

ADL - SCHEDULING AND ASSIGNMENT OPTIMISATION: THE DYNAMIC VERSION

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ABSTRACT

After five years of the project starting is possible to describe the evolution of ADL System, the homemade Enel solution developed for scheduling and dispatching tasks for the crews (where ADL is the acronym for Assegnazione Dinamica Lavori: the Italian translation is OTA - Optimal Task Assignment).

*The ADL System from the roll out of the first solution, **the assisted version**, changed the approach of thinking about the organization of the crews on the field and the activities in Enel Infrastructure & Network Division.*

*A strong connection with the device (from rugged Tablet to Smartphone), assigned today to each field worker, and the new solution of **the dynamic version** bring results always higher and more important about efficiency.*

INTRODUCTION

In all the Utilities the factory is the whole territory and the travel time is a normal part of the working day on the field.

To optimize the travel time means to optimize working time instead of driving, and to optimize the petrol used for the car, to optimize the car's cost for maintenance.

And to optimize the connection with field crews through devices as Notebook or Smartphone connecting with the OTA via GPRS or GPS means to assign tasks by remote, means to move to a place without knowing it, means to optimize the management of the back office, the speed and the accuracy of working on the data entry.

Up to now 25 % of the scheduled working time is spent on driving from one working place to another, and route's optimization can save more time for managing of other tasks.

CONTEXT

Enel is a leader Utility in the International markets with an essential presence in Europe (Italy, Spain, Romania,

Russia), and South America (Peru, Chile, Argentina, Brazil, Colombia).

Enel provides energy for more than 30 million customers in Italy as DSO (Distribution System Operator), managing networks from Primary Substations (HV/MV) to the metering.

Up to 2014 Enel managed the activities on the field through 114 Zone, organized on the second level in 387 Units.

Nowadays the organization is moving to a new structure with 77 Zones and 296 Units even if the field workers will be always approximately the same number.

Due to the important investment in technology as remote control, automation, smart meters Enel could obtain this management change recording always better performances in terms of efficiency and efficacy.

As it's true that part of the evolution was the consequence of the developments of the Work Force Management System (OTA and Device) that, substantially, have contributed to optimize and standardize a new approach for managing the field activities, to speed the information's acquirement, to reduce the data entry in all the different systems used.

ADL PROJECT

The ADL is the Enel System for scheduling and dispatching tasks with the goal of optimizing the daily trips to the crews.

The project is based on two fundamental items of development:

1. Each separate kind of task (from substation HV/MV to the meter) and each separate crew must be scheduled by ADL System;
2. System must be adapted to the users and not the users to the System.

The project is divided in two stages:

- The first stage called "Assisted" in operation from January 2012 where the dispatcher following some pre- built rules proposed by the System composes

manually with Drag & Drop application the optimized trips to the crews, observing the position of the tasks on the map, respecting their own priority.

- The second stage called “Dynamic”, in operation from June 2014, where some logics for scheduling are rebuilt by a partially automatic guided tour optimized by algorithms, which proposes the best solutions, and with a manual reconfiguration for urgent tasks.

ADL is strictly connected with the device (before rugged tablet and nowadays the Smartphone) offering a driving navigation, with the whole MV and LV electrical networks, encompassing the total number of customers supply points (meters).

The field workers receive the daily list of the tasks by the device, they register data from the field, and they connect to smart meters for IT dialogue.

The device must be communicate with the Central Operational Centre and allows localizing the vehicles and crews quickly to provide the field engineers with a valued “always on” connection with the Enel Central Systems.

ADL: ASSISTED VERSION

The Assisted version is made to communicate to the Unit as the approach of thinking scheduling changes and to communicate to the Project Team the Unit needs.

After one year and half of working this first version offered the way to understand needs, conditions, and approaches of the single Units in facing tasks and managing crews, and allowed to prepare the basic logics for building the dynamic solution engine for balancing tasks assigned and human resources.

To let it be acceptable and user-friendly a strong work on the design was done, involving some users to acquire their own evaluation.

So, for example, for preparing the crew’s working day, the system presents a box as the Internet “shopping trolley” for proposing tasks, a box for crews and another box for the map. Drag and drop solution let to move objects on the screen from the shopping trolley or from the map to the crews to prepare the working day.

The Assisted version proposes a sort of guided tour that brings the dispatcher to compose an optimized solution of scheduling.

Each task just worked by the crew returns from device on the field to the system in few seconds and let understand the real time situation. At the end of working day all devices give back to the System assigned tasks not worked yet.

Under this version ADL starts to offer a view of how the Unit manages people, a translation from the number of resources to Full Time Equivalent (FTE): Assisted scheduling moved to consider continually the FTE

optimization. Estimated times were assumed for the duration of each task based from the experience: this could be always an element to improve, as it was communicated during the roll out.

