OPTIMIZED MANAGEMENT OF OPERATIONAL COSTS BASED ON REGULATORY GOALS (REFERENCE FIRM)

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ABSTRACT

This paper presents the results of R&D project "Optimized management of operating costs based on the Reference Firm", developed for a distribution company in Brazil - "CELESC Distribuição". The methodology implemented to aid the decision making of managers is based on developing models to quantify the impacts of actions and works of operation and maintenance (O&M) in the business indicators of cost and performance, as well as, the presentation of these indicators through computational system with visual tracking tools, like a control panel, based on the operational costs recognized in the Reference Firm Model and on the regulatory goals of the operational indicators set in the last periodic tariff revision by the regulatory agency.

I-INTRODUCTION

In Brazil, the benchmark regulation approach is applied to periodic tariff revision of the electricity distribution utilities for calculate the efficient operational costs. Thus, the regulatory agency builds a reference firm model based on real parameters of the distribution company during the last review period and sets down the operational costs which the new tariffs are calculated. However, this amount of operational costs may not be sufficient to effectively cover the real costs of the company, either for historical reasons or because of the required service quality.

The development of methodologies and control systems based on business indicators for easy handling and simple building allows business managers redirect their resources according with the references costs and standard service quality, aiming at the efficiency of operational actions, in order to increase profitability of the company.

The project R&D "Optimized Management of operational costs based on the reference firm" tried to develop the following innovative solutions:

- Model to quantify the impacts of actions and works of operation and maintenance (O&M) in the business indicators of cost and performance.
- Model to monitoring e control the management of resource allocation among the operational processes.
- Visual tools to flow and control business indicators of cost and performance, temporally, formed a methodology to aid decision making.

This paper presents a decision making tool for aid operational costs managers of electricity distribution utilities based on the reference firm and the impacts of actions and works of operation and maintenance (O&M) in the business indicators of cost and performance, through a computer system with visual tracking tools, like a control panel, as part of corporate management.

II - BENCHMARK REGULATION

The main goal of the incentive regulation method is improves the firm efficiency, rewarding good performance measured in relation of a previous reference (benchmark). Two important considerations arise: the choice of appropriate benchmarks and methods to performance measurement.

In the incentive regulation, there are a variety of methods and techniques of benchmarking, for which actual performance may be compared with related references that are "linked" – endogenous – or "un-linked" – exogenous – to performance or behavior of individual firms.

Jamasb and Pollitt use somewhat different classification: the references can be represent the **"best (frontier) practice**" or some measure of **"representative (average) performance"**. [1]

According to these authors:

> *The frontier-based benchmarking methods identify or estimate the efficient performance frontier from the best practice in an industry or a sample of firms. This frontier is the benchmark against which the relative performance of firms is measured. The main frontier benchmarking methods are Data Envelopment Analysis (DEA), Corrected Ordinary Least Square (COLS), and Stochastic Frontier Analysis (SFA). DEA is based on the linear programming technique while COLS and SFA are statistical techniques.*

In DEA the efficiency of the firms is calculated rather than estimated. DEA identifies an efficient frontier of the best practice by firms in the sector and measures the relative efficiency scores of the less efficient firms in relation to this border. All deviations from the efficient frontier are considered to inefficiencies. Further, the number of efficient firms on the frontier is sensitive to the number of inputs and outputs

In SFA and COLS the relative efficiency scores are estimated rather than computed. Both techniques require

specification of a production or cost function. In the method COLS as in DEA assumes all deviations from the efficient frontier are due to inefficiency. On the other hand, SFA recognizes the possibility of stochastic errors in the measurement of the inefficiencies.

Furthermore, unlike to frontier methods, the **benchmarking** in incentive regulation can be made with respect to some measure of average or intermediate performance.

One method is the OLS (Ordinary Least Square), very similar to the method COLS. OLS estimates **an average production or a cost function of a sample of firms.** The actual performance of firms can then be compared against the estimated performance by plugging their input, output, and environmental data measured into the estimated function.

III – REFERENCE FIRM MODEL

Brazilian Electricity Regulatory Agency – ANEEL has the following concept of economic regulation of monopoly services, especially in the search of efficiency through "*remodeling of the public service provided by the characteristics of private activity*". [2]

The tariff review process is carried out in two stages. In the first, called tariff increase, rates are established consistent to cover efficient operational costs – for a specified level of service quality – and the appropriate remuneration over prudent investments made. The second stage, consists in calculating the X Factor, which is to establish efficiency targets for the next tariff period as expressed in the rate.

For this, the regulator sets up the necessary assets to provide the service (Regulatory Asset Base - BRR) and the efficient operational costs (Reference Firm - ER).

In the methodologies of **Reference Firm** are highlighted regulatory models for comparison ("yardstick competition") or **benchmarking** that can be employed to stimulate the regulated company to achieve the regulatory goals through rewards and punishments.

