Social Profit of Legal Metrology in the Brazilian Electricity Sector

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Abstract. In Brazil, despite of the undeniable importance of metrology in society, there is still no consensus as to the most effective way to “quantify” this statement. The aims of this study is to present a method to quantify the social impact caused by legal metrological control, focusing on voluntary verification and legal metrology expertise in electrical energy meter. In this sense, this article presents a model, developed exclusively for the public sector, with the objective of quantifying the return or economy in favor of society through National Legal Metrology System direct and indirect actions in the Brazilian electricity sector, considering the 2017 year. This model is an adaptation of Social Profit mode the “Brazilian Agricultural Research Corporation – Embrapa”. Only laboratories under the control of the Legal Metrology Board, through their delegated bodies, which perform or supervise voluntary checks and metrological examinations performed by the technicians of the Brazilian Network of Legal Metrology and Quality – RBMLQ, were considered. Next step, performance indicators were proposed and validated to obtain social profit. The data show that Inmetro's actions enable a return to society of US$ 32 million for each US$ 1 million of investment in this activity, pointing to the effectiveness of the model in quantifying the social profit of the agency. In a more detailed analysis it was possible to evaluate a potential revenue recovery for the states, through Taxes, of the order of US$ 400 million, if the actions of expertise and verification are intensified, pointing to a promising horizon of revenue increase for the Brazilian government through the fight against fraud. Preliminary analyzes show both the massive presence and extreme remoteness of the state are not the best management models to be adopted for the electricity sector. The study suggests, at first, a direct correlation of Inmetro intervention and participation actions in partnership with the private sector in the electricity sector and revenue recovery with reduction in the increase of electric bills. Thus, we infer that the presence of the state as regulator in this case can be effective if adapted to reality. Further studies, however, need to be done. Social profit proved to be effective for use in actions to improve public governance, another point to be explored further on.

Key words. Social profit; governance; Legal Metrology; Electric Sector.

1. Introduction

Metrology, according to the International Vocabulary of Metrology – VIM (2012), is defined as the “science of measurement and its applications and encompasses all theoretical and practical aspects of measurement, regardless of measurement uncertainty and field of application” [1].
In this article, will cover only aspects of metrology that take into account legal aspects, when it is necessary for society, both buyer and seller, in situations of commercial relation of goods or services, as well as in cases where the result of a measurement is used for a sanction, Legal Metrology expertise area.

Legal metrology is that part of metrology related to activities where statutory requirements are required and activities that pertain to measurement, units of measurement, measuring instruments and measurement methods are performed by the State [2].

Therefore, it is object of state regulation any measuring instrument or method whose measurement result generates a decision making, which may occur within the scope of a business relationship, as well as health, safety or environment. This statement is valid whenever one or more of the following factors are present:

- There is a conflict of interest in the measurement result;
- The market or an area of activity is not organized or cannot self-regulate or assimilate the point of view between the parties;
- The market or area of operation is very important for the government.
- The instrument or method is used in a significant market share;
- The instrument or method can cause great damage to the health or safety protection of the citizen;

The scope of legal metrology is wide, ranging from non-automatic weighing instruments (commercial scales) to “utility” instruments such as electricity, water, and gas meters. This article is limited to assessing the recovery of revenue for non-technical losses due to fraud in power meters whose tests are performed or supervised by INMETRO technicians and their delegated body.

Social Profit is a tool developed by the Brazilian Agricultural Research Corporation (Embrapa) as a methodology to better present the results obtained with investments in the social area, according to Pereira [3], an innovative indicator that can add analysis parameters, relating the performance social with productive performance. According to the author, social profit in the EMBRAPA model is defined as:

"The sum of three variables, in cash, are: labor indicators, social indicators and economic, social and environmental impacts, divided by the net operating revenue, and transformed into a percentage, multiplying by one hundred, which is nothing more than the percentage of corporate social responsibility spending in relation to revenue "[3]

Thus, accountability actions to enforce the principle of transparency of governmental actions are the duty of the State. According to Marcia Frey [4] "society has the right to know how public resources are being spent, which impacts on the accountability of the public manager".

Based on these assumptions, the social profit tool was adapted, taking into account the peculiarities inherent in the public sector, focusing on executive institutions that perform collection, supervision, supervision, sanction, concession, and control actions. Thus, for the public sector, social profit is defined as the quantification of the return or economy, for the benefit of society, of investments made as a result of the action of a government agency, either directly, through actions of supervision, regulation and control, or indirectly, through splits of two actions.

That tool has been developed since 2009, having already been presented by direct1 and indirect2 public and private3 sector management bodies, through 4 workshops for the construction of social profit indicators specific to each institution. This practice has inspired several cases involving the subject [5][6].

