RECOGNIZE THE NEED FOR INNOVATION AND SMART SOLUTIONS FOR DISTRIBUTION

Doina VORNICU  
CEZ Romania - Romania  
Doina.Vornicu@cez.ro

Laurentia PREDESCU  
CEZ Romania - Romania  
Laurentia.Predescu@cez.ro

ABSTRACT
The paper aims to describe the ongoing project in our company, CEZ Group Romania, which was generated by the need for innovation and also in order to find smart solutions for our activity.
The target is to be a SMART company that develops automated processes and it is flexible and innovative.

INTRODUCTION
CEZ Group Romania is implementing Smart Transformation Project. The main goals are the improvement of network reliability, the reduction of operational costs and the good management of capital expenditures.
The implementation of this project will allow the company to manage resources more efficiently, to improve the network performance, to become more flexible and compliant, as well as to prepare the company for the future development.

Design principles of the project

Smart Transformation Project aimed the digitization of the operations performed within electricity distribution activities, through:

1. Implementation of smart metering systems

Developing smart metering systems leads to a greater transparency for the client and provides a larger variety of information needed for future services.
Starting with 2013, S.C. Distributie Energie Oltenia S.A., our distribution operator, began introducing the smart metering systems by developing pilot projects, continued in 2014 - 2016 and including approx. 35 000 clients, in:
a) urban and rural areas with electric networks in relatively good condition or recently refurbished/ modernized that operate within the nominal technical parameters;
b) urban and rural areas with high values of technological consumption.
Implementation approach has a significant impact on the feasibility and profitability of smart metering projects. It is important to locate relevant piloting areas, to verify assumptions and to create an overview of the expected impact that a full implementation might have.
For the next period, S.C. Distributie Energie Oltenia S.A. is working on the installation of more than 435,000 smart meters given the experience of mounted so far, with the condition cost-benefit analyses of the investment to be positive [1].

Smart metering systems include [2]:
a) metering subsystems containing at least meter, instrument transformers and equipment to secure access to the meter;
b) subsystems for transmitting information;
c) subsystems for information management from meters.

The security of smart meters and the data communication is ensured, also the privacy of end users is ensured in accordance with relevant European Union legislation on data protection and privacy [3].

Benefits targeted after the implementation of smart metering systems

The clients have the possibility to access at advance tariff structures, by smart meters, which leads to the opportunity to manage efficiently the electricity consumption and to obtain savings. The electricity billing is based on actual consumption.
The smart meters allow the facility of supplier switching process in the context of the total opening of the electricity market in Romania.
The electricity customer becomes active participant in electricity market.

The smart metering systems help the distribution operator to monitor low voltage networks.
One of the biggest benefits in implementing smart metering systems is to monitor and to calculate any time network losses, in order to reduce the losses in distribution networks and especially the commercial losses.
The losses can be monitored and accurately calculated, not estimated as before, because it can benefit from measured data obtained in real time for electricity consumption.
The smart meter allows recording the values of the active and reactive energy at time intervals \( j \), of 15 to 60 minutes. The transforming stations are equipped with balance meters, which measure the total losses based on the difference between the energy measured in the transforming station and the sum of all energies measured on the consumers’ meters.
The calculation of technical energy losses on each line section and phase can be very accurate, using formula (1) based on the following equation [4]:
\[
\Delta W = R \sum_{i=1}^{N} \frac{P_j^2 + Q_j^2}{U_j^2} t_j
\]

(1)

where:

R - represents the electrical resistance of the line section (a part of the length electric line);
P - represents the active energy;
Q - represents the reactive energy;
U - represents the electrical voltage;

The smart meters are connected to a computer, and the software allows the determination of the technical losses in a very short time.
The commercial losses will be calculated with the difference between total losses and technical losses. Obviously it can calculate more accurately and rapidly the technical losses and the commercial losses.

2. Adoption of the best practices for the management of the measured data by meters

For increasing the volume and quality of measurement data is being implemented Data Management System (MDM). This is needed to store, process and transmit data from smart meters (see Fig.1). Also, it includes the possibility of exchanging information with other databases (GIS, SAP software, SCADA).

Through enhanced quality of data obtained from smart meters it is possible to do a much better management of low voltage of electricity networks and a faster identification of the areas with problems (including detecting of the frauds).

Ensuring a unified database system will provide a complex system of high quality information from various sources. It is possible the further use of data provided by the smart meters, due to the functionality of data storage. Providing of higher quality data lead to reducing or even eliminating billing errors.

Smart Transformation Project is designed to reorganize the electricity distribution activity of the coming years, to provide a high quality service to our customers and to significantly reduce the duration and frequency of interruptions in electricity supply, by continuing to increase the degree of automation of electrical networks, namely by installing remotely operated equipment.

The result of these operations for improvement of the indicators SAIFI (System Average Interruption Frequency Index) and SAIDI (System Average Interruption Duration Index) is checked by the software which allows easily and transparently their calculation, using the formulas (2) and (3):

\[
SAIFI = \frac{\sum_{i=1}^{n} N_i}{N_f}
\]

(2)

\[
SAIDI = \frac{\sum_{i=1}^{n} (N_i \times D_i)}{N_f}
\]

(3)

where:

\(n\) - the total number of long interruptions (for more than 3 minutes);
\(N_i\) – number of the users who have suffered an interruption with a duration more than 3 minutes to interrupt \(i\);
\(D_i\) – the duration of interruption for users of the lack of voltage until reconnecting, for interruption \(i\);
\(N_f\) – the total number of served users [5].