However, one of the most important issues of the regulatory process is the requirement of information from the companies, which may lead to "Asymmetric information" between the regulator and the regulated companies, such as real costs and revenues of the service provided. To overcome this issue of "Asymmetric Information, ANEEL chose, between different methodologies for calculating the level of the efficient operational costs of the regulated company, **the Reference Firm Model (ER).**[3]

Thus, the aim is to simulate the conditions of an entering firm in the market, where the real company provides the service, in other words, to draw a model company with which the real company competes with incentive to get their cost values do not exceed the recognized in the Reference Firm. Often, the Reference Firm is called mirror firm or shadow firm.

The Reference Firm concept is associated with three fundamental aspects:

- management efficiency;
- consistent regulatory treatment of the concepts of efficient operating costs and asset valuation;
- Specific conditions in each concession area.

In the process of building the Reference Firm highlights the determination of efficient costs of each of the **processes and activities (P&A) of the operation and maintenance (O&M)** of the assets of the electric power distribution networks. For this project R&D, specifically, the determination of all costs of operation and maintenance (O&M) of installations include:

- Identification of the O&M actions of the Reference Firm;
- the criteria for the determination of costs associated with each O&M action and their frequency of occurrence and execution time, per year;
- the resources (staff, materials and vehicles) required for the efficient performance of each O&M action;
- the costs of the staff, materials and vehicles for each O&M action by amount of installation of the company.

IV - INDICATORS FOR OPTIMIZED MANAGEMENT

The indicators defined for monitoring and control were divided into 2 (two) types: financial, related to costs of O&M actions per installation (physical asset), and operational, related to quality of the service provided and to the performance of the electric distribution system (continuity supply)

From the model used by ANEEL for the Reference Firm, it is possible to identify the **financial indicators**, in a first classification, based on the O&M actions for the following types of physical assets (installations), also divided into urban and rural:

- Networks (RD) of low, medium and high voltage;
- Equipment (EQ) installed in networks of medium and high voltage;
- Substations (SE) open and mobile.

So, each physical asset is linked to their respective O&M actions, divided into the following categories: **Operation, Modification, Predictive, Preventive and Corrective**.

In addition, each O&M action are assigned its annual costs, divided into: Staff (R$), Vehicle (R$) and Material (R$);

Thus, the O&M costs can be formatted into a matrix of annual costs (staff, material and vehicle) of each physical asset in accordance with their respective O&M actions and physical parameters, for example: Length (km) or area (m2); Capacity (MVA, MVAr, A); Number of elements or connections (quantity).

In this case, the financial indicators are defined from

relations chosen by the company as more representative or explanatory to optimize its cost compared to the Reference Firm model established by ANEEL, for example:

Financial Indicator = annual cost of staff for the O&M corrective actions per km of conventional aerial MV distribution network, urban area (US$/km)

In turn, the **operational indicators** are defined based on parameters of quality of service related to continuity of the quality of the electrical energy provided to the consumers established by ANEEL, in this case, **SAIDI** and the **SAIFI**, and also calculated by physical asset or assets group, region, municipality and company.

The operational indicators related to service quality should also be linked to their O&M costs actually spent on each group of consumer units, by quantifying the following items:

- **Mean time of Attendance (TMA)** of the O&M actions resulting from the sum of the Mean Time of Preparation (TMP), the Mean Time of Displacement (TMD) and Mean Time to Execution (TME);
- **Duration of interruption**, if any, for consumer or consumers, by physical asset or assets group;
- **Number of consumers** affected by the O&M action (with or without interruption), by physical asset or assets group;

Thus, for each control element (physical asset or group of assets) are defined the following parameters:

$$SAIDI = \frac{\sum_{i=1}^{k} Ca(i) \ x \ t(i)}{Cc} \qquad SAIFI = \frac{\sum_{i=1}^{k} Ca(i)}{Cc}$$

Where: Cc = total number of consumers of group.
Ca(i) = number of consumers of the control element affected by the interruption i.
t(i) = duration of interruption i (hour)

The determination of these parameters can be done individually for each interrupt, and brings great facility when it is implemented the calculation of **operational indicators SAIFI and SAIDI** for each control element (physical asset or group of assets).

V – DATA MODELING

The conceptual model used for developing the system enables an overview of the context of operational and environmental information for distribution company, until the getting of the indicators, with the diversity and heterogeneity of information sources as well as aspects of technology infrastructure of both Hardware and software.

