WORK FORCE MANAGEMENT OPTIMIZATION: BOOSTING STRATEGIES BASED ON SCHEDULING AND ASSIGNMENT

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ABSTRACT

In an 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.
Despite the flourishing market of commercial applications devoted to work force management optimization, these applications present major limits in tackling complex infrastructures and organizations. For this reason, Enel, the largest Italian utility, decided to design and implement its own custom system with the collaboration of its Business and ICT Departments.
Two major challenges have been tackled and solved during the project. First, the integration of several different data systems, providing heterogeneous and widespread data. Second, the usability and accessibility of the system for the end users.

INTRODUCTION

Current commercial applications for work force management do not fully respond to the needs of complex, advanced organizations such as Enel.

The development of a fully customized system was started in 2007. Enel Business and ICT Departments designed and deployed a WFM system that exploits notebook integration to provide full support for all the field activities (Petroni et al., 2007). However, to date the system is unable to assign tasks to the end users (the crews).
Currently the system is limited to the provision of geographical mappings of the intervention areas to the crews. The actual tasks that they have to perform are assigned by a human operator.
Tasks worked by Enel's crews cover the complete electric network from the Primary Substation all the way to the low voltage customer, managing every single aspect of the network: maintenance, new lines building, electronic meters, etc.
The assignment of such a large number of tasks cannot be fully optimized by a human operator in relation to the travelling time and the reduction of inefficiencies.
The WFM infrastructure has been operating like this for three years.

Building on this system, Enel started a new project aimed at optimizing the scheduling of the whole WFM activity. The expected result is an application that optimizes tasks that are geographically close but of different nature, related to every aspect of power network management.

The project aimed at delivering significant improvements in:

- the reduction of total driving time which results in more operating working time;
- the training of a complete multi skilled field professional workforce;
- the implementation of a standardized way for scheduling;
- the reduction of documents (less paper).

CONTEXT

ENEL is the leading utility in one of the largest European markets and has the responsibility to provide energy in Italy to more than 30 million customers, managing about 2,200 Primary Substations (HV/MV), approximately 400,000 MV-LV substations and pole mounted transformers, 340,000 km of MV lines and some 750,000 km of LV lines.

More than 7,500 technical ("field") engineers, organized in 391 territorial units, are employed daily to provide services to ENEL's customer base and to maintain the MV and the LV network.

In order to enhance field force operations, Enel implemented a new Work Force Management system, completed in 2008.

Around 5,300 vehicles used by field engineers were transformed into "mobile offices" equipped with "rugged" notebooks and a satellite navigator, integrating both commercially available navigation tools and maps and Enel's proprietary technical GIS information.
The display of the notebook was "replicated" in an "in-dash", to help the field crews in the navigation .

Enel's technical cartography provides a detailed mapping of the whole MV and LV electrical networks, encompassing the total number of customer supply points (meters). The notebook communicates with a GPS box and a GPRS modem. This system allows the Central

Operational Centre to localize vehicles and crews, thus providing the field engineers with a valued "always on" connection with the Enel Central Systems.

All other applications available in the notebooks are continuously synchronised with Enel's IT systems to guarantee the quality and the consistency of the data. Mobile applications were developed and installed on the notebooks.

In early 2009, with this technology architecture, Enel began the second part of the project.

DESIGNING THE PROJECT

In three months the most important high-level requirements of the project were collected by a group of professionals, half of them coming from the Central Offices and the other half from the Territorial Offices.

The project involved a two step process to optimize scheduling.
The first half of the project is called "Assisted" and is expected to finalize in June 2011. Here, the dispatcher manually follows some pre- built rules, proposed by the System. Position of the tasks is observable on a map and a user-friendly drag & drop application helps to build the optimized journey for crews, respecting task priorities at all times.

In the second step called "Dynamic", expected to finalize one year later, a partially automatic guided tour, optimized by algorithms, suggests the best schedule solutions to the dispatcher. Urgent tasks are manually scheduled through a redistribution of the daily activities.

This "two steps" transition allows the calibration of the algorithms for the dynamic version and, at same time, allows the dispatcher and the head of the crews to get used to the new approach.

The project not only presented a high technical impact, but more importantly a critical human impact, which was observed to be different in every single territorial unit. Some specific aspects were faced on the field just after the first steps of deployment.

