BENEFITS AND RESULTS OF A REVENUE ASSURANCE AND AUDIT PROGRAM FOR DISTRIBUTION UTILITIES

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INTRODUCTION

This article describes the results in SCL companies SAELPA and CELB, comparing initiatives performed before and after the implementation of new methods of commercial loss detection using Revenue Intelligence technology. An increase in the field inspection productivity of 128% in SAELPA and 143% in CELB was verified. Through the monitoring of load in two SAELPA feeders, 30.5% losses were reduced to 20.1%, increasing invoicing in 13.7% (recovered revenue) and reducing required energy in 13.5%, a significant cost reduction in purchased energy.

COMMERCIAL LOSS RECOVERY CONCEPTS

Companies use different methodologies to calculate commercial loss recovery, but under the focus of total net cash flow, equation 1 appropriately represents all the recovery activity. The distributing utilities aim to achieve as much net cash as possible with the smaller correspondent cost, and for that it is necessary to analyze the productivity curve of the commercial loss recovery process.

\[ \text{Productivity} = \frac{\text{recovered net cash}}{\text{recovery cost}} \]

Equation 1

The productivity curve of the loss recovery process is a function, with endogenous variables: operational procedures, human resources and recovery technology; and exogenous variables: social-economic conditions and fraud procedures. Productivity curve shown in picture 1 is a relation between the recovered net cash and the recovery cost, maintaining other function’s variables (operational procedures, human resources, technologies used, social-economic conditions and fraud procedures). This means that, without changing the other variables, the curve will represent the relation between recovered net cash and the recovery cost for the utility.

CHALLENGES FOR LOSS RECOVERY STRATEGIES

Utilities use some strategies and procedures to reduce commercial losses:

- Awareness of the population in the distribution area, for reducing fraud and energy theft
- Use of hardware technologies to prevent energy theft by creating a higher level of difficulty
- Performing field inspections in domiciles and consumer installations for the verification of frauds
- Negotiation and collection processes for defrauding customers.

Important challenges faced by the loss recovery groups are:

- Which consumers shall be inspected?
- Which technology should be used in which consumers?

A utility normally select the consumers to inspect by using:

- Denunciations
- Inspection campaigns in reading routes
- Irregularities informed by meter readers
- Consumption anomalies, selected using:
Fraud management software modules, which is generally a part of the commercial system.

Reports requests for the Information Technology area.

Technologies like special anti-theft cables, meters and seals, load balance, enhanced designs for customer connections and distribution wiring, and sometimes AMR (picture 2) are used to increase the difficulty to make illegal connections and/or perform meter frauds, but selection strategies fail in determining most relevant groups to apply. Then most utilities, in spite of the investments in the loss recovery processes, have verified increasing commercial losses.

By the intrinsic dynamics in the evolution of the internal procedures, technologies and competences, the parameter that has, historically, affected more the productivity curves is the technological innovation, which can drive large improvements in the internal procedures. Since 2003, SCL is using Revenue Intelligence (RI) to improve the productivity of the loss recovery process. RI represented a technological innovation related to the modus operandi that substantially increased the loss recovery rates in SCL (see picture 1).

**SCL EXPERIENCES IN IMPLEMENTING REVENUE INTELLIGENCE**

The Sistema Cataguazes-Leopoldina serves approximately 1.8 million consumers in four Brazilian States, covering an area of 91,134 km² (picture 3).

**Case a: Two distribution feeders in SAELPA**

Two feeders (L2 and L4) with very high total losses in the district of Sousa in the State of Paraiba were monitored. The increase in productivity was of 63%, representing a outstanding increase in loss recovery, and an increment of 13,7% in invoicing (including the invoice of recovered kWh). Chart 1 shows that the required energy reduced by 13,5%, maintaining almost the same invoice level (without the invoice of recovered kWh), and the total loss decreased from 30,5% to 20,1%, a reduction of 10,4%.

**Case b: SAELPA**

SAELPA has 837,000 consumers in a geographic area of 54,595 Km², with a density of 15.33 consumers / km², with a total loss of 18,88% (April 2004). The average inspection productivity (recovered kWh / inspection) has increased by 128%. The amount of total recovered kWh has increased by 161% (chart 2).

**Case c – CELB:**

CELB has 131,000 consumers in a geographic area of 1,789 km², with a density of 73.23 consumers / km², with total commercial losses of 8.89% (April 2004). The average inspection productivity (recovered kWh / inspection) has increased by 143%. The amount of total recovered kWh has increased by 105% (chart 3).

