CHANGING THE DSO TO REAP THE FULL BENEFITS OF SMART GRIDS

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ABSTRACT

The purpose of this paper is to present the transformation process that is currently being implemented in EDP Distribuição (EDPD), the main Portuguese DSO, in order to reap the full benefits of the ongoing smart grids' investments. With the emergence of distributed resources, DSOs are called to deploy smart grids technologies to cope with new challenges. In this context, EDPD is installing smart grids' technologies such as network automation devices, data management systems and smart meters in large scale. However, a full realization of smart grids' benefits goes far beyond the installation of technological devices and requires a far-reaching transformation of the entire organization involving business processes, organizational structure and systems. Aware of the gap that exists between deploying hardware/software and realizing benefits, EDPD launched in 2015 the move2future initiative to prepare a transformation throughout the organization and to be able to materialize all the potential of smart grids' technologies to create business value. As a result, 59 different use cases, related to the new technologies under implementation, were identified in the project and they will be fully implemented until 2020. This paper will present the methodology to determine the use cases, assess the existing gaps and observe the insights reached so far.

INTRODUCTION

With the growing relevance of distributed renewable energy sources in the generation mix [1] and the emergence of new market players offering data intensive services, power systems and distribution operator's role need to evolve. This transformation will require enhanced levels of observability and controllability over the network and its distributed energy resources (DER), fostering a new paradigm of knowledge about real conditions of network assets. Higher levels of quality of service and operational efficiency will always be part of distribution operators' attributions. Nevertheless, they will be called to widen their scope to others activities such as (big) data aggregation and provision to market players as well as manage flexibility of distribution grid resources.

This digital transformation positions DSOs as *Market Facilitators*, able to ensure a level playing field of infrastructure development and quality of service, fostering the necessary conditions for a competitive and efficient environment for market players to focus on the development of their innovative products and services.

In this context, smart grids are key to open the door of DER's integration, promoting higher levels of efficiency and reliability (e.g. through demand response) and ensure comprehensive capabilities of network control and monitoring with impact on outages reduction or prevention [2]. Thus, smart grids technologies' deployment has become a global trend among DSOs. Network automation devices, data and distribution management systems, asset management equipment (e.g. sensors) and smart meters are being deployed in large scale (e.g. 200 million smart meters are expected to be deployed in 2020 in EU-27 countries [3]).

However, to accomplish a wider evolution towards an effective smart grid and ensure the realization of full smart grids' benefits, new processes, tools and systems are needed. This new approach will increasingly challenge DSOs to adapt and change their processes more frequently than they were used to, due to constant technological developments of "new digital power" grid components.

InovGrid*: Smart Grids transformation in *EDP Distribuição

Recognizing the potential of Smart Grids as an approach to address current DSO challenges, *EDP Distribuição* is in the frontline of this transformation with its umbrella project, *InovGrid*. EDPD has also an ambitious investment plan for the upcoming years and consequently several smart grids' technologies are being deployed, namely:

- Smart meters (*EDP Box*) in ~100% of LV customers, allowing LV metering and other features such as voltage monitoring. EDPD aims to reach 20% of LV customers by the end of 2017;
- DTC (*Distribution Transformer Controller*) in secondary substations able to concentrate data from smart meters and contribute for MV network monitoring, automation and asset management;

- Smart meters in 100% of secondary substations that support energy balance and contribute for business processes such as commercial losses reduction;
- Smart meters in 100% of public lighting circuits allowing its metering and control and supporting new DSO's services for municipalities;
- MV automation devices, contributing for the improvement of quality of service and OPEX reduction (~7 thousand points at the end of 2016 were installed). EDPD has a plan to continue the installation of this devices in overhead and underground feeders depending on length and power criteria (e.g. 1 automation point per each 3,5MVA in underground feeders).

EDPD has also created a Supervision Center that gathers in the same location several technological platforms and organizational units with complementary business processes as an important pillar of its smart grid strategy.

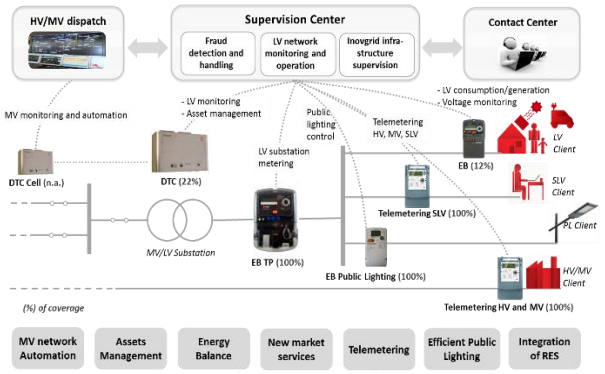

Figure 1: Integration of Smart Grids' data into EDPD's supervision center

However, to reap the full benefits from smart grids, technologies' deployment is not enough. It is essential to implement a far-reaching transformation of business processes, systems and human resources throughout the organization. For instance, the deployment of smart meters will allow new billing business processes (e.g. without estimation) demanding higher capacity systems and new interfaces with suppliers and customers. Disruptive processes, such as related with demand response, will require new capabilities of prediction, estimation and resources management as well as innovative tools and processes that need to be developed involving interfaces among different entities. In this sense, this transformation will have impact into DSO's stakeholders. For instance, regulators will also need to adapt their processes to support this transformation. Concerning customers, they will be given new tools that will enhance their levels of proactivity in their decisions.