Starting from 01/01/2017, the distribution operator, Distributie Energie Oltenia, recorded and calculated data that provides information about network reliability and about performance of equipments, such as:

a) the number of short interruptions (less than 3 minutes);
b) MAIFI (Momentary Average Interruption Frequency Index)
Index) - short interruptions - the ratio of total number of interrupted users for short periods and total number of users served [5]. The calculation formula is (4):

$$MAIFI = \frac{\sum_{m=1}^{M} N_{m}}{N_{t}}$$  \hspace{1cm} (4)

where:

- $M$ - the total number of outages of short duration;
- $N_{m}$ - number of users who have had an outages with a short duration (under 3 minutes), for each $m$ interruption;
- $N_{t}$ – the total number of served users.

SAIFI, SAIDI and MAIFI indicators are determined on the basis of automatic recordings of disruptions in MV and HV and in LV are estimated from the calculation.

- **Major expected benefits include:**
  - Reducing the cost of maintenance which leads to decreasing of the operating costs (OPEX); for the next period, the target for controllable OPEX is to decrease annually by an efficiency factor of 1.5% ;
  - SAIFI and SAIDI are expected to decline by 2020, each of them, with approx. 21% from the current value;
  - Reducing the network losses with approx. 15% until 2020, from the current value;
  - Better and efficient capital expenditure (CAPEX) allocation at the level of technical losses.

3. **Realizing a unique source of secure technical data, which helps to increase the accuracy and the precision of analysis in operational processes [3]**

The meter data are received and stored for more than 1,4 million meters, some of which will be received at intervals starting with 15 minutes, correlated with the contracts signed by clients.

The data recorded by the meters is stored for a period at least 5-years and at least 7 years history is required for events and instrumentation value.

The meter parameters, the event data, the status of meter data are received and stored also.

For meter data received from all systems there are received and stored the timestamp for consumption and reading.

- **Visualization and reporting data**

  - Can be visualized the monthly reports, with the quantities of electricity distributed to end users. These reports contain the amounts of electricity delivered by generators to suppliers, as well as electricity exchanged with other participants in the market.
  - Display data daily in portal for clients and monthly for market partners.

4. **Smart Transformation Project includes also the implementation of GIS (Geographic Information System)**

GIS is designed to provide a performance platform for storing, analyzing and processing information distributed spatially related to electricity networks: location, routes, coexistence with neighbouring buildings and properties, structure, volume, technical and functional features, technical condition, and loading (see Fig. 2).

This will improve the ability to make decisions in asset management and speed of making these decisions by accessing the GIS interface to all data concerning the location of equipments, operating characteristics and their history.

![GIS implementation](image)

**Fig.2 - Distributie Energie Oltenia - geographical location**

The main processes to be managed higher, resulting in increased management efficiency are:

- Prioritization of service orders based on certain criteria;
- Route optimization (GIS integration requirements, GPS coordinates teams and service orders);
- Improving the identification of the installations in field.

- **Major benefit is:**

GIS will be used to increase the efficiency in faster localization of the equipments and the consumers in the field.

Calculations will be performed from the office, without field trips, that means time saved.

Reduced development time of new interfaces.

The policies for security and monitoring of the electricity networks will be improved.

It is assured the suitability for advanced analytics solution.

5. **Mobile Workforce Management (MWM)**

MWM is the last component of Smart Transformation Project but not least. The MWM initiative implements a
complex application, regarding the improvement of the workforce management involved in operating and maintaining of the distribution network. The implementation of this initiative involves the ensuring mobile devices for operational staff. MWM intervenes also in the core processes of other sectors of the energy distribution (such as: verification of the activities performed, network losses, etc.).

The main processes to be managed higher, resulting in increasing of the efficiency management are:
- operation and control networks;
- operation of equipment in the distribution networks;
- settlement of damages;
- prioritization for the execution of the works, in case of major disaster;
- perform preventive maintenance, including diagnosis;
- investigation of non-technical losses;
- data management.

It is a management application designed for field teams activities, which has a series of automatic or semiautomatic functionalities.

The diagram of MWM concept is presented in Fig. 3.

![Diagram of MWM concept](image)

✔ The expected results

- **Planning of the activities** involve increasing the transparency of workforce by offering a centralized perspective of current and planned allocation of the staff. With the MWM application will be possible the monitoring of the activities in field and thus an increased control for the working teams because of the tracking in real time and of geographical position location.
- **The issuance of the service orders** is based on the standardized processes of specific activities, number of personnel, materials and asset registers. This reduces the inefficient times of operating staff.
- **Execution** – The MWM application wishes to increase the degree of automation of workflows in NOM by increasing the responsibility and visibility of the workforce or reducing time spent on unproductive tasks providing time for other activities, ensuring a better monitoring of workforce.
- **Closure of the services orders**- The service orders can be closed in mobile device and the transmission in SAP software will be done in real time.
- **Efficient use of the materials** – The necessary materials for the execution of the works are provided in real time and the material losses are reduced.
- **Reporting** - The works documentation is electronic. It will last less time the displacement. It will decrease paper work and will increase analytical capabilities. It will make the comparison between the norms of time and effective realised time to perform a work.

CONCLUSIONS

Through this project, we want to test and manage the future needs. At the same time we intend to describe the business model of the next years. It is recognized the necessity for an efficient and integrated system and the need to become more flexible, adaptable and compliant. The smart solutions for distribution activity ensure flexibility of the system for new developments.

REFERENCES


