Customer Satisfaction with Public Services: An Analysis of the Impacts of Public Policies in the Brazilian Electricity Sector

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Abstract: *Customer focus is one of the most disseminated management mindsets demanded by the ISO9001 standard, thus the assessment of customer satisfaction is one of its mandatory requirements. The perceptions of consumer satisfaction within the electricity sector has been collected and disclosed by the IASC – ANEEL Consumer Satisfaction Index since 2000. This article aims to analyze the main regulatory frameworks and their impacts on customer satisfaction in the Brazilian electricity sector over the twenty years of IASC data analysis and calculation. As a methodological procedure, IASC data were submitted and assessed in statistical tests to evaluate the behavior of consumer perception, regarding satisfaction with the service provided. The results of the study suggest that the enactment of public policies positively affects the perception of customers. This article is a contribution to promoting the institutionalization of performance analysis measures regarding the perception of consumer satisfaction in policies and guidelines for public service control bodies.*

Keywords: Customer satisfaction; ISO9001; Energy distribution; Electricity; Regulation; Quality of service

1. Introduction

1.1 Relevance

Since the 1990s, the Brazilian federal government has established rules and minimum quality standards for electricity distributors, through ANEEL – National Electric Energy Agency (BALTAZAR, 2007). Thus, the general conditions of supply and the rights and duties of consumers are determined by ANEEL Normative Resolution No.414/2010 [1]. (ANEEL, 2010).

Starting in 2000, ANEEL (2021a) annually conducts a survey to obtain the IASC - ANEEL Consumer Satisfaction Index. This methodology aims to evaluate residential consumer satisfaction with the services provided by electricity distributors.

Implemented by Normative Resolution 2502/2017, the IASC Award regulation was instituted by ANEEL to recognize the best Brazilian distributors in terms of performance and results (GOULART, 2013).

Reinforcing the principle of focusing on customers, Normative Resolution 414/2[2] makes mandatory for electricity distributors the certification ISO9001 - Quality Management Systems under four (4) scopes: (i) article 155 - process of data collection and assessment of commercial service standards; (ii) article 163 - process of handling consumer complaints; (iii) article 191 - process of data collection and generation for calculating telephone service quality indicators and; (iv) article 137 - process for measuring equipment calibration (ANEEL, 2010).

Additionally, Aneel (2021b) established in module 8 of the Electricity Distribution Procedure in the National Electricity System - PRODIST - that distributors have certifications for their data collection processes and calculation of individual and collective indicators in the standards of ISO9001 – Quality Management Systems.

The ISO9001 standard – Quality Management Systems – brings requirements for organizations that intend to demonstrate their ability to provide products/services that meet customer requirements, in addition to other subscribed requirements, and with a view to increasing customer satisfaction (ABNT, 2010).

In this environment regulated by ANEEL and supervised by the State electric energy agencies, the distributors, then, have the obligatory certification of their quality management systems in the ISO9001 normative standard, at least in the processes defined by Resolution 414/2010 and Prodist module 8.

Given this context, there is the possibility of gathering data from the last twenty IASC calculations that are publicly available[3], assessing the impact of regulatory frameworks and analyzing whether the indicator presents a differentiated behavior, based on ANEEL's efforts so that electricity distributors maintain a customer - centric mindset.

The central question of the research, therefore, is to understand whether the policies, actions, and norms of the regulatory body ANEEL have produced impacts on the perception of customers, having as a starting point the compulsory ISO9001 certifications for electricity distributors.

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[1] Author's note: In 2022, Normative Resolution No. 1,000/2021 came into force, which consolidates the main rules of the Agency for the provision of the public electricity distribution service, which sets out the rights and duties of consumers.
[2] Author's note: With the enactment of Resolution No. 1,000/2021, the mandatory certification of ISO9001 in the scopes defined by

ANEEL became a requirement of Annex VIII of Normative Resolution No. 956/2021 PRODIST Module 8 – Quality of Electric Energy Supply.
[3] IASC data are published annually, after verification, on the ANEEL website - https:// aneel.gov.br/indicadores

Although ANEEL establishes policies and norms aimed at improving the sector, the latest available survey of the CNI Survey, on the quality of public services, shows that only 48% of consumers positively evaluate the electricity supply service (CNI, 2026), as shown in Graph 1.
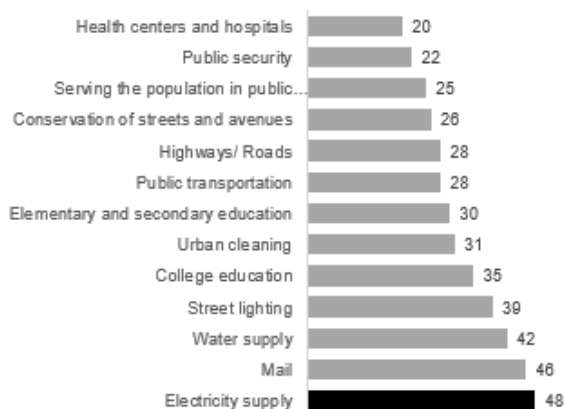
Graph 1: CNI survey evaluating the quality of public services (%)
Source: Adaptation prepared by the author of the Bulletin of the National Confederation of Industry, (CNI, 2016).

One of the benefits obtained from ANEEL's operating strategy can be seen in the CNI survey itself, shown in Graph 1, which shows that the electricity supply service has the best evaluation when compared to other public sectors (CNI, 2016).

2. Literature Review

2.1 The Electric Sector

In 1990, President Fernando Collor created the National Privatization Program – PND. With the election of President Fernando Henrique Cardoso, the privatization program continued. This program provided a broad opening for the sector, creating a free market for contracting energy. Such changes were intended to reduce the vulnerability of the national electricity sector and establish competition in order to achieve the objectives that ensure efficiency in the operation and provision of services to consumers. Another purpose of this reorganization was to guarantee reasonable tariffs and the creation of a stable regulatory environment that would serve as a stimulus for competition, bringing attractiveness to private investments under the guidance of short, medium and long - term sectoral planning (CAMARGO, 2005; ABRADEE, 2020b).

