SMART AND WIRELESS FIELD FORCE MANAGEMENT: TODAY AND TOMORROW

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ABSTRACT

During the few past years, electricity distribution companies have payed an increasing attention to mobile technologies applications to manage and supervise their field-force employee activities. From planning and scheduling to real time work dispatch, tracking and reporting, field-force work management process is evolving to move part of the information system out to the field crews.
However, to implement such Mobile workforce management system, companies have to overcome several challenges to harness the targeted efficiency and operational excellence benefits:
- Mobile technologies integration and deployment
- Business process optimization and automation
- Change management and mobile technologies appropriation by Field teams
This paper will describe ERDF's TAMARIS Mobile Workforce management project and SWAN's (Smart and Wireless Agents on Network) EDF's R&D initiative to design the future mobile workstation of network operation field crews. ERDF is the EDF Group distribution subsidiary.

INTRODUCTION

Improve network operation efficiency and costs, increase customer satisfaction by reducing outage time and increasing quality of supply are major objectives for electricity distribution companies. Success keys, to reach these targets can be summarized on Mobile Work Force Management (MWFM) challenge.
According to these facts, ERDF launched in 2009 the TAMARIS project to rollout a national industrial solution aimed to:
- Centralise and improve maintenance and repairs activities, planning and dispatching
- Streamline field operators works by reducing office-to-field delays through wireless communication and sat navigation travel time optimization.
- Maximise work quality, by bringing to field necessary technical expertise over knowledge base and documentations access.
- Eliminate redundant data recording and reduce paper works
- Improve unplanned activities management in incident and crisis situation with real time field crew location.
- Enhance field operations archiving and storage process

Alongside TAMARIS project, EDF R&D has launched SWAN project (Smart and Wireless Agents on Network) to design the future mobile workstation of network operation field crews.
SWAN project is prospective and aims at getting a long term vision addressing business issues (the future of network operation) as well as technical issues (mobile workstations, communication infrastructures and wireless technologies).
The designed mobile workstation is being implemented on an experimental platform MENOFIS (Metering, Network, On the Field Information System) with related communication infrastructures

TAMARIS: ERDF'S MOBILE WORKFORCE MANAGEMENT PROJECT

ERDF for "Electricité Réseau Distribution France"; subsidiary of EDF; is the main operator for electric utility distribution network in France.

ERDF is responsible for overall 95% of France electrical network, covering 1,2 million KM of low voltage (LV) and medium voltage (MV) networks, 33 million LV users, 100 000 MV users, 1232 contracts with local authorities and 6300 small producers (wind or solar generators).
17500 field operators in 8 regions, 23 professional units and 100 local agencies, undertake a variety of tasks on networks and transforming installations.

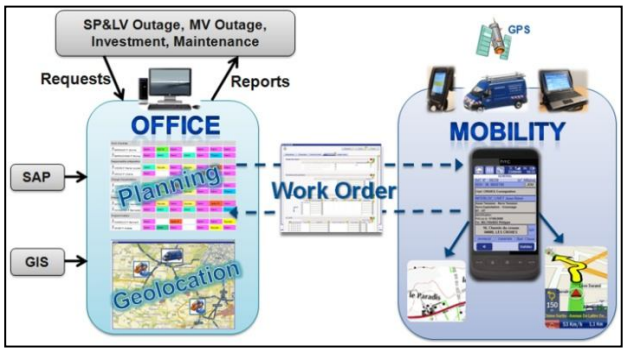
Project background and objectives

Like all electricity distribution operators, ERDF environment is changing. Regulator service quality exigencies evolution, economic needs to improve network operations efficiency and costs, upcoming massive operators' retirement wave to manage …
Managed in agile modelling method, TAMARIS is built through iterations where project team is closely working with a panel of field engineers and crew from different regions to benchmark application development and collect their feedbacks. Iteration by iteration, new functionalities are implemented and field team asked to track and report problems and evolutions perspectives.
Today in pilot phase, TAMARIS is used by 1200 users with target generalization rollout end 2012 for 10 000 operators over all France.

How does it work?

Field work orders processing cycle was reviewed and optimised to get read of paper forms and automate the work order flow processing. Orders flow in real time from/to TAMARIS advanced dispatching system to/from field mobile devices (PDA and laptops).
Office supervisors and field crews are continuously

updated on work progress and work planning evolution.



Tamaris Process

Centralised Dispatching system

Work orders from existing network applications (Outage call centres, SCADA …) are collected in the dispatch system for scheduling and affectation.