1 Brazilian Ministry of Industry Trade and Services - MDIC e Brazilian Ministry of Planning, Budget and Management – MPOG
2 Fiocruz, IBGE, INPI, CVM, Suframa and IPEA
3 FenaPRF, Dieese, Condsef
The purpose of this paper is to present the Social Profit of Legal Metrology, through exploratory and descriptive analysis with secondary data analysis, focusing on the fight against fraud, through voluntary verification actions and legal metrological expertise for these instruments.

2. Methodology

Since 2007, Inmetro has implemented and encouraged the establishment of laboratories to perform tests on electricity meters to expand the metrological control of these instruments. Its implementation was motivated by the growing distrust in the process of measurement and collection of amounts related to electricity bills. Consumers simply did not believe in the smoothness of the verification process that was done by the utility. The Parliamentary Committee of Inquiry (CPI) launched during this period ratified this need.

At the same time, several consumer fraud attempts on household meters have been identified. The situation reached such an extent that several state prosecutors edited Terms of Conduct Adjustment (TAC), concluded between the MP, Inmetro and the delegated bodies.

Among the bases of the term, the distributor was committed to provide the infrastructure (including technical and administrative personnel and equipment), to be used under Inmetro’s supervision to perform voluntary verification and metrological expertise on both electromechanical and electronic electricity meters.

Inmetro would provide traceability of measurements and calibration of standards and would enable the technical body of the metrological agency to perform these activities.

Thus, Inmetro has defined 3 possible modalities for the implementation of this type of installations presented in table 1.

In the three models presented, the State does not fail to exercise control, however, varying in the intensity of its presence and the costs associated with each form of control.

The initial understanding was that the more present the state at all stages of the process, the better the enforcement. Later it was decided to fully delegate the supervision, being the concessionaire responsible for all stages, except the issuance of test reports, which would be under the responsibility of the delegated metrological body.

More recently, a mixed model has emerged in the state of Maranhão, in which neither the state assumed full responsibility nor would it totally deviate. This mixed model was adopted by 3 more states, Paraíba, Rondônia and Pará.
Table 1 – Types of testing facilities for electricity meters

| Localization of Laboratory | Description | Execution Form |
|----------------------------|-------------|----------------|
| Delegate Body Dependencies  | • Public resources: Government is responsible for 100% of installation / maintenance costs. | • Terms of conduct adjustment - TAC, signed between the state government, Inmetro (through the delegated body) and the concessionaire; |
| Utility Concessions Dependency | • Public Private Partnership: the government hosts the space and validates the facilities and equipment, and the utility provides all infrastructure ranging from just the equipment to the construction of the entire laboratory, including technicians performing tests under the supervision of RBMLQ-I agents | • Agreement, signed between Inmetro and the concessionaire; or |
|                            | • Private Resources: the concessionaire provides is responsible for all costs, providing equipment, facilities and technicians who perform tests under the supervision of RBMLQ-I agents | • Payment through collection of fees established by Brazilian Law 9.933/1999. |

From the assembly of the laboratories to the present day, this partnership has been bearing fruit to all parties, especially society. To ensure this, Inmetro's Electric Quantities Sector has been calculating the social profit of this process for monitoring and decision making purposes. The process of creating the profit indicator will be detailed below.

2.1. Creation of the Social Profit Indicator

To calculate Inmetro's Social Profit in this area, the following steps were followed:

2.1.1. Formulation and choice of hypothesis.

In this step, a mapping of the most relevant processes was made taking as a parameter of choice:

a. The Alignment with the institutional mission;

b. Importance of the process; and

c. Easy data collection

Afterwards, meetings were held with specialists from Inmetro's electrical quantities sector to choose the hypotheses with the highest adherence to the predefined parameters. As a result, the hypothesis was chosen:

“Legal Metrology contributes to the increase in tax collection, loss recovery and reduction of operating cost impacting the annual review of tariffs in the electricity sector through metrological expertise and voluntary verification”.

After this phase, the data were debugged and applied considering the criteria of validity, reliability and representativeness. There were the Simulated, Flexibility, Ease of obtaining, Operational Cost and Opportunity.

In order to obtain efficiency indicators, with simple and compound objectives, quantitative, results, performance, based on ex post reference, relative and absolute nature.
The creation of the indicators occurred after several brainstorming sessions between all Segel members, conducted by the authors of this study. Data were ratified and analyzed.