According to Camargo (2005), in 1996 the National Electric Energy Agency – ANEEL was created, an autarchy under a special regime linked to the Ministry of Mines and Energy, with the attribution of legislating and supervising compliance with pre - established objectives. Still according to Camargo (2005), the regulation, then, disaggregated the sector in the segments of commercialization, generation, transmission and distribution of electric energy, creating autarchies that allow and regulate the functioning of the whole system. Figure 1 demonstrates how the segmentation of the electricity market in Brazil was carried out.

The main regulatory frameworks were arranged in the timeline of Figure 2, to summarize the interventions carried out in the respective presidential governments in the history of Brazil.
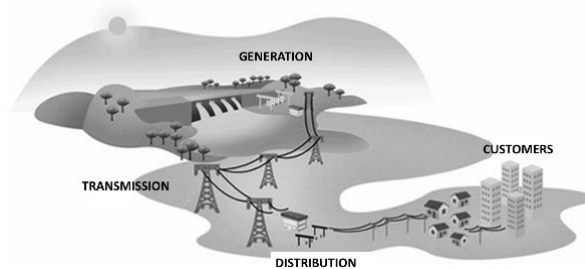

Figure 1: Segmentation of the electricity sector
Source: ABRADEE (2020b)

Considered legal monopolies, the transmission and distribution segments have a dynamic in which prices and quality of services are regulated and the incentive price regulation model prevails, requiring scale and high investments so that they can be economically viable and practice fair prices (ANEEL, 2020).

Aneel has the attributions of regulating and supervising the production, transmission, distribution and commercialization of electric energy, ensuring the quality of the services provided, the universalization of service and the establishment of tariffs for final consumers, always preserving the economic and financial viability of the agents and industry. (Camargo, 2005)

The typical value chain of an electric energy distributor consists of the activities of (i) Purchase of energy; (ii) maintenance of the network that distributes electricity, which is within reliable quality parameters; (iii) revenue management and; d) support processes to guarantee the necessary resources for these activities. Regarding the tariffs, they are regulated by ANEEL itself, based on the Concession Contracts of each distributor and their respective readjustment/revision criteria (ANEEL, 2020).

The performance of the distributors is measured in accordance with established ANEEL resolutions, in addition to the deadlines and processes to be implemented in the relationship with customers, including losses, quality of supply, service times and, in some cases, parameters of operational processes (ANEEL, 2010).

Such regulatory and legal dynamics of distributors, according to ANEEL (2020), establishes a series of specific requirements and indicators for the electricity distribution sector. Part of these indicators have regulated limits and are constantly inspected by state electric power agencies.

2.2 ISO 9001 - Quality Management System

According to the Brazilian Association of Technical Standards - ABNT (2020), ISO9001 is the most accepted standard worldwide and its adoption is considered a strategic decision for companies that operate in complex, demanding and competitive environments.

The benefits associated with the adoption of the ISO9001 normative requirements are characterized by greater profitability, higher revenues, better budgetary performance, cost reduction, greater return on investment, better competitiveness, greater customer retention and loyalty, greater effectiveness in decision making, optimized use of resources and processes, among others (ABNT, 2020).

For Vitoreli (2011), the ISO9001 standard is based on the principles of total quality management, which addresses customer focus, leadership, people involvement, process and systemic approach to management, continuous improvement, and fact - based decision as principles.

According to the *International Organization for Standardization* – ISO (2020), at the end of 2019 the total number of ISO9001 certificates issued in the world was 883, 521.
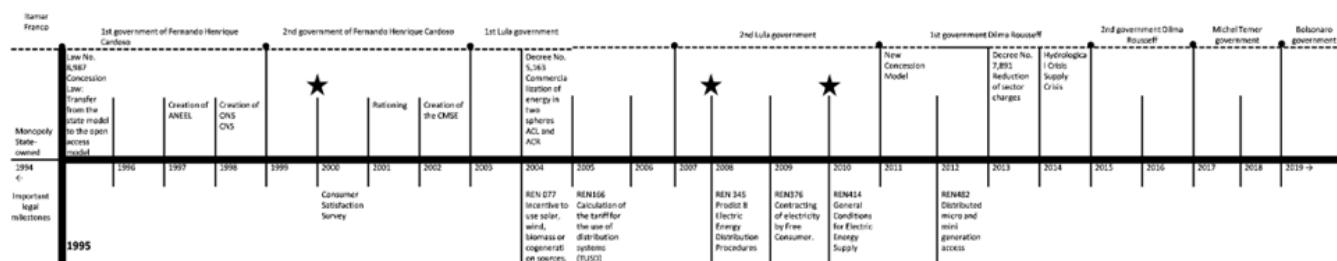

Figure 2: Main regulatory frameworks for the electricity sector
Source: Synthesis and elaboration carried out by the authors

In 2020, there were 988, 305 certificates and, compared to 2021, another 86, 338 certificates were added to the base, totaling 107, 4643. In these 3 years, even in a scenario of the COVID - 2019 pandemic, a growth of 22% was identified.

It should also be noted that, even if these numbers demonstrate the growth of certifications at a global level, the real number may be significantly higher, since many accreditors delay sending or simply do not provide data for consolidation by ISO, implying in underreporting.

In Brazil, the last measurement in 2019 (INMETRO, 2020) informed that a total of 3, 517 valid certificates were registered in ISO9001.

ISO9001 promotes the process approach as a path to quality management with the aim of increasing customer satisfaction by meeting defined requirements and associated obligations, as provided for in the regulation of the electricity sector, reinforcing the importance of maintaining a management system in accordance with the requirements of this normative standard.

2.3 Measurement of consumer satisfaction in the electricity sector

Used as a tool to assess the quality of services provided by concessionaires and to improve regulation, Aneel conducts research based on studies of methods published by Marchetti and Prado (2001). Starting in 2000, ANEEL promotes the IASC award that recognizes the organizations that obtained the highest scores in the IASC satisfaction survey (ANEEL, 2021a).

Generated from the qualitative survey carried out in 2000 and consolidated in discussions with representatives of ANEEL and state agencies and electricity distributors, the model used to calculate the IASC was developed, consisting of five variables evaluated in the questionnaire applied through scales of measurement (ANEEL, 2021a).