GIS asset system, SAP time tracking and payroll system, gears management are integrated with the dispatch system providing a real time updated overview to schedule and affect work orders efficiently.

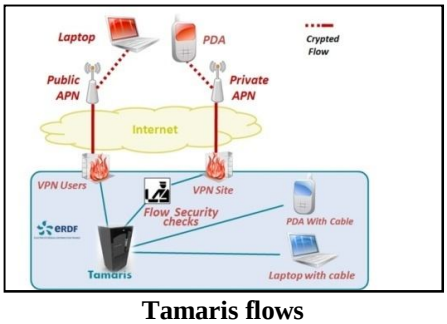
MWFM solution

Laptops equip supervisor and field team leaders to manage advanced operations requiring large screen or keyboarding like work orders assignment or rescheduling on the field.

PDA allows field operator to get work orders in real time, update and report on the work carried out. Sat navigation, tracking and technical support applications are integrated in the PDA leading a significant improvement of crew field productivity and operations quality.

Laptops and PDA can be used inside and outside ERDF's IT network. External communications links and flows security is guaranteed by data encryption and ERDF's control protocols and systems.

Two dedicated private APN (Access Point Name) are used for PDA communications. Key operation steps and crews geo-localisation data flows from the PDA into dispatching system in real time using the 3G network. For orders upload, mobile devices initiate secure connection for synchronisation.



Tamaris flows

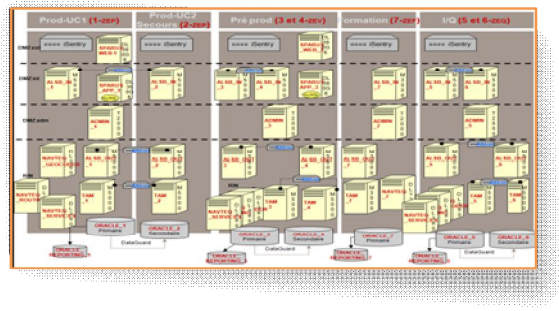
Lessons learned and Roll out challenges

With regards to ERDF's network size, current heterogeneous practices in the different units and the targeted number of end users, TAMARIS rollout is a complex project in various aspects and a lot of challenges have to be managed every day.

Complex Industrialization

TAMARIS industrialization process took 4 incompressible months!

Infrastructure architecture complexity; 39 servers, more than 600 different flows; proved more complicated than expected to manage.



TAMARIS infrastructure architecture

System cross-functionality covers a large range of technologies and expertise, multi-expertise Mobility project managers, to orchestrate deployment traps and pitfalls. To get over mobile technologies integration mastering; inside and outside ERDF; long and time consuming coordination cycles between different IT departments' teams (System infrastructure, Functional analyst, Telecom …) are needed to investigate and manage deployment contingencies.

Fast changing mobile technologies

A quick examination of the mobile OS's battle and mobile devices fast evolution, gives a picture of the complexity of operating a long term technology choice. TAMARIS implementation life cycle is confronted to the high speed mobile ecosystems evolution.

One year ago, when TAMARIS was launched, with regards to technology offers, Windows Mobile 6.5(tm) was selected to implement the system. Today, even if the project is not fully deployed WM6.5(tm) is already nearly obsolete and strategic questioning imposes to evaluate TAMARIS platform upgrade/migration.

Same dilemma is faced on PDA and mobile devices selection.

Change management challenges

Field teams' involvement since the beginning of the project was a key point to prevent massive organisational changes and impacts. TAMARIS was successfully designed to serve and fit into field organisation. However, change management process has to be run to

manage PDA adoption by field crew's and dissipate what can be called a "Big brother syndrome".
TAMARIS real time full transparency brings to light field crews' operations management used to be done in fully autonomic way. This new fact is quite hardly accepted by some change resistant crews who need to be convinced by the benefits brought on their daily activities management. On other side, PDA's users have to be configured to prevent non authorized use of the mobility devices (Personal data transmission, uncontrolled applications downloads …).
From IT perspectives, local support teams used to work on fully proved and mastered internal network, have to be trained to manage daily proximity support tasks on mobile network (3G, geo-localisation …) and complicated to operate PDA's (PDA owner is administrator of his PDA) dispersed all over the country.

SWAN: THE FUTURE MOBILE WORKSTATION

The future mobile workstation

The main goal of SWAN EDF R&D project is to define a long term (10 years) vision of the mobile workstation for ERDF field crews in the continuity of TAMARIS project. The field workers missions addressed in SWAN project are mainly operation, maintenance and outage management.
To address business as well as technical issues, SWAN relied on workshops including business and technical people and led a three step study.