High risk of failure was highlighted by thinking about an ideal territorial unit where you applied the System forcing workers to modify their habits instead of designing a system on the needs of the final customer.

Specifically the project high level requirements included:

- the design of the System, fully integrated with ENEL's IT systems
- the correct priorities, number of people needed to execute and the duration assigned to every task;
- the different rules for proposing tasks expected by the System (booking, data limited, obliged container, normal container);
- the reduction of paper (considering safety, legal and commercial aspects);

Considering the need to develop the System very close to the field, knowing all the central enterprise applications and understanding the different Enel realities, led Enel to build its own personalized product.

FOCUS ON CRITICAL POINTS

In order to analyze the standard current methods of scheduling some on field visits were performed.
Some critical points surfaced showing different attempts of manual optimisation, which allowed to calibrate the impact of the new System.

At the moment, a field worker could theoretically operate on all types of activities, on his own or in a crew, but frequently scheduling was independently performed on three different lines of work: one for the customer tasks and new lines, another for maintenance tasks and the last for managing faults coming from our electronic meters.

Following this approach, often, journeys of different crews crossed each other daily. This is highlighted by the average number of kilometers driven by ENEL crews in 2008 (50% of the vehicles driven for 70 to 120 km per day) and the resulting time wasted in driving every day.

Paper documents are still necessary, even though it is still possible to assign the same task on tablets (a transitory solution for starting the WFM's project at the start).
The concurrent presence of papers and tablets oblige maintaining two parallel ways of scheduling.
Consequently, tablets are like a simple database of tasks, while papers fix the defined schedule: the paper is assigned to a single person, who is also the safety responsible of the task.

Furthermore, this condition leads to great difficulties for reading the results at the end of the working day.

The last important consideration is the great number of tasks presented for scheduling, which the dispatcher can choose from simultaneously. Usually, in the first months of the year there are thousands of tasks, each presented with its own rules for time scheduling.

DEVELOPING THE PROJECT

In September 2009 ICT started the development of the Assisted Scheduling System. From the beginning of its

development, weekly appointments were scheduled to realise a strict coordination between the ICT and Business Departments.

A sort of marketing plan was organized where all our customers must not only use it, but also be fully satisfied with their experience: it was strategically vital that the system be adaptable to different Territorial Units.
This point lead to consider, on the Information Technology side, the need for great integration and the simplifying of activities. On the field side, the importance of making the System understood as a success opportunity, built with people working on the field and not commanded from the centre, working far away.

A Territorial Unit located in different regions changes the way of managing and tackling activities depending on the number and the skills of the workers, on the kind of territory (mountain, coast, urban, rural, etc) and the type of customer (HV, MV, LV, industrial or citizens).
This heterogeneity meant our model couldn't be a standard model, designed on the organization chart, but adaptable to the different realities.

Another consideration is to understand who is the customer of the product. Who do we want to "sell" it to? For the project to be a success, our customer must be satisfied and not frightened by it.

The dispatcher and the supervisor of the crews have been identified as the first customers. These workers do not normally trust information systems. For them the product must be very user-friendly. Furthermore, great attention must be paid to the manager of the Unit who is the first person responsible of the scheduling, given that it greatly changes the way the Territorial Unit works.

Design the Technical part

Microsoft's Silver Light Solution was selected for the implementation. This system presented from the beginning a user-friendly and simple approach, great flexibility and a comfortable design.

Great efforts are being employed in the building of the architecture through the interaction with all the different systems for the management of the single activity: Customer Information Systems (FOUR, EGC, SOLC, SMILE), Network Maintenance System (SIGMA, MARE), the Outage Management System (GESI) the Automatic Meter Reading and Management System (Problem Manager), the Remote Control System (SCADA) and the ERP System (SAP).
All these systems produce tasks, most of them in the SMILE's or SAP format, although others are in different forms.

Obviously for optimizing it was necessary to realize all the tasks in the same format.
A great part of the work has been dedicated to rebuilding the task in the SMILE's configuration, the system which the Enel Mobile System is built on.

Design the Human approach

To understand the different possible kinds of organizations on the field, professionals coming from different territories were involved.