According to ANEEL regulation (2021a), approved by order 2, 502, the IASC has an annual calculation, carried out by the sampling method of face - to - face interviews with consumers and has the following evaluation items:

- Perceived Quality: (i) customer information; (ii) access to the company and; (iii) service reliability.
- Perceived Value: (i) fee paid in relation to benefits; (ii) fee paid in connection with supply and; (iii) General fee in relation to Service
- Trust: (i) general trust; (ii) Concern for the customer; (iii) Competence and; (iv) Integrity
- Loyalty: (i) change of supplier depending on the tariff; (ii) change of supplier due to supply and; (iii) change of supplier due to the service.
- Satisfaction: (i) Overall Satisfaction; (ii) Non - compliance and; (iii) Distance from the Ideal.

Figure 3 presents the constructs of the current IASC model and the indication regarding the level of performance of the scale of the questions, where the (+) sign indicates that the higher the score, the better the satisfaction and (-) the lower the score. customer satisfaction is better.
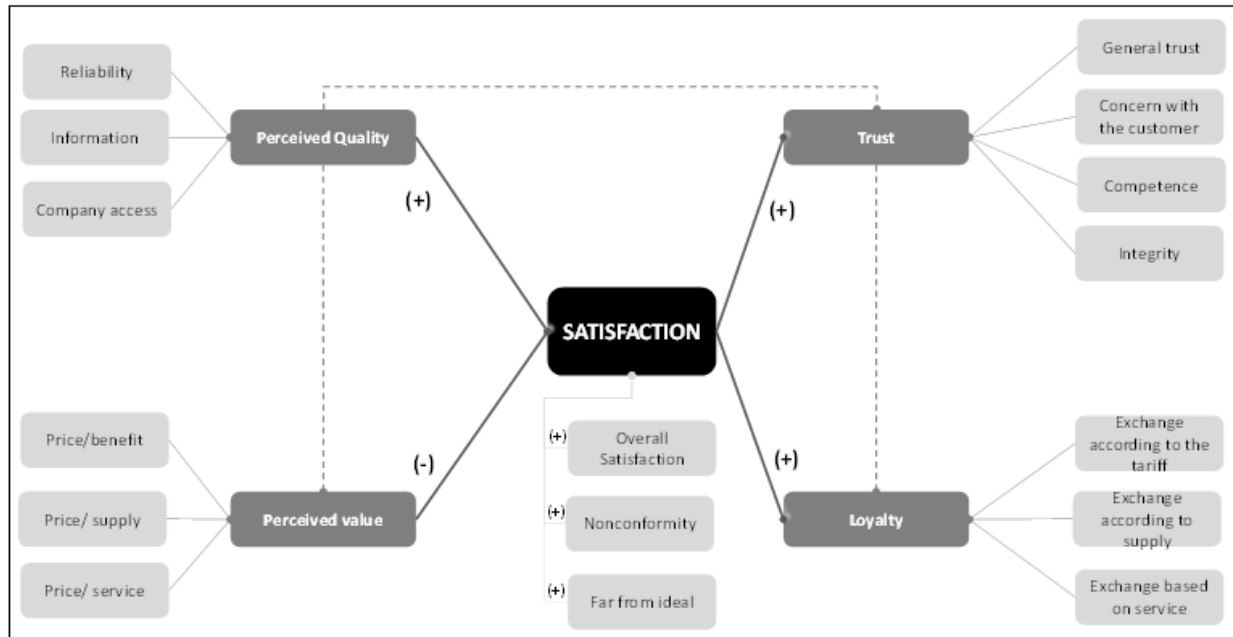
Figure 3: IASC – Current Model

Source: Synthesis and elaboration carried out by the author

According to studies by Sarmento de Carvalho (2022, 47p), the construct "perceived quality" consists of 17 questions, divided into its three dimensions, namely:

- Customer information: (i) clarification of their rights and duties; (ii) information/guidance on risks associated with energy use; (iii) details of the accounts; (iv) explanation of the proper use of energy; (v) equal service to all consumers; (vi) security in the amount charged.
- Access to the company: (vii) ease of hiring the company services; (viii) quick responses to customer requests; (ix) punctuality in providing services; (x) cordiality in service; (xi) ease of access to bill collection points.
- Service reliability: (xii) uninterrupted energy supply; (xiii) power supply without voltage variation; (xiv) advance warnings about power cuts – non - payment; (xv) reliability of given solutions; (xvi) speed in the return of energy when there is an interruption; (xvii) advance warnings about power shutdown – maintenance.

The IASC is an index based on a sample survey carried out with consumers of all distributors, concessionaires and permit holders operating in Brazil. For sampling, around 27, 000 interviews are carried out in each cycle (ANEEL, 2021a).

As a result of research by Marchetti and Prado (2001), the IASC uses structural equations, with satisfaction as a latent variable, and is based on the Nonconformity Paradigm, which uses the PLS method (*Partial Least squares*) [4].

The analysis model provided by ANEEL (2019, 7p) refers to a cause - and - effect model. As shown in figure 4, the coefficients inside the arrows that connect the five evaluated items represent the marginal impact of the antecedents (where the arrows come from) on the focal ones (where the arrows arrive). The R² index represents how much a change in the focal variable is explained by its antecedents. As for the smaller arrows, linked to each item evaluated to its components, these contain the weights calculated by the PLS method [4] for each indicator.

Aneel still uses the IASC as a single component for the ANEEL Quality Award, which recognizes the best rated distributors by consumers. Thus, the award is granted to the distributors that receive the highest scores according to categories of region and market size (ANEEL, 2021a).