The model is composed by the blocks: Legacy Systems, Data Extraction Layer, Application for Food and Data Management, Domain Model, Business Intelligence Tool and Model of Indicators, and shown in Figure 1:

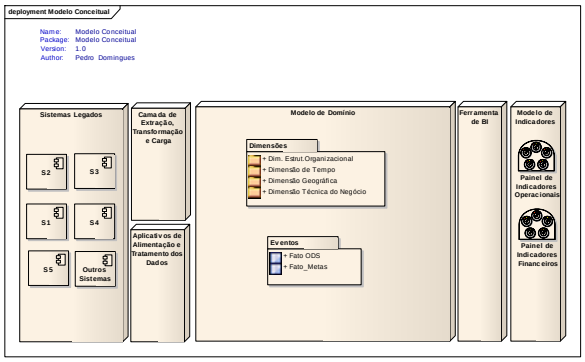

Figure 1: Conceptual Model

Using the Tool Business Intelligence (BI) is a relatively new concept that goes beyond corporate governance. It also involves the use of products and solutions designed with leading-edge analytical technology that transforms data stored and databases in information that aid the various levels of a company in decision making, among other things.

Here, Intelligence is put towards research and is the product of turning data into information, after being examined or introduced into a particular environment. This transformed information is applied to a decision-making process and creates competitive advantage for the company.

VI – IMPACT OF O&M ACTIONS IN THE OPERATIONAL INDICATORS

The maintenance annual plan and operating and maintaining reports of the distribution companies provide valuable information to evaluate the impacts of the O&M actions in the operational indicators. Thus, the various O&M actions in physical assets can be related to financial and operational indicators by the matrix of impacts of the O&M actions in operational indicators (SAIDI and SAIFI) by physical asset or assets group.

In the **objective methods**, the impact of the O&M actions is determined by: consulting the literature, history, studies conducted by distribution companies or by appropriate computational tools. Thus, From **projection function** of operational indicators expected trend of available historic data to chosen variables: dependent (DEC and FEC represented by **Y**) and explicative (O&M Actions represented by **X**), by means of statistical regression models, a coefficient to measure elasticity of a dependent variable **(Y)** in relation to **(X)**, is obtained, i.e., **Y** percentage variation of given **X** percentage variation.

In the **subjective methods**, the O&M action impact is determined by experts through the various techniques, such as: the Expert Panel or **Analytic Hierarchy Process (AHP)**, wich uses the renowned experts experience to obtain the effect of these O&M actions in the operational indicators.

Operational indicators projection, based on O&M

action **impact factors ("elasticity")**, is obtained by number of planned actions (Annual Plan Maintenance or maintenance historical) and by the ones effectively performed within period. The projected trends of indicators allow the manager for checking on cost effectiveness of each action of the utility, represented by the equations below:

$$SAIDI_{Proj}mes(j)=SAIDI_{Ref}mes(j)\left(1\sum_{i=1}^{n}F_{ImpDEC}(\text{Action i})\right) \quad (1)$$

$$SAIFI_{Proj}mes(j)=SAIFI_{Ref}mes(j)\left(1\sum_{i=1}^{n}F_{ImpFEC}(\text{Action i})\right) \quad (2)$$

VII – COMPUTATIONAL TOOL

The developed tool is a follow-up system and a timely operational and financial performance management of the Reference Firm model, through a yardstick competition approach, based on customization of the BI Tool chosen. It's a new concept that goes beyond company management, including the use of state-of-the-art products and solutions, which permits the transformation of data stored in corporative databank in information that help different levels of the company to make their decisions.

The computational tool are described by:

Corporative Databases – They are those who already exists and in operation in Celesc.

System Database – Set of stored information, in an organized way, which is needed to feed the computational tool intelligence.

O&M actions' impacts – Consists in evaluation of certain O&M actions' impacts on SAIDI and SAIFI operational indicators related to actives or actives' set.

BI Tool- Customized BI platform "Pentaho".

Output management reports – Default output management reports that already and the developed temporal monitoring panels of operational and financial performance indicators that compose the Reference Firm model.

VII – CASE STUDY – SIMULATION

In order to present the computational tools' features is presented a case study.

The **Analytic module** is accessed through the **Exploratory Vision**. In this module are available several tools for the manipulation of the multidimensional data, considered the measure (quantity that is being observed) and dimension (classification under which is observing the measure) concepts. Multidimensional data (hypercube) are arranged according to multiple dimensions, and, generally, each dimension has its own hierarchy.

The **Monitoring Module** allows viewing the several financial and operational indicators, as defined by the user, and the information of the active's set on the concessionaire's map by regional and by city.

The figures 2 and 3 shows, respectively, the **Financial Indicator's Panel**, which allows the viewing, and the **Operational Indicator Panel**, that allows the viewing of the operational indicators defined for the actives set relative to the O&M actions and supply interruptions to consumers (SIADI and SAIFI).

Figure 2- Financial Indicators Panel

Figure 3 - Operational Indicators Panel

IX – CONCLUSIONS

The customized and supplemented computational tool is a practical system and its using is simple, being agile and important for the temporal monitoring of operational and financial performance indicators constant on the Reference Firm, established by ANEEL.

The system allows, for managers, a global vision of how the resources are being used temporally, comparatively observes the performance of the teams on task execution, checks the existence of variations on the resources' application by the regional, and subsidizes important information for the investment, maintenance, operation and regulatory agencies.

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