Besides RI, no other technical loss reduction methods have changed, and the increase of productivity reflects only the implementation of Revenue Intelligence. These results demonstrate in three different situations the effectiveness of Revenue Intelligence in increasing the productivity, and consequently, loss recovery increase.

**DESCRIPTION OF REVENUE INTELLIGENCE**
Revenue Intelligence is based on a detection, analysis, action and feedback architecture (picture 4).

Detection:
The system has a functionality of creating investigation rules and alarms that allows the identification of the existing loss traces, using combinations of any information source internal or external to the utility. The investigation rules are created using a graphic and friendly interface, by mouse clicks. No specific IT knowledge is required. Investigation rules may use complex parameters and combine information from several distinct existing databases. The rules are built through logical clauses, allowing an easy creation by loss recovery professionals. The loss analyst can create rules that combine information of registers, reading, consumption, invoice, payment, attendance, service orders, load balance, frauds, credit risk, taxes, social-economical bases, information of commercial segments, mapping bases of electro-intensive sectors, etc.

For each investigation rule a weight is associated, and it will be used for definition of risk level. The rules can be executed at any moment or can be scheduled with a certain periodicity.

Analysis:
The investigation rules filters a set of consumers that were intercepted by the parameters of each rule. The Revenue Intelligence©® also allows the creation of consumer profiles, which is a sophisticated analysis of the detected traces. A profile is a combination of rules and filters.

Revenue Intelligence creates for each intercepted consumer two pieces of information:
- Risk level: the sum of the weights of all the rules of the profile by which the consumer was intercepted. The risk level represents the higher or lower possibility of the consumer being a defrauder.
- Financial impact: is related to the expected financial impact that the consumer represents to the distributing utility. This information allows the prioritization of consumers for field inspection, significantly improving the effectiveness and productivity of field inspections and, therefore, loss recovery.

Action, Logging, Statistics and Feedback:
The defined actions will be send by Revenue Intelligence to field inspection system, creating actions with starting time, expected finishing time, responsible, financial impact, among other information, which can be followed up until its termination.

After the field inspections are performed, RI will receive the results of the inspections. These information will be logged and efficiency statistics of actions, profiles and rules, besides inspection productivity, open inspections, etc, will be produced.

SCL uses SIAIF©® - Fraud Inspection Follow-up system, which is fed with the information generated by Revenue Intelligence and performs the attendance of all stages of inspections since the generation of the inspection list until the insertion in the Billing System of the revenue related to recovered energy, and then feeds back Revenue Intelligence with inspections’ results. The efficiency reports are essential for the continuous improvement of the loss recovery area.

LOSS COMBAT INTELLIGENCE DATABASE

Another objective is the creation of an intelligence database about the utility’s losses. This is a dynamic base. Rules and profiles tend to change constantly, as the defrauders also adapt continuously. The cat-rat relation between the loss recovery area and the defrauders is like a predator-prey relationship existing in ecosystems. The evolution theory indicates that the more the predators develop their hunting abilities, the more the preys develop their abilities of escaping the predators’ menace, indefinitely, and creates what’s called an arms race.

This demonstrates the importance of a software technology that is able to build an loss intelligence knowledge base, with all the information of rules, profiles and actions for fraud verification, along with customer information, in a historical and dynamic database, which allows real-time analyses, with agility and simplicity. It has also proved necessary the creation of a Loss Combat Intelligence Center, to act along with Revenue Intelligence. Even utilities that already have achieved low losses should invest in intelligence so that the losses don’t grow, because of the arms race and the application of the Red Queen theory. The American biologist Leigh van Valen developed this theory and made the analogy with Lewis Carol’s *Alice in Wonderland* novel, where Alice ran with the Red Queen but didn’t move from her place. In this moment, she says that in her country, if they ran like that, they would get somewhere. Then Red Queen replies: “What a slow country. Here you must run fast to remain where you are; if you want to get somewhere else, you have to run much faster than that”.

As a conclusion, only new loss recovery productivity curves allows by new technology will make possible to be faster that the defrauders’ adaptation and then be able to reduce the loss levels until its stabilization in adequate low levels, the optimum point of the new recovery productivity curve.

Revenue Intelligence©® software supports formalizing a Revenue Assurance and Audit Program – RAAP – which requires an adequate organizational structure in order to support it. The dedicated team and with the appropriate profile for the utilization of Revenue Intelligence and other loss recovery technologies is in a structure called loss combat intelligence center. This team will be responsible for the generation of the loss recovery actions, whether action may be field inspection, customer disconnection, debt negotiation, auditing, among others, which will be performed by other teams of other areas of the utility. The creation of the
intelligence center, with the dedicated and appropriate team, is a critical success factor for outstanding increase in loss recovery productivity for the distribution utility. According the authors’ evaluation, the utilization of Revenue Assurance by the intelligence center of SCL is still in the beginning of the learning curve, which implicates that the productivity shall increase with experience. SCL intends to use Revenue Assurance for other applications, such as bad debt and demand and marketing planning for sales of other products. The authors expect that SCL’s experience in the creation of a loss combat intelligence center with the utilization of the Revenue Intelligence©® software is a reference for initiatives of other distributing companies in the challenge of reducing their losses.