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[4] PLS (Partial Least Square) or Partial Least Squares regression method. It is used for building equations in situations where there are a large number of explanatory variables and a relatively small number of sample data. The central objective is to determine the optimal number of such components and evaluate the method under different dependency structures between variables (Da Silveira et al., 2012).
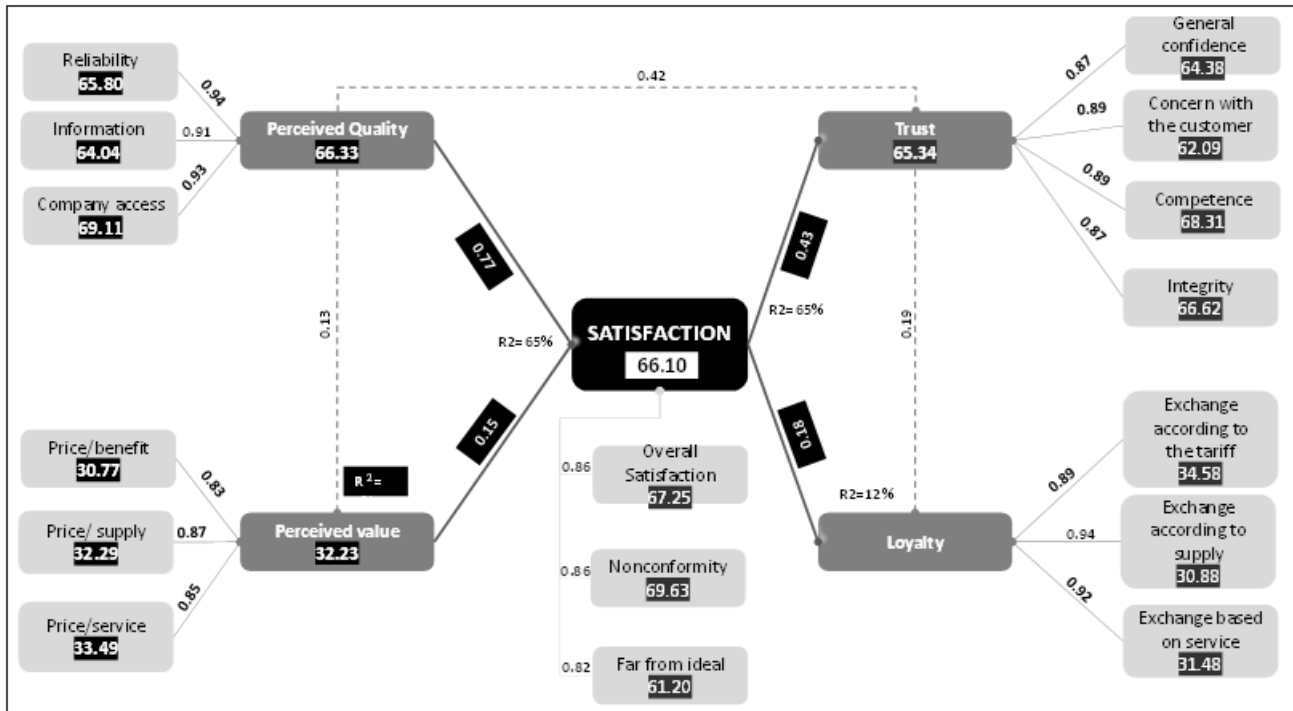
Figure 4: IASC 2018 Brazil – Results applied to the model.
Source: Adaptation carried out by the author (Aneel, 2019)

IASC data from 2014 to 2018, Santos Neto et. al (2022, 14p) pondered that reliability indicates the consistency of measures and the results allow us to assess that it is not necessary to exclude items from the applied questionnaire, as all items have factor loadings above 0.50. Regarding the confidence intervals (CI - 95%), the study also states that all weights are significant, which indicates the importance of all items for the formation of indicators that represent the constructs.

Santos Neto et al. al (2022, 26p) also found the influence between the quality construct on the satisfaction construct. According to the study, there is a tendency for customers to be satisfied when the services provided have a quality assessment in relation to customer expectations. The influence of the value construct on the satisfaction construct was also verified, which indicated that the higher the amount paid on the energy bill, the lower the customer satisfaction.

3. Method

3.1 Research Classifying

Based on Vergara's proposal (1998), the classification of this research was based on the taxonomy that qualifies it in terms of ends and means.

As for the purposes, the research can be classified as exploratory, descriptive, and explanatory.

Exploratory given that, although there are studies that address the use of satisfaction indicators in public services, no academic studies were identified on the IASC, its behavior over time, the correlation with the compulsory certifications of ISO9001 and the regulatory frameworks of the sector electric.

Descriptive, as it aims to identify, evaluate, and combine data, using statistical measures in the results of distributors evaluated at IASC in the last 20 years.

3.2 Population, sample and analysis period

According to ABRADEE (2020a), the Brazilian electricity sector currently has 58 concessionaires responsible for serving 85.1 million consumers, covering 99.8% of households, and representing a consumption of 424.2 thousand GWh.

The sampling will consist of the 33 distributors, which have more than 400 thousand customers and which together correspond to 98% of consumers, as shown in table 3.

Table 1: List of electricity distributors of the study

Distributor	Total Consumers (2019)	Total GWh/year (2019)
CEMIG	8, 538, 908	25, 583
ENEL SP	7, 314, 648	32, 367
COELBA	6, 104, 567	17, 176
COPEL	4, 713, 318	19, 677
CPFL PAULISTA	4, 503, 097	20, 884
LIGHT	4, 422, 818	17, 986
CELPE	3, 759, 975	11, 013
ENEL CE	3, 724, 822	10, 025
ENEL GO	3, 111, 700	11, 235
CELESC	3, 049, 943	14, 377
RGE	2, 892, 818	12, 151
EQUATORIAL PARÁ	2, 710, 157	7, 207
ELEKTRO	2, 710, 004	10, 935
ENEL RJ	2, 652, 454	8, 534
EQUATORIAL MARANHÃO	2, 548, 652	5, 930
EDP SP	1, 935, 611	7, 986
CPFL PIRATININGA	1, 749, 452	7, 838
CEEE	1, 748, 002	6, 519

Distributor	Total Consumers (2019)	Total GWh/year (2019)
EDP ES	1, 587, 279	6, 171
COSERN	1, 475, 924	4, 695
ENERGISA MT	1, 457, 990	7, 640
ENERGISA PB	1, 438, 240	3, 768
EQTL PIAUÍ	1, 297, 277	3, 564
EQTL ALAGOAS	1, 104, 551	3, 143
CEB	1, 084, 975	5, 564
ENERGISA MS	1, 039, 207	4, 562
AMAZONAS ENERGIA	1, 020, 740	4, 565
ENERGISA SS	799, 376	3, 417
ENERGISA SE	788, 177	2, 501
ENERGISA RO	643, 355	3, 044
ENERGISA TO	599, 563	2, 176
CPFL SANTA CRUZ	461, 415	2, 165
ENERGISA MG	460, 048	1, 241

Source: ABRADEE (2020a)

3.3 Data collection and investigated variables

The source for collecting customer satisfaction results, the IASC, was the website of the regulatory agent Aneel [5], from which data for the last 20 years of the indicator's calculation (2000 - 2019) was extracted.