EDP Distribuição is fully aware of this necessary transformation of creating smarter grids encompassing new technology, processes, systems and organization able to provide benefits for the entire organization, market players and society in general.

MOVE2FUTURE INICIATIVE IN *EDP DISTRIBUIÇÃO*: FIRST STEPS

In the beginning of 2015, *EDP Distribuição* launched the initiative *move2future* to prepare a transformation throughout the organization with the main objective of materialize all the potential of smart grids' technologies to create business value by acting over processes, organizational structure and systems.

Figure 2: *Move2future* project overview

Furthermore, some questions arose and helped the clarification of EDPD's future business needs, regarding the change in processes, systems and organization:

1) What is the vision of transformation for 2017-2020 period?

2) How do smart grid's benefits materialize?

3) What has to change in terms of processes, systems and organization?

4) How can this transformation happen?

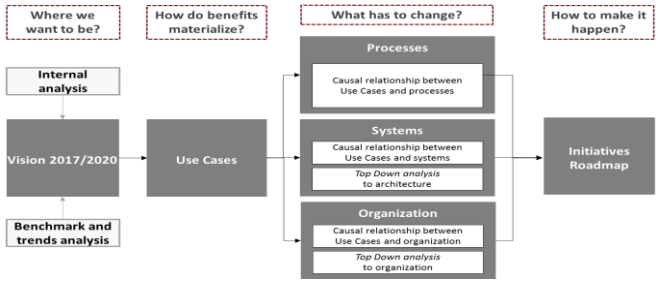

Figure 3: *Move2future* initial framework

The first steps of this initiative were characterized by a set of meetings involving the EDPD's organizational units (from strategic to operational ones) with the following objectives:

1) Gather inputs to define EDPD's business vision;
2) Define the new use cases;
3) Assessment of current IT infrastructure as well as the existing gaps that must be filled to support the transformation;
4) Identify organizational impacts arising from the future implementation of the use cases;
5) Ensure a full commitment of all organizational areas.

This initial process was supported by external consultants that contributed with their methodology and benchmarks to EDPD' vision definition.

Vision 2017-2020

To address and anticipate future challenges, EDPD's vision is deeply supported on new investments and their full integration in new business processes, enabling an effective evolution towards expected changes in the short and medium term. In this sense, requirements regarding higher levels of predictability, observability controllability and flexibility over network-connected resources and a new approach towards customers were taken into account in vision's design. As such, different abilities and goals were mapped to be addressed in two different periods:

Until 2017-2018:

- Increase observability over networks, including LV level (active LV grid supervision);
- Increase controllability over the network thru remote operation;
- Increase capacity and flexibility of face exceptional events to minimize outage times;
- Improve knowledge of real condition of assets and evolution in processes related to their operation and maintenance;
- Assume the natural role of aggregator and data provider to all clients and other stakeholders (with consent by customers);
- Start paving the way to assume in future the role of system operator.

Until the end of 2019:

- Assume the role of the distribution system operator, showing ability to actively manage the network, and thus promoting the integration of all types of distributed resources (e.g. active control of DRES, reduction of power under specific circumstances);
- Enhance new services related with energy efficiency for market players (e.g. suppliers, ESCOs).

Use Cases

In order to materialize EDPD's target vision, 59 new and concrete use cases were defined, comprising 19 different initiatives grouped in five major areas encompassing planning and maintenance, network supervision and operation, commercial operations and market dynamization, new services to municipalities and network information quality (low voltage level).

The implementation of this set of use cases requires different levels of transformation of current EDPD's processes, ranging from the integration of core functionalities of smart meters to a relevant change of DSO paradigm.

Major Areas	Initiatives	# UC
Network information quality	Quality of LV network's topology	1
	Quality of LV network works (e.g. expansion)	1
Network supervision and operation	HV and MV network operation	5
	LV network supervision	4
	Customers power control to grid support	1
	HV, MV, LV DRES management (set-points)	2
	Demand Response (flexibilities' validation)	3
	Storage (grid management)	2
Network planning and maintenance	Network planning	3
	Maintenance of HV and MV assets	2
	Maintenance of Secondary Substations	2
	Assets Management (e.g. sensorization)	7
Commercial operations and market dynamization	Revenue and Business Assurance	7
	Management and data provision	7
	Commercial remote operations	4
	Energy efficiency	2
	Dynamic tariffs	1
	Commercial events management	3
New services to municipalities	Public lighting management	2

Figure 4: Initiatives per major areas and UC number

Hereby we mention some examples (not exhaustive).

