ENEL WORK FORCE MANAGEMENT SYSTEM

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ABSTRACT

In a world of increasingly - and tightly - regulated market, Work Force Management operations are a key driver of optimization and performance improvement for electricity utilities, struggling to achieve further cost reductions to preserve their margins. ENEL WFM System provides ENEL with a challenging opportunity for ENEL to design from scratch every aspect of field force operations for 8,000 field engineers with the aim of leveraging on the ubiquitous utilization of mobile technology and innovative automated processes.

INTRODUCTION

In a competitive world, where companies face very powerful incentives to achieve high levels of efficiency and to deliver an ever improving service quality to customers, the intelligent automation of the field force management is a key factor of success.

ENEL is the leading utility in one of the largest European markets and has the responsibilities to provide energy to 30 millions of customers, managing about 20,000 km of HV lines, more than 330,000 km of MV lines, and some 750,000 km of LV lines.

More than 8,000 technical ("field") engineers, working in about 5,300 crews and organized in 510 territorial units, are employed daily to provide services to ENEL's customer base and to maintain the MV and the LV network. These field engineers undertake a variety of tasks, ranging from inspections and repairs to construction works. This skilled workforce is also bestowed with the crucial task of prioritizing and promptly and effectively responding to emergencies to meet out customers' expectations on service quality.

In 2005, ENEL launched a challenging and ambitious project, to identify the best solutions for the optimization of its work force management process.

The project aimed at delivering significant improvements in three main areas:

- the definition and provision of an adequate vehicle equipment
- the development of a range of "mobile applications" well suited to support the daily work of field engineers
- the design of a centralized "field force solution", fully integrated with the ENEL's IT systems.

VEHICLE EQUIPMENT

One of the principal aims of the project was to supply all vehicles used by field engineers with a satellite navigator, using both commercially provided maps and proprietary ENEL technical GIS information.

The ENEL technical cartography provides a detailed mapping of the whole medium voltage electrical network (including lines and more than 400,000 MV-LV substations and pole mounted transformers), as well as all the low voltage network. This system encompasses details of about 30 million of carefully geo-referenced customer supply points.

The availability of this "on board" information for the whole fleet can significantly ease the day-by-day work to the field engineers, as well as deliver efficiencies by shortening the time of intervention and speeding-up operations.

The second key aim of the project was to set up an effective communication system between the vehicle and the Central Operational Center. This has been achieved by introducing the use of "mobile communication units" that include a GPS box and a GPRS modem. This system has insured both the ability to localize the vehicles and crews quickly and provided our field engineers with a valued "always on" connection with the ENEL Central Systems.

The third goal of the project was to identify the most suited mobile devices and applications to complement vehicle equipment, to support out work force daily activities.

Our approach to this issue developed from ENEL's consolidated experience in the use of the palmtops. These have been used by our field engineers since 2001 (until present) to replace the old electromechanical meters with the new electronic ones. Specifically ENEL has replaced more than 29 million meters over 5 years, using 8,000 palmtops of different brands and specifications.

For the new WFM project, ENEL decided to move to a different solution. As many as 5,300 vehicles (and related

crews) will be equipped with a rugged notebook. Notebooks will be installed in a docking station placed in the rear of the car. The display of the notebook is "replicated" in an "in-dash" monitor in the front of the car, especially suited to provide navigation support to the technicians. Navigation tools and all maps (commercial and proprietary) are installed in the notebook, allowing the navigator to switch easily between commercial maps and ENEL's proprietary technical maps.

The choice of a notebook (instead of a palmtop) has been driven by the need to store large amount of data (maps, various technical documentations needed for different types of activity, databases and software applications).

Another important factor underpinning the choice is the rich range of applications available in a "standard" Windows environment, and the potential for an easy development of new applications in this standard environment. Furthermore, these advantages are coupled with notebook capability of running more than one complex (heavy) application quickly.

Lastly, we also considered the benefits associated with the availability of a larger screen, since this facilitates the use of the applications by to the technicians.

We opted for a "rugged" PC based on ENEL's extensive past experience with palmtops, also taking into account the specificities of the environment where the ENEL's field engineers operate.

Ruggedized notebook computers are necessary where environmental and/or user requirements clearly necessitate machines designed to ensure a higher degree of survivability. In particular, rugged PCs have superior shock and vibration specifications. This is a highly desirable feature for PCs that need to be "switched on" and "working" as a navigator tool while vehicles move.

The incremental cost of a "rugged PC," compared with the cost of a "rugged" palmtop or with the cost of a "semi-rugged" notebook, has been traded-off against the longer "life cycle" of this type of equipment.