The year 2020 was not the subject of the study, given that due to the Covid - 19 pandemic scenario, the research was not carried out.

There are also no results for the 2012 series, due to the lack of results available for this year on the ANEEL website.

3.4 Data analysis strategies

IASC's behavior over the last 20 years, using Minitab and Microsoft Excel software for data manipulation. The test submission sequence met the criteria described below:
a) *Outlier* Test: apply the test with data from 2 periods (years 00 to 09 and years 10 and 19, before and after the enactment of REN 414/2010, which makes ISO9001 certification compulsory for distributors).
b) Basic statistics calculations: after applying the *Outlier Test*, results classified as outliers will be excluded from the data.
c) *Boxplot:* application of the Box Diagram or *Boxplot method,* considering the periods: pre - enactment of REN414/2010 (2000 - 2006), enactment (2007 - 2014) and post - enactment (2015 - 2019) of regulatory frameworks).
d) Performing the ANOVA variability test: submit the data to the group difference test pre - enactment of REN414/2010 (2000 - 2006), enactment (2007 - 2014) and post - enactment (2015 - 2019) of the regulatory frameworks).
e) Cluster Analysis application: submit data to the hierarchical clustering procedure to assess similarity between groups.

To this end, explanations were included throughout the research to report the steps of the procedure adopted.
Data analysis was based on the behavior of the obtained results. Then, they were compared with the studies raised in the theoretical knowledge formulation stage (item 1.2.1), to allow conclusions about the generated content.

4. Results

4.1 Data Analysis Strategy

The data collected on the ANEEL website were submitted to statistical methods for analyzing the IASC's behavior over the last 20 years, using the Minitab and Excel tools for data manipulation.

Such data consist of a single annual calculation per distributor in order to understand their respective behavior grouped into cycles to test the hypotheses of each statistical analysis adopted, as shown in Table 8.

Table 2: Steps for the procedure adopted for data analysis

Procedure	Objective	Adopted Criteria
1) Outlier Test	Evaluate the existence of outliers, that is, values that deviate from normality and that cause anomalies in the results.	The test was applied with data from 2 periods (years 00 to 09 and years 10 and 19, before and after the enactment of Resolution 414/2010).
2) Basic statistics	Organize frequency distributions and measures of central tendency.	After applying the Outlier Test, results classified as outliers were excluded from the data.
3) *Boxplot or* Box Diagram	Perform statistical analysis such as minimum, first quartile, second quartile (median), third quartile, maximum and possible *outliers.*	Applied the *boxplot* with data considering 3 periods, namely: pre - enactment, enactment, and post - enactment of regulatory frameworks.
4) Calculation of the moving average	Identify the trend of the data in the studied time interval.	The data were ordered to demonstrate the general moving with a moving average length criterion equal to 3 with data from the twenty years of calculation of the Iasc indicator.

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[5] ANEEL website: https:// aneel.gov.br/pesquisas-iasc

Procedure	Objective	Adopted Criteria
5) One - way ANOVA	Verify the existence of a significant difference between the averages and whether the observed sample differences are real (caused by significant differences in the data) or casual (resulting from mere sample variability).	The test was applied, considering 3 groups of the total sample. The first sample (2000 - 2006 cycle) was considered as pre - enactment of ISO9001, as the legal frameworks had not yet been instituted. The second sample (2007 - 2014 cycle) was considered as the enactment period, as the regulator had already notified the distributors about the legal framework (via public consultation) and launched in 2007 the first version of compulsory nature (Prodist module 8). The third sample (2015 - 2019 cycle) was considered as the post - enactment period.
6) Cluster Analysis	Application of a hierarchical method so that the data are successively partitioned, producing a hierarchical representation of the groups, in order to facilitate the visualization of the degree of similarity between them.	The test was applied to define the grouping of distributors based on their performance. The War method scans for partitions that minimize the loss associated with each cluster. This loss is quantified by the difference between the sum of squared errors of each pattern and the mean of the partition in which it is contained. Thus, 4 clusters were defined according to the average result of the respective distributors.

Source: Elaborated by the author

4.2 Application of Statistical Tests

Table 9 shows that only one of the results in the period 2000 - 2009 was classified as an *Outlier.*

Table 3: Results obtained with the application of the Outlier – *Grubbs test.*

Grubbs test							
Variable	No	Average	StdDev	Min	Max	G	P
2000	29	61, 499	5, 765	49, 240	73.01	2.126	0.801
2001	30	63.326	5, 556	53, 310	75.05	2, 110	0.875
2002	30	63, 820	5.122	51, 930	73, 450	2, 321	0.461
2003	30	63, 251	4, 448	53, 970	70, 330	2, 086	0.936
2004	30	58, 390	4, 679	47.04	66, 690	2, 426	0.327
2005	30	59.502	5, 726	47, 760	74, 440	2, 609	0.17
2006	30	59, 399	7.023	40.91	69, 960	2, 633	0.156
2007	30	64, 488	6, 824	44, 260	73, 240	2, 964	0.039
2008	31	61, 420	8, 336	42.03	74, 880	2, 326	0.475
2009	31	65, 457	6, 556	50, 890	78, 980	2, 222	0.655

Outlier

Variable	Line	outlier
2007	23	44.26

| Grubbs test							
Variable	No	Average	StdDev	Min	Max	G	P
2010	31	62, 574	6, 868	46, 250	73, 360	2, 377	0.403
2012	31	60.015	6, 996	39, 890	71, 990	2, 877	0.061
2013	31	60.335	5.605	46, 730	69, 560	2, 427	0.340
2014	31	64, 618	7, 989	45, 930	75, 240	2, 339	0.455
2015	31	54, 634	6, 836	38.050	70, 120	2, 426	0.342
2016	31	62, 747	9, 432	35, 470	77, 910	2, 892	0.057
2017	31	61, 553	7, 718	45, 150	80, 690	2, 479	0.285
2018	31	65, 320	5, 320	50.010	74, 130	2, 878	0.061
2019	30	66.101	7, 689	43, 840	77, 100	2, 895	0.053

* NOTE * No outliers at the 5% significance level
Source: Elaborated by the author

After excluding the data classified as Outlier, the data were submitted to basic statistics analysis, according to tables 10 and 11.

In view of the results, it can be seen that the average results of the second period (2010 - 2019) had less occurrences below 50%, only 1 occurrence in 2015 versus 3 occurrences in the first period (2000 - 2009).