Integration of core functionalities of smart meters:

- UC30-34: Remote business operations (e.g. readings, tariffs, contracted power switching);
- UC53: Providing access to EDP Box's han port, enabling customers' access to new products and services provided by suppliers or ESCOs;
- UC49: Billing synchronized with billing dates in LV (without estimation).

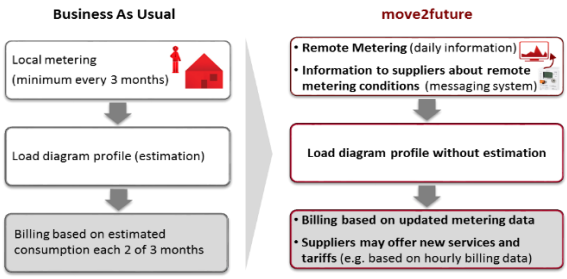

Figure 5: Use Case 49 - Billing LV customers without estimation

Relevant level of transformation of current processes:

- UC27: Planning the moment of substitution of equipment based on their real condition instead of systematic and less efficient management procedures;
- UC35: Automatic detection of LV networks with higher losses through energy balance per secondary substation;

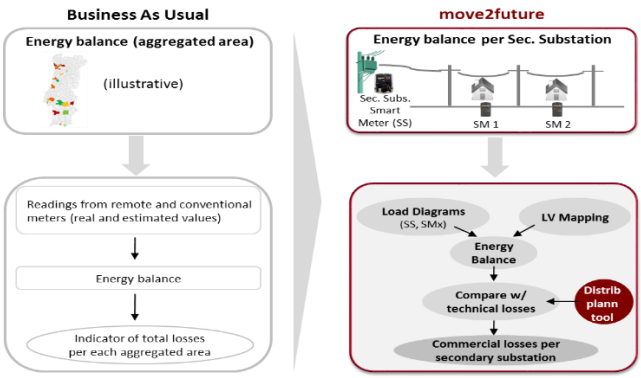

Figure 6: UC 35 – Energy balance per secondary substation

- UC7-8: Automatic outage detection and location of problematic networks (e.g. voltage violations) using information from Smart Meters and DTC;

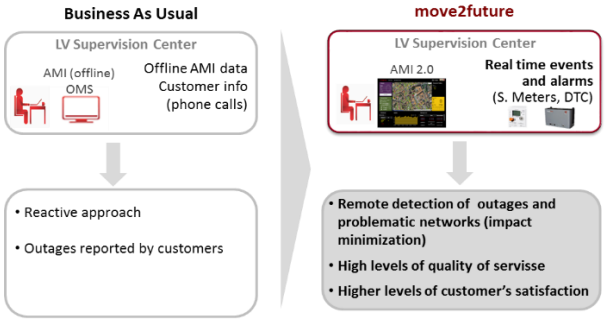

Figure 7: Use Cases 7-8 – Using data from EB and DTC for automatic detection of MV/LV network technical problems

New paradigm of DSO:

- UC14: Control of DRES (P,Q,V) in HV and MV through a set of control actions (set-points) which enables a coordinated operation;
- UC44-47: Provision of detailed consumption data to customers, suppliers or ESCOs (with a formal authorization by customers) fostering new market data intensive services and products;
- UC13: Temporary reduction of contracted power of customers to restore service after failure (disturbed regime situations). Combination of information (outages, customers' load diagrams, commercial information and power flow) to specify the set of customers and amount of power reduction that will be used to restore the network more effectively.

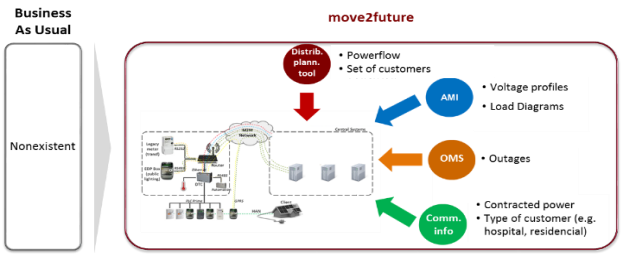

Figure 8: Use Case 13 – Using reduction of contracted power to support network restauration

Processes, Systems and Organization

The referred use cases implied the revision of the existing processes or even creation of new ones in order to accomplish its purposes. New requirements for existing macro processes related to planning or network construction, commercial and switching management, network operation, maintenance and energy metering or billing were created or modified to support new needs. These comprises, among others, remote operations using smart metering devices, real time LV network operations using data from EDP Box and DTC, maintenance decisions based on asset condition analysis from events' correlation or even using smart meter data to analyze and manager customer complaints. Furthermore, there was the need to create new processes encompassing dynamic validation of LV network topology, monitoring, supervision and control of the smart grid infrastructure or processes related to provision of detailed consumption data to clients, ESCOs or suppliers.