Through the data collected, it’s possible to bring some important considerations about the normal crew activities.

Thinking about how a Unit manages resources we could sum up:

1. 10 % FTE were invested in back office activities, included time spent in managing papers;
2. 10 % FTE were spent for loading materials on the vehicles, acquiring or returning information about tasks and organisation;
3. more than 25 % FTE were scheduled for driving (this percentage was higher considering the executed tasks at the end of the working day) ;
4. less than 55% FTE were scheduled for working (this percentage was lower considering the executed tasks at the end of the working day).

For reducing the FTE involved on back office activities of the points 1) and 2), we focused on:

- moving forward a paperless managing of the tasks considering this as a key element for a dynamic scheduling (in this way the dispatcher could move task from a crew to another without moving paper);
- creating a virtual desk for managing tasks and respecting the expire data, reducing the back office and put in evidence IT problems.

For reducing the FTE involved on driving of the point 3) we focused on building rules to create the algorithmic for the dynamic version, for standardizing the field approach.

To summarize, one of the main goal of the project is to increase the percentage value on FTE invested in working time.

PAPERLESS PLANNING

Paperless is not only a goal but it is a strategic key for crossing from the Assisted version to the Dynamic. This is clear thinking about all the difficulties in managing quickly the tasks in a papers world, composing different plan with different people each days.

Papers must be assigned, papers must be written, papers must be given back, papers must be read, papers must be archived and paper must be analyzed during inspections for quality certification.

Paper is not dynamic, so for moving from an assisted to a dynamic version it was necessary a paperless planning,

for moving people in a paperless world.

Since 2012 every papers printed by SAP System had been signed by the crew responsible person.

The accurate plan had been developed for working paperless on the field involving the Headquarters Office for defining aspects first of all in Safety, Authority & Commercial aspects.

All the phases of the plan were followed under a strict control of the internal processes.

Needs of the Unit were collected to no create a strong gap and let the people be in confidence with the new way for managing activities.

The dialogue between ADL and Device was considered to guarantee the process certification as to catch a signature.

Nowadays papers are printed by ADL and the signature is not necessary except the customer's confirmation.

The crews could choose to bring just one or few papers where were described the daily tasks, but they were obliged to put data entry on the own device: it is possible to collect all data by device in a strict connection with OTA.

The plan was started in November 2012 and was finished in July 2013.

The result is synthesized by observing the reduction of 75% documents that need to be archived in SmartP@per Warehouse (about 2.3 MI documents per year).

On the residual 25% of documents Enel needs to collect the customer's signature: a specific plan will start during 2015 on this issue for managing the whole process paperless.

VIRTUAL DESK

This issue we could consider a part of the paperless plan but for the impact and the project's time spent it is an independent item.

We move from 3 different lines utilized for scheduling (one for the customers tasks, one for maintenance tasks and the last for managing smart meters problems), generally managed in each Unit by two or three different persons to a virtual desk where only a dispatcher manages tasks without necessity to control papers but just to control data on a screen.

All the back office activities of the dispatcher are synthesized on the Virtual Desk before and after the work on the field. Tasks are highlighted for guiding the dispatcher to avoid of possible problems, as the respect of the expiry data and expected program or to verify uncertain data acquired.

Most of the tasks in the System are designed for being scheduled without human action and the virtual desk is presented for simplifying each necessary control.

A high level impact is waited on the back office activities, partially yet obtained: the plan is still not concluded.

DYNAMIC SCHEDULING: HOW IT WORKS

On the results of the assisted scheduling, we built the algorithmic of the dynamic version.

Nowadays the dispatcher can just organize the crews, launches the dynamic logic and verifies the result, making just some modifies if he thinks necessary.

Dynamic version works matching the task profile and crew profile, looking for reducing time in driving: this is not simple.

But to obtain the expected scheduling the System must consider several additional conditions enhanced by the management and by the field that allowed introducing ADL with a lower resistance.

Task

Each job is configured as a task defined through:

- Priority,
- Duration,
- Number of field workers and profile needed
- Geo position
- Expiry data
- Equipments

Each task has a safety field worker profile, and ADL verifies the correct association to the workers with the right profile.

Most of the tasks are designed for being scheduled without human action, respecting SLA compliance & translate direct in a field language: tasks connecting with a complex planning are also organized through other systems acquired by ADL and scheduled in an automatic way.

ADL allows schedule of all kinds of tasks even for operators that must support back office activities or bring the car to the mechanic.

Skill profile

A great attention was paid for offering the possibility to profile the field workers skills.

Each operator has his own safety profile, based on his own experience, verified and confirmed by Enel.