Afterwards, the dispersion of the results was analyzed via a Boxplot graph, to show the frequency of each interval, according to graph 2, which shows the data in the 3 periods defined for the study.
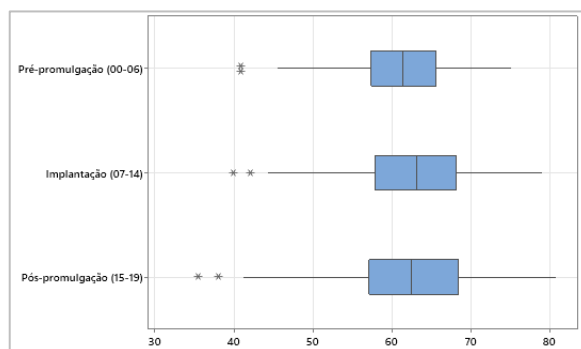
Graph 2: Boxplot of data by period
Source: Elaborated by the author
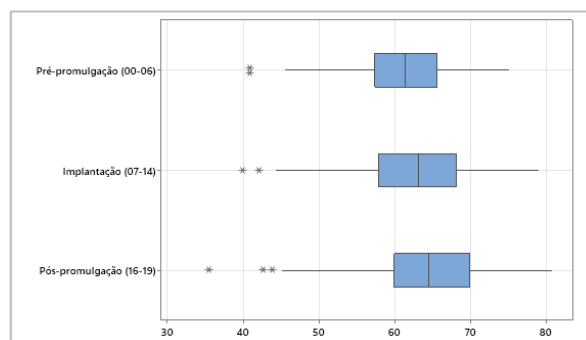
Graph 3: Boxplot of data by period (except 2015 data)
Source: Elaborated by the author

The implementation period of REN414/2010 showed a greater concentration of results above 60, even with a greater number of outliers among the 3 groups. The chart also makes it possible to assess that the maintenance period presented a large dispersion of data.

Thus, to assess whether the impact of the artificial fall in energy prices (Decree 7891/2013) and the subsequent increase, due to the Hydrological Crisis in 2014, data from the 2015 satisfaction assessment were removed and graph 3 shows the respective dispersion.

The objective of the analysis of Graph 3 is to assess whether there is an improvement trend in relation to customer satisfaction in the period 2000 - 2019.

The data were ordered to calculate the moving average of the 20 years of calculation of the premium, based on the annual averages shown in tables 3 and 4, as shown in graph 4.

Next, the data were submitted to one - way ANOVA analysis. The results are displayed in Table 18.

As with the procedure performed during the application of the *Boxplot test,* data from the 2015 satisfaction assessment were removed and a new application of the ANOVA test was carried out, as shown in Table 19.
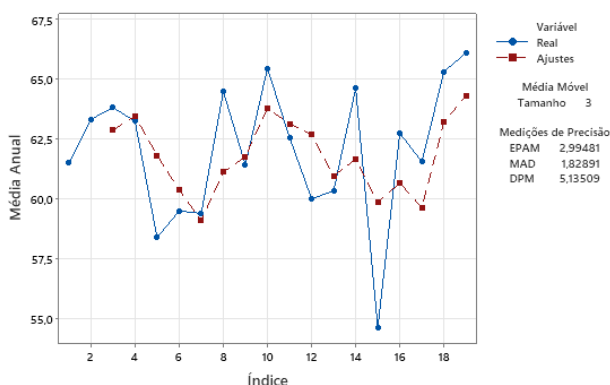
Graph 4: General Annual Moving Average of data comprised in the period 2000 - 2019
Source: Elaborated by the author

Table 4: Summary of the Model for calculating the moving average with data from 2000 to 2019

Time	Annual average	MM	Prediction	Error
1	61, 499	*	*	*
2	63.326	62, 881	*	*
3	63, 820	63, 465	62, 881	0.938
4	63, 251	61, 820	63, 465	-0.215
5	58, 390	60.381	61, 820	- 3, 430
6	59.502	59.097	60.381	-0.879
7	59, 399	61, 130	59.097	0.302
8	64, 488	61, 769	61, 130	3, 358
9	61, 420	63, 788	61, 769	-0.349
10	65, 457	63, 150	63, 788	1, 669
11	62, 574	62, 682	63, 150	-0.577
12	60.015	60.974	62, 682	- 2, 667
13	60.335	61, 656	60.974	-0.639
14	64, 618	59, 862	61, 656	2, 962
15	54, 634	60.666	59, 862	- 5, 228
16	62, 747	59.645	60.666	2.081
17	61, 553	63.207	59.645	1908
18	65, 320	64.325	63.207	2.113
19	66.101	*	64.325	1, 776

Source: Elaborated by the author

Table 5: Statistics obtained with data comprised in the period 2000 – 2009

Variable	No	N*	Average	PE Average	StdDev	Minimum	Q1	median	Q3	Maximum
2000	29	4	61, 499	1.071	5, 765	49, 240	57, 550	61, 670	65, 200	73.01
2001	30	3	63.326	1.014	5, 556	53, 310	59, 953	63, 090	67.513	75.05
2002	30	3	63, 820	0.935	5.122	51, 930	61, 468	65, 185	67.008	73, 450
2003	30	3	63, 251	0.812	4, 448	53, 970	60, 190	63, 475	67.055	70, 330
2004	30	3	58, 390	0.854	4, 679	47.04	55, 708	58.845	61.225	66, 690
2005	30	3	59.502	1.045	5, 726	47, 760	55, 883	59.755	62.317	74, 440
2006	30	3	59, 399	1, 282	7.023	40.91	56, 280	60.845	64, 782	69, 960
2007	29	4	65, 185	1, 069	5, 754	50, 530	61, 570	66, 500	70, 750	73, 240
2008	31	two	61, 420	1, 497	8, 336	42.03	56, 510	63, 060	67, 220	74, 880
2009	31	two	65, 457	1.177	6, 556	50, 890	61, 360	67, 440	69, 450	78, 980