Use Cases' implementation requires also a coordinated evolution on EDPD's current IT infrastructure. Changes concerning real time analysis, LV network supervision, smart meter data collection, among others, demand new (or improved) major systems. Consequently, developments on AMI, Data and Asset Management, Advanced Distribution Management Systems, Revenue Assurance or Network Planning systems are being implemented with several releases foreseen between 2016 and 2019.

Regarding the organization, some steps were taken to turn smart grid management into a business as usual approach. Some organizational changes were already performed in order to clarify assets' responsibilities and accommodate new competencies in EDPD.

Roadmap of Initiatives

Use Cases were grouped in several initiatives, according to relative business process and whose implementation demands the mobilization of the entire organization. The roadmap of use cases implementation is very demanding and addresses activities such as processes design, interaction with the regulator, systems development, among others. As such, considering the long-term roadmap, the initiatives foresee the implementation of quick-wins versions on some UC in order to validate the principles and start to extract some value at an earlier stage.

The real implementation of the use cases started in the 1st quarter of 2016. About 1/3 of the use cases aspire a final version implementation until the end of 2017 (50% with a quick-win version) and the remaining ones are expected to be implemented along 2018 and 2019 (UC ending in 2019 are mostly related to new roles of DSO).

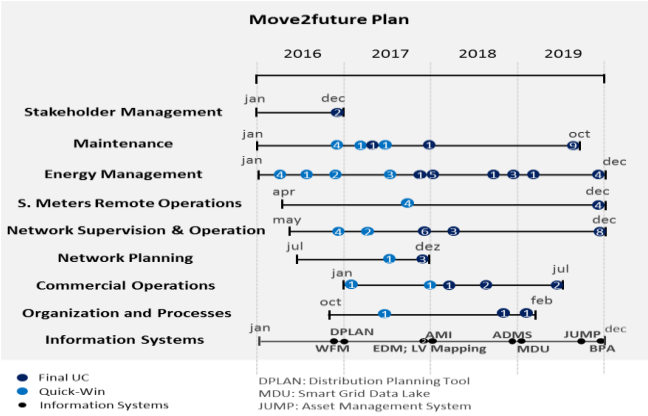

Figure 8: *Move2Future* Roadmap

CRITICAL SUCCESS FACTORS

Such a transformational initiative involving the entire organization and affecting a large percentage of current processes and systems is a big challenge. Thus, some critical factors that may influence the success of this initiative were considered in *move2future* approach:

- Top management commitment including all board members of EDPD, with whom it is shared a quarterly report of initiative's implementation and participate actively in biannual *steerings*;
- Functional project management model, fostering the ownership of initiatives by each business units top managers as well as a high level of coordination between different initiatives (e.g. every UC depends on systems developments). This kind of model is key due to the amount of people involved as well as the complexity of deliverables;
- Communication strategy with every people involved (e.g. in the first quarter of 2017 will take place a *move2future*'s first year workshop where each business unit will present the main achievements so far);
- Identification at an early stage all of the IT requirements in order to be timely implemented and reflecting all processes' changes;
- Financial and human resources availability to the implementation of a wide set of IT developments (e.g. AMI, ADMS; EDM) and execution of a large number of use cases;
- Existence of Quick-Wins in the majority of Use Cases ensuring benefits are being extracted as IT developments are implemented.

MAIN RESULTS REACHED SO FAR

The *move2future* initiative started its implementation phase less than one year ago. As such, the main results achieved so far are related to process design, systems' new requirements listing and quick wins use cases definitions.

At the end of 2016, seventeen (17) use cases were already implemented, in final or quick-win versions and which main outcomes are being assessed during the first quarter of 2017.

CONCLUSIONS

In conclusion, it is clear that investing in smart grid's technologies is not enough to reap all the potential benefits they have. Along with it, comes a necessary path of transformation inside the company. Therefore, *move2future* intends to be the changing movement of processes, systems and organizational structure inside EDPD towards a smarter grid reality.

To succeed in this demanding transformation process, EDPD has involved all the organization since the very beginning, and will continue to do so over the next years.

With this kind of transformation, DSOs will benefit from higher efficiency in their processes. Moreover, they will foster benefits into the entire system by ensuring a level playing field for new market players provide their innovative products and services to proactive customers.

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