Thirteen Units were selected as Pilot, from different regions of Italy, representing different kinds of typologies.

One of these was defined as a Laboratory.
In the Laboratory a monthly access has been organized, in collaboration with the ICT Department, to present single steps of the project and to verify the approach, gather necessities and desires.

Reports of these meetings have been sent to the other Pilots to receive their considerations. Meetings have been organized to discuss some critical points and developments of the project.

THE SYSTEM

The Assisted Scheduling System presents a design based on different steps.
After automatically receiving from other systems the absent people list (even sudden absences), the System proposes a guided tour. Following it, the dispatcher is lead to the composition of an optimized scheduling solution.

All the tasks worked or not worked, assigned to a crew in the morning, return to the System at the end of the day, emptying every notebook: this allows speeding the connectivity via LAN or GPRS, too.

When the System starts, it displays different boxes; a "shopping trolley" with proposed tasks, a box for the crews, another box for the map and another one for having a translation of the scheduling in terms of the budget (FTE), highlighting the expected values.

To make the System adaptable at different request, it's possible to compose the crews in different ways, immediately indicating the names of the components of the crews or just preparing empty boxes, where the dispatcher drags & drops the tasks.

Symbols are used to simplify the communication of the status of the task, the priority, the number of needed people, appointment, and so on.
In any case, on request it's possible to have the complete details of every task.

Every task is geographically located on a map represented by a flag before the assignment: coloured in blue if it only requires execution by a single person, coloured in blue and orange in the case of a crew. After the scheduling, the flag changes into a ball, taking the colour of the crews.

The map and "shopping trolley" are interconnected. For example, when a task is selected, the corresponding flag on the map becomes bigger. On the other hand, when the flag on the map is selected, the corresponding task is highlighted.

As the working day of the crew is defined, the total amount of the working time grows: on request it's possible to calculate the theoretical kilometres to drive during the day and the time needed.

On the map the dispatcher could design the working day of each crew. It's possible to select the task from the "shopping trolley" or directly from the map and drag and drop on the crews.

All the scheduled tasks arrive on the notebook of every responsible of the crew and only he is able to read it, accessed through their personal passwords. This solution allows reaching one of the goals: a strong reduction of the paper documents.
Together with the expected working time, the field workers receive the expected driving time.
At the end of the working day it is possible to read on the System, received from the WFM's vehicles, the effective number of kilometers driven.

The flux diagram propose the jobs following different steps. Tasks are selected on the basis of their nature and priority.
In the first step, the System proposes the highest priority tasks for customers or tasks booked with an appointment or a working plan.
In the second step, the System proposes some maintenance related tasks. Third, the most important tasks from Automatic Meter Reading and Management System are suggested.

Successively the System automatically proposes tasks at first selected from obliged containers to fill up to 100% the working time. Then from the normal container to fill the working time to 130%.
130% of total working time was covered, in case there existed difficult to execute assigned tasks.

ON THE FIELD

Before its launch, the complete project was presented to the Unions with the help of Central Human Resource Department.

In March 2010, the System was introduced to Upper-Level Territory Management to make clear the project goals and its complexity.

In October the Laboratory Unit started operating and in December three more.
Their evolution and their experienced difficulties are followed step by step by the Central Team in collaboration with ICT Department.
Currently the System proposed is still under development. This allows to better calibrate the wishes expressed by the different territories.

The System in the Unit is presented to every person, white collar workers and field workers, explaining clearly what the System allows and what its goals are.

Some of the goals are expected to be achieved in the Pilot Units in the first months of this year.

CONCLUSION

First results lead to think that a gradual implementation asking a strong collaboration with the final users is key for a successful solution. This allows:

- building a user friendly system
- ensuring the system and its goals are well understood by the territorial users;
- calibrating a dynamic version;

At the moment, the territorial units are not just using the system but also providing useful feedback.
Indeed the foundations for the second part of the project are being built, the Dynamic Scheduling. The first tests with algorithms have been performed and the expected requirements are being profiled for the transition from Assisted to Dynamic Scheduling.

REFERENCES

Paola Petroni, Eugenio Di Marino, Fabio Veronese 2007 "ENEL Work Force Mangement System"
C I R E D19th International Conference on Electricity Distribution Paper 0034