Source: Elaborated by the author

Table 6: Statistics obtained with the data comprised in the period 2010 – 2019

Variable	No	N*	Average	PE Average	StdDev	Minimum	Q1	median	Q3	Maximum
2010	31	0	62, 574	1, 233	6, 868	46, 250	58, 400	62, 220	67, 960	73, 360
2012	31	0	60.015	1, 256	6, 996	39, 890	55, 340	61, 550	64, 300	71, 990
2013	31	0	60.335	1.007	5.605	46, 730	55, 910	60, 700	65, 300	69, 560
2014	31	0	64, 618	1, 435	7, 989	45, 930	58, 750	66, 270	70, 720	75, 240
2015	31	0	54, 634	1, 228	6, 836	38.05	50.62	54, 560	58, 820	70, 120
2016	31	0	62, 747	1, 694	9, 432	35, 470	59, 180	63, 920	69, 100	77, 910
2017	31	0	61, 553	1, 386	7, 718	45, 150	55, 670	60, 690	66, 640	80, 690
2018	31	0	65, 320	0.956	5, 320	50.01	62, 180	64, 990	69, 880	74, 130
2019	30	1	66.101	1, 404	7, 689	43, 840	61, 435	66.095	72, 823	77, 100

Source: Elaborated by the author

Table 7: Result of Application of the Anova Test with one factor

SUMMARY				
Group	*Score*	*Sum*	*Average*	*variance*
Pre - promulgation (00 - 06)	209	12814.09	61.31144	33.96724
Implementation (07 - 14)	216	13541.61	62.69264	52.82907
Post - enactment (15 - 19)	154	9554.9	62.04481	71.72197

THE NEW					
Variation source	*SQ*	*gl*	*MQ*	*F*	*p - value*	*F critical*
Between groups	202.7517	2	101.3759	1.986349	0.138134	3.011367
Within the groups	29396.9	576	51.03628			
Total	29599.65	578				

Source: Elaborated by the author

Table 8: Result of Application of the Anova Test with one factor

SUMMARY				
Group	*Score*	*Sum*	*Average*	*variance*
Pre - promulgation (00 - 06)	209	12814.09	61.31144	33.96724
Implementation (07 - 14)	216	13541.61	62.69264	52.82907
Post - enactment (15 - 19)	123	7861.25	63.9126	60.98254

THE NEW					
Variation source	*SQ*	*gl*	*MQ*	*F*	*p - value*	*F critical*
Between groups	546.7128	2	273.3564	5.760256	0.003345	3.01226
Within the groups	25863.3	545	47.4556			
Total	26410.02	547				

(no data from 2015)
Source: Elaborated by the author

After the application of the one - way ANOVA test, the data were submitted to Cluster Analysis, for the definition of cluster and allocation of distributors in their respective grouping.

Graphs 10 and 11 present the clusters and distribution of distributors in their respective groups. Table 20 presents the list of distributors by group, according to the result of applying the Cluster Analysis.
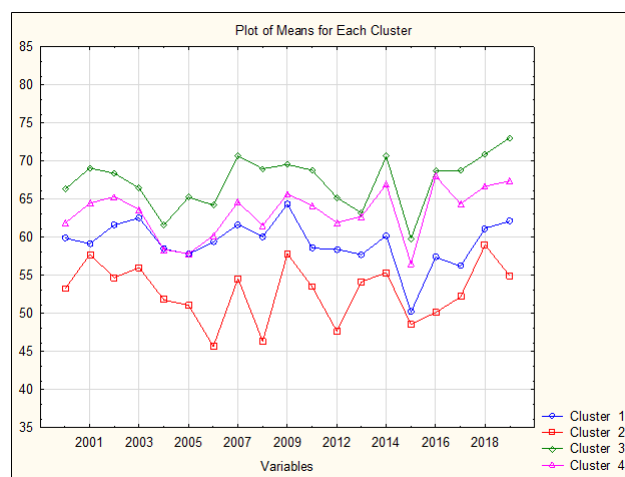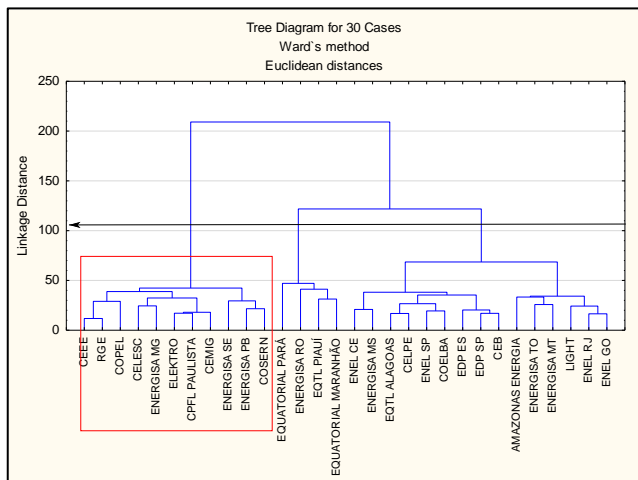

Graph 4: Cluster Analysis
Source: Elaborated by the authors

Table 9: Cluster Analysis - Cluster Results

Members of Cluster Number 1	Members of Cluster Number 2	Members of Cluster Number 3	Members of Cluster Number 4
ENEL GO; ENERGISA MT COELBA; EQTL ALAGOAS AMAZONAS ENERGIA; ENERGISA TO; ENEL SP LIGHT; ENEL RJ	EQUATORIAL MARANHÃO; EQTL PIAUI EQUATORIAL PARA; ENERGISA RO	COSERN; CEMIG; CPFL PAULISTA; ELEKTRO ENERGISA MG; COPEL; CELESC; RGE; CEEE	CEB; ENERGISA MS; CELPE; ENEL CE; ENERGISA PB; ENERGISA SE; EDP SP; EDP ES

Source: Elaborated by the authors

Graph 5: Cluster Analysis – Dendrogram.
Source: Elaborated by the authors

5. Discussion

The study of the Annual Moving Average made it possible to verify the alternation in cycles of better averages and reduced averages, both for regional and general analysis.

IASC service levels of 70% is still a challenge to be achieved by distributors, given that the last result of the series was 64, 3% and was the best achieved in the studied sample.

In all the Moving Average graphs, it is possible to identify that the year 2015 was the worst result recorded by the distributors. Crossing this information with Figure 2, it is possible to establish links with two political movements that occurred during the Dilma Rousseff government. In 2013, Decree 7, 891 was enacted, which aimed to reduce tariffs, changing taxation on residential and industrial supply of electricity in Brazil. With the bet on increasing employment and reducing the prices of products and services provided in a future scenario, but in fact the country was affected by an energy crisis for the following two years affecting consumers perception as a result. This State intervention in the tariffs followed by adjustments to the real price can explain the below - average results in customer satisfaction for all Brazilian regions.