2.2. **Assumptions for Elaboration of Indicators**

To make the indicators, the following assumptions were considered:

i. Only the meters tested in the laboratory, in the premises of Inmetro / RBMLQ or under its supervision, whether by agreement or TAC are considered;

ii. For the purpose of calculating voluntary checks, only the results of the meters failing the accuracy tests are analyzed, according to sub-item C.2 of ANNEX C of the RTM referred to in Inmetro Ordinance 587 of 5 November 2012, in the case of electronic meters [7] and, according to sub-item 3.2.3 of the RTM referred to in Ordinance 285 of 11 August 2008, in the case of electromechanical meters [8]

iii. For purposes of calculation for legal metrological expertise and voluntary verification, only failing meters that presented outside the maximum permissible error for each class up to “- 100%” are considered.

iv. All consumers are assumed to have the same monthly consumption profile, 150 kWh, and their electricity bill is calculated based on the “social tariff” of the corresponding state;

v. In case of negative error, the differences in the percentage of electricity should be multiplied by the monthly consumption and by 6, according to article 130 of Normative Resolution No. 414, of September 9, 2010 of National Electric Energy Agency, ANEEL [9]

vi. They are considered for calculation purposes:

- The watt-hour value of the corresponding state;
- The number of 6 cycles to consider for reimbursement;
- The average percentage error of the 3 conditions (CN, CP and CI);
- Number of electricity meters tested;

Measurement data provided by the delegates' bodies that have implemented the voluntary verification processes in their states were considered, as well as data available in ANEEL loss report [10].

The data collection periodicity adopted was annual based on the validation date of the systems that perform the tests. This decision resulted from the fact that traceability is considered by experts to be the most critical control variable.

Regarding the validity period, the intervals chosen as ideal were arbitrary, since the system for storing and issuing reports is computerized.

2.3. **Validation of Indicator**

After the qualification stage, the indicators were validated. The steps followed obeyed the Delphi Method. Professionals who work directly in the area, from various backgrounds, with at least 10 years of experience in the area (legal metrology, electrical area with emphasis on verification for detection of electricity meters) were chosen. The ages of the experts ranged from 35 to 68 at the time of the survey.

2.4. **Calculation Memory**

In 2017, 139,962 meters of electricity were verified by the laboratories under Inmetro's control, almost all of which are Class A and B (electronic) and Class II (electromechanical) instruments. About 88.2% of these presented some kind of irregularity regarding physical integrity (external and internal), evidence of
manipulation attempts, locking and errors in energy measurement. Until the end of this article, 2018 data were not yet available.

The following calculation memory was used to compose the indicator:

\[
\sum_{j=1}^{m} \left( (A + B + (B \times ICMS) - \chi) \right)_j
\]

where:

A = Value collected directly through the rates provided for in the agreement;
B = Value collected with fine\(^4\);
C = Value collected by tax (ICMS)\(^5\) (declared) by the concessionaire as a result of the increase in revenue from revenue recovery;
\(\chi\) = Operating costs\(^6\) ; and
m = number of laboratories evaluated\(^7\)

### 3. Results

After analysis of the obtained data, it could be evidenced that the actions resulting from the legal metrological control in the electric sector, by the legal metrology in several dimensions:

#### 3.1. Social Profit

Inmetro's social profit calculated for the electricity sector in 2017 was US $ 29,567,044.43. The composition of this value is described in table 2:

| Inmetro Fees  | Penalties Fees | Taxes      | Costs      |
|---------------|----------------|------------|------------|
| R$ 2.203.452,08 | R$ 13.978.552,20 | R$ 106.876.353,87 | R$ 4.494.510,00 |

#### 3.2. Estructure

The laboratories were evaluated for their economic activity, as described in table 1. The laboratories that presented the highest Social Profit were those with a mixed model, with the highest incomes and the lowest expenses. The laboratories that adopted the private model, although being the majority of them (9 laboratories), had 69% of the laboratories that adopted the mixed model, with costs 65% higher.

The model with the worst relationship was the private model, raising 15% compared to the mixed model, with costs 46% higher, with twice as many laboratories compared to the mixed model.

All models proved to be surpluses. Figure 1 shows the compilation of the analyzed data.

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\(^4\) The parameters for the calculation of fines are defined in articles 129 and 137 of Aneel Resolution 414/2010. According to Aneel definition, through Prodist 7, the recovered loss values cannot compose the cost spreadsheet increase of the electricity tariff in the following year.

\(^5\) Municipal taxes were not considered for calculation purposes.

\(^6\) Laboratory staff salary expenses and calibration costs (including technicians' daily and transportation) were considered.

\(^7\) In this paper we analyzed data from 21 states, except for AC, AL, ES, DF, PI and RN that did not perform tests in the period.
4. Conclusions

From the data presented, it can be concluded that the social profit of the legal metrology in the electric power sector, through metrological expertise and voluntary verification actions, was R $ 118.5 million, for 2017.

Almost 50% of this value comes from 4 laboratories, located in the Pará, Maranhão, Rondônia and Paraíba States. This points to an exponential growth in loss reduction and revenue collection, as the states mentioned are not among the 10 most populous nor with the highest demand for this activity.

The mixed model it was presented lower implementation and maintenance costs and higher collection. This model showed up significantly better than the other models, pointing out that the total State interference or its absence, in this case does not constitute the most efficient solution.

How suggestion, on further research papers, this model can be used as another management tool, assisting public governance.

Accountability can be obtained from the quantification of the return or economy of the investment made by society to public agencies through the calculation of social profit.

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