differentiated financial performance.

In that sense, based on the description of the performance indicators in the methods section, it can be argued that the need to frame the performance within regulatory limits may be a limiting factor to the adoption or incorporation of artifacts. Day-to-day control activities, in this sense, can make the search for managerial improvement via modern artifacts a non-priority aspect, as the regulatory measure itself serves as the "guide" of management efforts, or the search for balance between different indicators is the main objective to be achieved. Thus, it is assumed that more personalized tools are used.

4.2 Use of modern artifacts and perceived quality

To investigate the hypothesis that the use of modern accounting artifacts would imply a better perception of the consumer as to the quality of the services provided by the concessionaires (H3), the Mann-Whitney test was adopted. The result of the statistical test displayed in Figure 4 proves that there are no significant differences between the values of consumer satisfaction indices and the use of modern artifacts, as the p-value was higher than the level of significance (0.0692 > 0.05 with U=32).

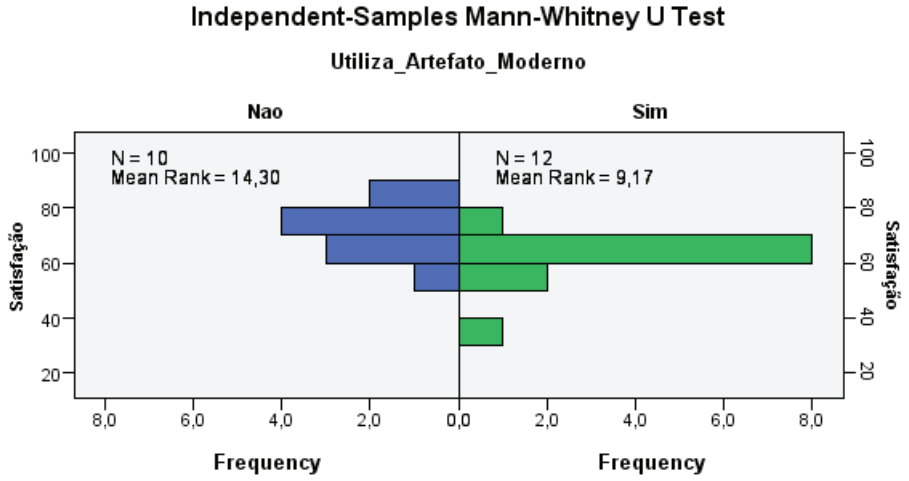

Figure 4. Mann-Whitney test for independent samples (consumer satisfaction)

In view of these considerations and the results obtained, it can be argued that, although the use of the modern artifacts implies a better basis for decisions regarding the reduction of operational costs and value creation for the end customer through operations, their use within the surveyed companies is not preponderant for compliance with the regulatory quality standards.

On the other hand, it is worth discussing some of the indicators: in much of the country, there is no way for the consumer to switch suppliers, which ultimately distorts the fidelity variable (intention to change). In addition, global satisfaction envisages consumer knowledge or discernment about the potential evolution of the company's operations and services, which can also lead to distortions in the evaluations. Therefore, quality indicators may be dissociated from what the modern artifacts can provide in terms of support for strategies to create value for consumers.

Hence, it is speculated that business management as a whole is more focused on meeting the sectoral regulations, which do not necessarily reflect the conditions or value attributes for energy users, which characterizes the government and regulatory agencies as priority *stakeholders*.

4.4 Complementary analyses

As a complement to the analysis of the variables, the Kendall correlation test (τ) was adopted. Kendall's *Tau* is a non-parametric correlation coefficient, similar to Spearman's correlation coefficient, however, used when one has a small set of data and a large number of tied ranks (Field, 2009). This coefficient is used to measure the association between two variables at the ordinal level and its value varies between +1 and -1, Both the sense, whether positive or negative, and the intensity of this relationship can be determined (Malhotra, 2012). Thus, we have H0: τ = 0, when there is no correlation between the two variables and H1: τ 0 0, when there is a correlation between the two variables. If the p-value is below a given significance level (*p-value* < 0.05), the null hypothesis is rejected for that significance level. Table 6 shows the accepted hypothesis, the intensity of the association and the sense of the relationship.

Table 6
Kendall correlation test

Variable	Variable	Kendall τ	P-value	Hipótese
Efficiency	Obs. Modern Artifact	0.0485	0.7556	H0
Efficiency	Obs. Traditional	0.0493	0.7545	H0
Profitability	Obs. Modern Artifact	0.0749	0.6305	H0
Profitability	Obs. Traditional	0.0493	0.7546	H0
Profitability	Efficiency	-0.6711	<,0001*	H1
DGC	Obs. Modern Artifact	0.1363	0.3806	H0
DGC	Obs. Traditional	0.1522	0.3342	H0
DGC	Efficiency	0.3764	0.0151*	H1
DGC	Profitability	-0.2101	0.1750	H0
Satisfaction	Obs. Modern Artifact	-0.2276	0.1417	H0
Satisfaction	Obs. Traditional	-0.2585	0.0997	H0
Satisfaction	Efficiency	-0.3486	0,0239*	H1
Satisfaction	Profitability	0.1482	0.3371	H0
Satisfaction	DGC	-0.2130	0.1667	H0
Qty. Modern Artifacts	Efficiency	0.0774	0.7322	H0
Qty. Modern Artifacts	Profitability	0.1505	0.5037	H0
Qty. Modern Artifacts	DGC	0.3568	0.1031	H0

Obs.: (*) Test significant at 5%.