Stacking the sample data into periods (Pre - enactment, Promulgation and Post - enactment) and applying the *Boxplot test,* it was possible to verify an increase in the frequency in the range of grades between 70% and 75% in the periods 2007 to 2014 and 2015 to 2019. This fact signals an effort by the distributors to adhere to the standards established to meet the IASC defined by ANEEL, which determines the minimum value of 70%.

Boxplot test was applied without the 2015 data, as it presented the worst annual historical average (see Table 12). Based on the ordering of the data, it is possible to conclude that there is indeed an advance in data dispersion in the period 2000 - 2019.

The application of the ANOVA test demonstrated that the p - value is greater than 0.05 (a result obtained of 0.138), allowing the assertion that there is no difference between the averages, even with high critical F. Based only on this test, there would be no evidence to affirm difference between the means of the data.

However, to contribute to the evaluation of the hypothesis that political interventions interfere with customer satisfaction, a new ANOVA test was applied without the 2015 results, since this period presents the worst annual historical average (see table 12). Based on this result, it was possible to evaluate the p - value of 0.003 (less than 0.05) and high critical F. Thus, a significant difference between means can be established.

In summary, it can be observed that there is a significant difference between the averages of customer perception, when comparing the pre - implantation (2000 - 2006), implementation (2007 to 2014) and post - implementation (2015 - 2019) periods regarding to ISO9001, which corroborates the aim of improving customer experience, carried out by ANEEL, through regulatory intervention in the management of distributors.

Other factors that impact the customers' perception of their satisfaction with the service provided were mentioned by Santos - Neto et. al (2022, 27p). The study mentions factors such as increases, reductions, discounts, and installments, all related to the tariff, as the most impacting on the perceived value and not the changes in the quality of the service.

To finalize the studies, the data were submitted to Cluster Analysis, to identify the group of distributors with the best performance in the last 20 years of IASC calculation. The result showed that, mostly, the cluster with superior performance is composed of distributors established in the South and Southeast of the country, although there is a distributor from the Northeast in the group.

The distributors Energisa Roraima and Equatorial Piauí, mentioned in the studies by Goulart (2013), as the only distributors that had not carried out the certification of their scopes in ISO9001, were established in the last cluster (see table 19), validating the theoretical understanding that application of the regulatory standard contributes to improving consumer satisfaction.

All distributors established in the South region (COPEL, CELESC, RGE and CEEE) were established in the best performance cluster and together presented the best result of the sector's moving average. Such indicators point, therefore, to greater assertiveness in acting with consumers when compared to the others.

Given the above, the results corroborate the studied literature, which converge in the statement that the implementation of ISO9001 improves the perception of customer satisfaction, and that state intervention can (positively or negatively) impact the perception of electricity consumers.

6. Conclusion

This study aimed to raise policies, guidelines, and strategic actions in the Brazilian electricity sector and how they contributed to the establishment of quality management systems in distributors.

Based on the bibliographic review, the problem, objectives, and hypotheses were validated, which structured the design of the entire study.

The collected data were submitted to statistical tests for analysis and subsequent validation of the hypotheses which, in turn, allowed the discussion and conclusion of the studied object.

IASC's behavior, from 2000 to 2019, in the light of the effects of implementation in such organizations, made it possible to understand the impact of state intervention, since this can be correlated with the performance of distributors in the perception consumers on their satisfaction.

It was also possible to establish the grouping of distributors in clusters, sorting them into groups according to their performance. This contribution of the present study demonstrates the companies that are more adherent to the search for a vision focused on the customer experience.

The research is justified by the search for efficiency within the organizations, since the IASC is part of the key - indicators that make up the X Factor, which is used as a parameter in the annual tariff readjustments, calculated by ANEEL.

Although the challenge is common to companies in the electricity sector, it also encompasses other public and private organizations around the world as consumer or customer satisfaction becomes a competitive factor in the market.

7. Implications for practice

The finding that the implementation of ISO9001 is associated with improved consumer satisfaction in the electricity sector suggests that other sector bodies or class associations encourage the adoption of policies like those practiced by ANEEL.

Similar to what was proposed by Carrasco (2017), the promotion of public service companies can occur through obligation, financial reward or other recognition, such as awards or honorable mentions.

As for companies in conventional sectors, Oliveira et al (2011) point out that good performance in this item considerably increases the chances of greater financial return and increased longevity of organizations.

Santos - Neto et al. al (2022, 28p), in his study on the IASC, highlights that user satisfaction can be achieved if electricity distributors demonstrate genuine concern for the interests of their customers, highlighting factors such as providing correct and accurate information when requested, product quality related to constant voltage compliance and undisturbed waveform, service quality related to the continuity of its provision and customer service quality.

For a broader analysis, it is necessary to improve the methodology used to calculate the IASC, so that the perceptions of other customer segments and not just residential customers are also evaluated (SANTOS - NETO et al, 2022).

8. Limitations

The first limiting aspect of this study was the use of an indicator (IASC) as an object of study and correlation with the perception of satisfaction by consumers.

Another limitation is geographical, as results from other countries were not used for comparison since there are methodological differences in the satisfaction survey metrics of consumers from other countries. According to ANEEL (2020), the IASC can be compared with similar indexes in the United Kingdom and the United States of America, issued by UK Customer Satisfaction Index (UKCSI) – The Institute of Customer Service and the American Customer Satisfaction Index (ACSI) respectively. However, these countries do not have similar characteristics between their business models.

9. Suggestion for Future Research

Considering the challenges observed throughout this present study there are some suggestions for the future ones:

ANEEL has clear collection methods with easy and public access, thus a correlation study of customer satisfaction in the electricity sector with other indicators regulated by ANEEL should be developed.

The evaluation should be expanded by sorting groups formed by governance structure, quality management models and company size by characteristics and applying group differences tests so that a cause model can be developed, using logistic regression.

Studies should be developed to compare satisfaction with the provision of electricity distribution services with other countries.
Reference models applied in national and international companies should be evaluated to enhance the customer journey and satisfaction with companies in the electricity sector.

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