ADL, received the profile from other system, composes the schedule managing the association with the task profile.

Through another menu, ADL allows the Zone Manager to indicate the System no to associate each single operator with some tasks (exceptions): in this way, on one side it reduces the efficiency of an optimal scheduling, on another side it makes the System closer to the reality of the field.

Some people have specialized jobs and prefer not to work on normal activities, some other people prefer to work only on maintenance tasks or just on commercial tasks, even when it's not necessary a particular level of specializations.

It's for development of theoretical calculation of reducing efficiency through the comparison between the scheduling with and without exceptions.

This will contribute to move people forwards to a multi-skilled field worker profile, observing that in several cases a competence separation is only theoretical.

Multi-skilled field workers bring obviously an important role in reducing FTE scheduled for driving, considering that in some situation to work a task of few minutes the person must drive for several kilometres.

Guided Tour

Nowadays, composed the crews by the dispatcher launched the Dynamic version manually or automatically in batch during the night, ADL starts to follow a 6 steps tour, for composing the working day, on the draft designed in the Assisted version.

Fundamentally ADL builds part of the process considering two kinds of tasks:

- Task with expiry data close to the day of scheduling;
- Task with expiry data no close to the day of scheduling and with an important number of the same kind of task (*task tank*).

The second condition moves to calculate a number of tasks to work each day for respecting the expire data: for example, considering 500 tasks to work in a year, the executing of 2 tasks each day for 250 working days during the year bring to respect the expected goal.

It is important to observe that in this condition we must respect the execution of 2 tasks but it is not important which tasks are and where they are: in this situation ADL can choose the best solution.

ADL, before starting, calculates the FTE working time needed to respect the execution of all kind of *tasks tank*

of the day and tries to preserve it, in function of the highest priority tasks.

When ADL starts, selects for each crew the tasks in the following order:

1. Highest priority tasks for customers or tasks booked with an appointment or a working plan.
2. Highest priority tasks for maintenance.
3. Highest priority tasks for Automatic Meter Reading.
4. High and medium priority tasks

At this step, ADL creates the crew's trip: following the road designed on the map for each crew, ADL looks for the *task tank* closer for respecting the expected goal.

The System automatically proposes tasks selected to fill up to 100% of the working time. Then proposes tasks selected to fill the working time up to 130%. These tasks are added in substitution in case of difficult to execute assigned tasks.

Manage the presence by Smartphone

As it previously describes, Device and OTA are strictly connected and field workers can advice the System about a sudden absence for the next day or first in the morning too.

This communication is acquired by ADL and showed the dispatcher at the beginning for modifying the daily scheduling.

In the next future the System will propose directly a new plan.

RESULT

Read the number produced by a system in development is not so simple and to be clear it is often necessary to explain details just for "specialist" of the system itself.

This is just because from the 2012, when ADL started to work, it did not schedule each job but a part of them and gradually arrived to manage the whole number of tasks.

Nevertheless we can consider one important data that shows well what happened reading the kilometers data.

This confirms that from the medium value from (2009 - 2011) to 2014 has been received the reduction around up to 8 % from the total amount of kilometers driving by operative cars.

We can consider that a great part of this decrease, probably not all, is a result connected with the starting of System.

A NEW METHOD OF THINKING

ADL is substantially a new way of thinking about the field organization for increasing efficiency and efficient of business processes and make force to reflect about the organization of the work itself.

This is possible just because ADL is an open window on the field organization and allows understand how much the Field is close to the organizational chart: to calibrate the System, the Unit must define the skill of each person and declare who do what.

At the same time ADL homogenizes the processes. The System designs the best solution for managing people and activities and offers a standard way to program and schedule.

Utility business is changing through new technologies and, comparing with the past, it is necessary to investigate continually about how could change work on the field. About this, through the lesson learned by the development of ADL we could declare three sentences:

- If you must go there, do more than you can;
- Verify if a specialist job could became standard job (if it started to be a normal activity of your business);
- The number of scheduled jobs must be close to the number of the jobs expected realized in a working day.

During the 2014 Enel hired 1500 young people as field workers.

For them provided to develop training about the job on the field, with particular attention to the safety aspect. It is important to highlight that the training course included one week in class and office to understand how ADL works.

LATIN AMERICA

Observing results obtained, Enel started with a similar project for OTA and Device in South America.

We must consider a great different application, considering in this case field workers are usually managed by Contractors.

The project is rolling out and we could read about it in the future.

FUTURE DEVELOPMENT

Future developments are concentrated around the management of the materials and the management of the faults during the not working hours.

Concerning about materials, the System will produce together with task list, the materials needed too.

The operative cars will be considered as a room of the warehouse: this issue opens the view to a new solution for managing people too.

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