According to the results shown, the lower the DGC indicator, the lower the efficiency indicator ($\tau = 0.3764$, *p-value* = 0.0151); the higher the company's profitability indicator, the lower the performance indicator ($\tau = -0.6711$, *p-value* < 0.001), and the lower the efficiency indicator, the higher the satisfaction indicator ($\tau = -0.3486$, *p-value* = 0.0239). There is no correlation between the number of modern artifacts used and the economic-financial performance of the concessionaires (*p-value* > 0.05). It is concluded that the DGC and profitability indicators are predominantly correlated, with the efficiency indicator, knowing that the efficiency indicator is the only variable correlated with customer satisfaction. The data suggest that company efficiency can be influenced by a satisfactory financial performance, which in turn can ensure greater consumer satisfaction by targeting resources to quality actions.

According to Aneel (2016A), not infrequently, difficulties related to the distributors' finances stem mainly from the low efficiency in managing operating costs, rather than from the companies' debt volume.

5. Conclusion

This research aimed to analyze the relationship between the use of modern accounting artifacts and the size, economic-financial performance and quality of services provided by a sample of Brazilian electricity distribution concessionaires.

To characterize the accounting artifacts the companies used, data analysis was segregated by stages, considering a higher frequency around the traditional artifacts. Strategic planning is present in 19 of the 22 companies; budget in 20 of them; *benchmarking* in 18 and *Balanced Scorecard* in 19 companies, these being the most used artifacts. On the other hand, Kaizen, in two of the companies; Gecon in two and *Just in Time* in three of them, are the least used artifacts. Overall, it can be concluded that very few concessionaires have their management accounting focused on value creation through the effective use of the funds based on drivers such as value to the customer, shareholder value, and organizational innovation (*International Federation of Management Accountants*, 1998; Soutes & Guerrero, 2007) and that even in sectors with complex regulatory conditions, the use of modern artifacts in line with these requirements is not preponderant, as it was conceived *a priori*.

To verify the relationship between the size of these companies and the use of modern management accounting artifacts, the hypothesis H1 was tested through the Chi-Squared test, proving the existence of an association between the size of the concessionaires and the use of modern artifacts. It can be speculated that, in sectors marked by intense regulation, especially in the case of the electricity sector, organizational growth, mainly through mergers and acquisitions, may be closely related to the use of resources focused on value creation, both for the consumer and for shareholders. Thus, the use of the modern artifacts becomes essential.

Regarding the existence of an association between the use of modern management accounting artifacts and economic-financial performance, hypothesis H2, its rejection was verified through Mann-Whitney U's test, i.e., it cannot be affirmed that the use of modern management accounting artifacts is related to the economic-financial performance. Based on a comparison with previous studies, this finding converged with the research by Reis and Teixeira (2013), but diverged from Soutes and Guerreiro (2007). It should be emphasized that those authors use a plural sample with companies from different sectors, unlike this study that uses a sample of companies with a specific profile. Thus, in order to enhance the visibility of the relationship between the use of artifacts and performance, further investigations are suggested about institutional influences on the drivers of these companies' operating costs, starting from the premise that charges deriving from regulatory frameworks do not necessarily require more sophisticated functions of management accounting practices to support management decision making. On the other hand, if the use of the modern artifacts in this regulatory context is essential, it can be argued that the adoption and institutionalization of these practices in the analyzed companies deserve a more detailed look. In this sphere of analysis, legal demands may supplant the need for management accounting practices more aligned with value creation by management.

To evaluate the relationship between the use of artifacts and the level of quality of the services provided by these companies, we applied hypothesis H3, according to which the use of the modern artifacts contributes towards a better consumer perception of the services provided by the concessionaires. The result of Mann-Whitney's U test rejected this hypothesis, which leads to the conclusion that there are no relevant differences between the coefficients of the Satisfaction Index and the use of modern artifacts. The absence of a relationship between the use of the modern artifacts and the quality perceived by the consumers of the companies in the sample leads us to believe that quality indicators are independent of the use of management accounting practices more focused on value creation, with low-cost actions such as transparency as an important factor of perceived quality.

According to Table 5, adopting the Kendall correlation test, it can be concluded that there is no correlation between the number of artifacts and the economic-financial performance of the concessionaires. The DGC and profitability indicators are significantly correlated with the efficiency indicator though, which, in turn, is exceptionally correlated with customer satisfaction. Therefore, a further causal check is suggested between the efficiency of companies and their consequent financial performance, and the guarantee of a better perceived service quality by the consumer.

Given these considerations, it is emphasized that the main contribution of this study is the fact that most of the companies in this investigation do not yet perceive the modern artifacts as relevant to the creation of value to the consumer or shareholder, or as a useful source of management support to the regulatory limitations inherent in a natural monopoly.

Despite the findings, some limitations should be considered with regard to this research: the fact that we worked with a non-probabilistic sample, which means that the results are valid only for the sample studied and the inherent inferences are restricted to the group in question. The quantitative analysis involved only modern artifacts. Therefore, caution is recommended with regard to the extrapolation of the research findings and also with regard to comparisons with other studies related to the use of management accounting artifacts.

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