REVENUE ASSURANCE AND AUDIT PROGRAM

The complement of Revenue Intelligence in a utility is the implementation of RAAP. RAAP integrates revenue protection and other business processes (commercial processes, field inspection, disconnection, debt negotiation, auditing, demand planning, distribution network management etc) of the utility with an organizational structure, having trained professionals dedicated to its utilization and with the appropriate profile. RAAP evaluates and plans the integration of the RI software with the business related processes and the organizational structure, through a competence analysis and team dimensioning.

Then RAAP proposes the understanding of the whole revenue chain as a comprehensive, structured and integrated process. Utility shall act on all aspects related to revenue protection and loss reduction in a systematic, and coordinated way.

According RAAP the Business Processes to fight losses include:

- Commercial losses: metering fraud, illegal connections, energy theft, permanent and temporary frauds, meter calibration, etc.
- Administrative losses: internal fraud, process flaws, wrong rates, missing customer id, customer switching, etc.
- Receivable: Non-payment, bad debt, payment delays, debt negotiation.
- IT and systems integration: Quality and completeness of the systems; Systems integration; Processing errors and rejection logs (invoices, bills, etc).

Data quality: Data consistency; Data accuracy; Data input and updating process; Change logs.

- Technical Processes related to network operation and technical loss reduction, including Metering: T-D Frontier metering, customer metering; Distribution network losses; Customer connection points (security, immunity, seals).

Distribution utilities perform approximately 244 different processes, 75% of them being covered by RAAP.

REFERENCES


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Picture 5 – Revenue Assurance integrated solution

Insert cliente in Database
Reading
Billing
Planning and Purchase Energy
Metas Instalation
Fraud Research
Invoking
Delivery

RAAP as an Integration Solution
Maciel Maia has been dedicated to conducting Choice in its quick expansion and high technologic innovation, with which it has helped leader companies in the segments of telecommunications, electric power distribution, oil, finances, pharmacy, foods and public administration to optimize their financial results, whether it is by reducing costs or increasing revenues.

Mr. Mano has 33 years of management and technical experience in the areas of Information Systems and SCADA/EMS/DMS, as project coordinator for several projects in South America, USA, and Europe. He has lectured Computer Sciences at the Pontifícia Universidade Católica– PUC-Rio, Brazil. He has been the Manager and Technical Coordinator for the software development and implementation project for a complete integrated Distribution Management System for the Companhia Energetica de Brasilia – CEB (including GIS, graphical operation support functions, workforce scheduling, load flow and short circuit applications, graphical editor, and trouble call); ITAIPU SCADA/EMS and Generator’s monitoring and diagnostics systems; and ELETROSUL SCADA/EMS and has participated in the implementation of 3 SCADA/EMS Contro Centers for ONS. Mr. Mano is presently the Director of KEMA Brazil and the Manager for the KEMA Revenue Assurance and Audit Program.

Dr. Renato Céspedes has 31 years of experience in the areas of Power System Analysis, SCADA/Energy Management Systems (EMS), Distribution Management System (DMS) functions and Distribution Planning as a consultant or as project engineer for systems implementation for several projects in the United States, Spain, Netherlands, Poland, Brazil, Mexico, India, Saudi Arabia, Colombia, Ecuador, Peru, Venezuela, Chile and other Latin-American countries. He has lectured at universities in Colombia on Power System Analysis and Control Theory. Dr. Cespedes is a Senior Member of IEEE, and has published several technical papers. Dr. Cespedes has been the coordinator by the National University of Colombia of the Latin American and Caribbean Manual for Electric Power Loss Control sponsored by OLADE and IDB. He has also participated in the “Modeling for Losses Reduction using a Real-Time Power Flow at ENELVEN”, with emphasis on extensive transformers and loads modeling developed as part of DSPF for ENELVEN’s distribution system. It also shows some uncommon DSPF results from the ENELVEN distribution feeders which prove a real need for such extensive modeling.

He also served as consultant and expert for various projects financed by the World Bank and Interamerican Development Bank (IDB). Dr. Cespedes is presently the Director of KEMA Inc. Latin-America.