In all vehicles, the GPS/GPRS communication system is integrated in the "in-dash" monitor. The geo-referenced coordinates of the vehicle position are transmitted to the Central System, allowing for the vehicle localization.

Furthermore, all applications available in the notebooks are continuously synchronized with the ENEL IT systems to guarantee the quality and the consistency of the data.

The notebook can be removed from the docking station in the vehicle and used as a mobile support while daily "off-vehicle" activities are undertaken.

The notebook GPRS Modem and SIM allow for synchronization with the Central system even for this type of use.

MOBILE APPLICATIONS

Several field activities can be carried out more effectively thanks to the support of the notebook applications. In what follows we present a selective account of the key applications developed for the ENEL WFM project.

Customer Meter Management

ENEL operates a powerful Automatic Meter Reading and Management System (AMM System). Most customer requests do not require a field intervention by an engineer, and can therefore be managed remotely.
For other customer requests, including meter installations, replacements and AMM operation failures we have developed a specific application: that manages the communication between notebooks and the meters through a serial infrared device.

AMR Concentrator Management

The Automatic Meter Reading and Management System communicates with the "concentrators" installed in the MV/LV substations. These "concentrators" collect and exchange information with the meters using the Power Line Communication on the low voltage network. The installation and maintenance of these concentrators (more than 350,000 spread all over the Italian territory) are supported by an application which manages the communication between notebooks and meters through a serial infrared device.

Telecontrol Equipment (RTU) Management

ENEL manages a very complex network: about 2,200 Primary Substations (HV/MV) and more than 100,000 remote controlled Secondary Substations (MV/LV). The installation, configuration and maintenance of these RTUs (of different types and vendors) is supported by a range specialized applications developed by RTU vendors and installed on the notebook.

Inspections

The inspections of lines, substations, pole mounted transformers and of all network electrical equipment are powerfully supported by an application installed on the notebook. The availability of the proprietary cartography is particularly useful for this type of activity. All the critical situations are registered and immediately reported to the Central System.

Low Voltage Fault Management

In case of outages, customer calls originating "trouble tickets" are immediately conveyed to the appropriate field crew, together with all information gathered from the customer phone call. Once again, the availability of the proprietary cartography on the notebook greatly facilitates these field tasks. The "fault status" is reported to the Central System and is updated "on-line", allowing to improve the quality of customer service.

Job Management

Work plans, with all related required information, are updated daily on the notebook, allowing the crew responsible for the job to safely manage the plan in coordination with the Control Centre.

Medium Voltage Fault Management

The Control Center can send a "Medium Voltage Trouble Ticket" to the appropriate crew, with all the information needed to support the fault localization on the MV network.

General activity framework and diaries

All the applications available on the notebook are integrated in a "general activity framework" which lists all the tasks assigned to a field engineer and gives her the ability to jump directly to a chosen application or to the navigator from a simple and common list of tasks to perform a single task.
As the day goes by and the tasks are completed by the field engineer the "diary" (log) of the day is automatically compiled with all information related to the materials used and to the time spent to carry out each individual job. This information is synched to the central system together with detailed task information. This provides a crucial input to the ERP System (SAP for ENEL) real-time accounting and to the HR System resource management.

FIELD FORCE SOLUTION

The "field force solution" can be divided in three major areas:

- asset management;
- vehicle localization; and
- optimized task assignment.

Asset Management

The management of the vehicle set up and maintenance processes need to be supported through IT applications. The "vehicle system" is composed by several different parts: the in-dash monitor with the built-it integrated communicator, the SIM cards for GPRS communication, the GPS antenna, the docking station and the cabling needed for all that hardware. Each part has to be properly identified, while the firmware versions of the "intelligent" components need to be kept updated.

The mobile devices (Rugged PC) need to be properly managed. The initial set up process, with the installation of specific security tools, the assignment to the field engineer or to the crew, the substitution process in case of fault, and the software update are all phases of the process that need to be supported by IT applications.

Furthermore, ENEL developed and made available to the field engineers a dedicated website in order to provide answers to FAQs and easy access to up to date information (new documentation, new maps, etc.).

Vehicle Localization

The vehicle positions are displayed on geographical maps and on ENEL proprietary cartography (GIS System), together with other information related to the crew on the vehicle. The Control Centre can use this information, when an emergency comes up, to identify the crew that is located nearest to the fault or to identify the crews that can provide additional support to the field engineers that are managing the fault.

Optimized Task Assignment

The centralized field force solution must keep into account that a leaner and more efficient work force management can only be achieved by intelligently automating the assignment of tasks to field engineers.

A dynamic engine - able to weigh several factors (engineer skills, current location , job kind, duration and priority of a job) and to perform the optimal schedule (the right task to the right engineer always) based on this information - can play an important role in defining ways to meet the goal of improving continuously effectiveness and efficiency in the day to day operational activity.

ENEL is now consolidating a scouting activity. This activity is being undertaken to identify the best solution for the Company. Different issues need to be addressed: ENEL's current territorial organization, the different types of activities (both for short and long term plans), the nature of the engineers' skills required for each job, the current dispatching and business rules. The latter are defined accordingly to the Italian regulatory framework by the need to provide high service quality to ENEL's customers, but also by the objective to be more and more efficient and competitive in the market arena.

The identification of the best solution must also keep into account the characteristics of the ENEL Information Technology System scenario (that is the Customer Information System, the ERP System, the Outage Management System, the Network Maintenance System, the Remote Control System, the Automatic Meter Reading and

Management System).

All tasks originated by different systems, need to be brought together and managed in one place, to ensure that each is properly assigned, synchronized with the mobile devices. Moreover, the results of each job need to be recorded and synchronized with the originating system.

Considering a level of activity that involves 8,000 field engineers and 30,000 tasks per day, scattered all over Italy, with different priority and features, the keywords of this challenge are integration, complexity, and scalability. Nonetheless, the possible advantages are huge in terms of field force productivity: a reduction of ten kilometers per day per engineer, or a step increase in daily operations (for example from six to seven tasks per day per engineer on average) are just simple examples of the significant savings ahead of us.

ENEL PROJECT ROADMAP

The project started in February 2005, with a first phase, aimed at identifying ENEL needs, and designed to verify the experience of the other utilities and the solutions available on the market.

During this first phase, two pilots where conducted: the first one to define, refine and test the vehicle equipment, the second one to conduct an internal "benchmarking" of the various "rugged PCs" available in the market.

A small number of vehicles were set up and assigned to four different territorial areas (in the northern, central and southern part of Italy) and different PCs where tested in the field by ENEL's technicians.

At the end of this first phase (March 2005) three objectives had been reached: the critical or weaker parts of the vehicle set up had been identified, the best PC had been selected and we had produced a rough estimation of the costs and benefits of the project.

The second phase of the project started on June, 2006. A new pilot was set up, with more vehicles equipped in the "final" configuration. All the ENEL Areas that cooperated to the first phase were involved in order to improve the estimations of the costs and benefits of the overall project.

Now ENEL is in the third phase of the project: 2,850 vehicles will be set up by the end of 2007, and additional 2,450 vehicles will be set up in 2008. Most of the mobile applications are already available, while the asset management application will be ready by April 2007.

A Vehicle Localization application is available, but will be further developed and improved to be implemented by April 2007.
The scouting and the impact analysis for the Optimized Task Assignment are nearly completed. We expect to deliver a controlled "dry run" in 2007 and to rollout the complete dynamic assignment solution during 2008.

CHANGE MANAGEMENT PROCESS

Finally, ENEL is aware that change management is a very important issue in this type of projects. Our staff is directly affected by these changes and their way of working and of organizing activities is heavily impacted.

From the very beginning, the project team felt that the proper attitude was not to work "for the people", but "with the people". We believe that field engineers should play a lead role in this change, and not just be passive subjects of changes determined by other teams.

During the pilots, the project team visited many field sites, and each time, the scope of the pilot was explained in detail. The engineers were asked to track and report all the problems they discovered and to provide every piece of advice they deemed useful to improve the application.

Weekly appointments with the field team involved were planned and maintained to exchange the above information and progress the implementation of the project.

At the end of the second phase, a meeting with all the teams directly involved was organized to collect and exchange feelings and experiences about the on-going project.

The meeting was structured as a one-day workshop, with a range of themes entrusted to various teams: very useful pieces of advice and observations emerged from the activities of the various groups in the workshop.

The change management process has also been extended to the whole organization: the HR department has been involved. Internal communication, workshops, ENEL's personnel involvement, field training programmes are scheduled and will start in the first quarter of 2007.

Lastly, throughout the project we have been fully aware that any big change management process is due to fail without a strong and clear management sponsorship. The ENEL top management is directly involved in the project organization by mean of a Steering Group and attends crucial project meetings where milestones are defined. In addition, periodic updates are provided by regular internal reports for company-wide circulation.