First step: 10 years vision of the future mobile work
The first step was dedicated to define scenarios describing the progress of field operator's activities, his interaction with his environment (the electrical network, his colleagues, his management, the Information System), the technologies he must have to achieve his missions. These scenarios take place in normal or under crisis situations.

Second step: The technical environment
The second step allowed identifying promising technologies:

- Internet of Things including sensor networks,
- Availability of high broadband technology on the whole territory: 4G cellular networks up to 100 Mbps
- Convergence of services: identical context available on fixed as well as on mobile devices, in fixed or moving environment.
- Tablet PC instead of laptop for many uses.
- Universality of data terminal equipments which will be used for all purposes: video phone calls, Internet access, identity card, payment...
- Data terminal equipments connected to multiple communication media and seamlessly choosing the best medium according to criteria such as application type, requested quality of services, cost, ...
- New communicating interfaces: extended reality, flexible screens and holographic displays.
- Geo-location largely deployed and allowing a wide range of services.
- Wireless networks more efficient thanks to various technologies such as cognitive radio which will provide a better use of the radio frequency spectrum, smart antennas, and software-defined radio. The widespread use of Wifi will supersede other technologies in the wireless local networks area.

From these technologies, SWAN project defined business uses: for instance with extended reality, the field worker could get information on the network equipment he has to operate, thanks to 4G network a business expert could help him by video call.

Third step: The future mobile workstation
The final step succeeded in determining the main characteristics of the future mobile workstation:

- **a communicating vehicle** which can seamlessly manage the access to the central IS through various media whenever in normal situation or under crisis situation (many electrical outages or lack of cellular networks),
- **an adaptive Information System** taking into account the places and circumstances of the agent's task, the task itself and the available bandwidth for data exchange between the central IS and the handheld device,
- **a smart phone and a tablet PC** as a workstation.

Mobility mock up included in MENOFIS experimental Smart Grid Platform

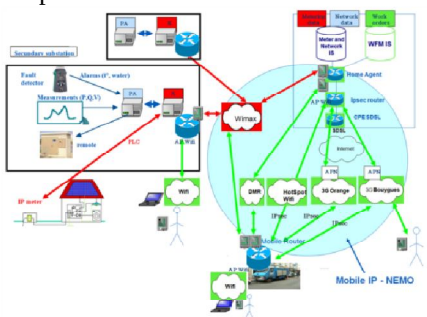
EDF R&D is currently studying the different opportunities brought by the upcoming smart grid deployment and building an experimental platform called MENOFIS (Metering, Network, On the Field operations and Information system) integrating smart metering, network and mobility requirements within the same telecommunication infrastructure and information system.
Within MENOFIS, SWAN project can deploy mobility features for metering and network business as well as include mobility in the electrical environment of the future: the smart grids.

The mobility features implemented in **MENOFIS platform aims at allowing field workers to get the data necessary to accomplish their missions**. These data can be of different types: works orders, meters and network sensors data, and from different sources: from central Information System or from the electrical networks equipments. The two main mobility features currently implemented on MENOFIS are:

- **improve interaction with business data** taking into account several contexts : field worker type of work, his location, the different available telecommunication media, his job's circumstances (normal or under crisis situation)
- **enhance the performance of the mobile workstation** based on:
  - a single smart phone allowing both access to telephony (GSM), business information system (3G) and having features as DMR (Digital Mobile Radio used as a telecommunication media for operation) for operation calls and data transfer
  - a Tablet PC for visualisation and modification on much more complex document than it is possible on a smart phone (screen and keyboard)
  - a communicating vehicle which manages various media.

The key points of the mobility mock-up included in MENOFIS are:

- **the deployment of a mobile infrastructure based on a mobile IP NEMO Protocol** and including a mobile router embedded in the vehicle managing the handover between different media : Wifi, Wimax, 3G and DMR) to improve the field workers connectivity,
- **Wifi access points connected to the HV/LV secondary substations** to get local access to data,
- **a WWAN to connect secondary substations between them** and to the central IS,
- **the use of Ipv4.** Ipv6 was not selected because some equipments currently deployed in MENOFIS platform don't handle this version of the protocol.



General principle of the mobility's features on MENOFIS

We implemented several technical components which contribute to the mobility requirements:

- To improve interaction with business data: in a vehicle, **a mobile router** which manages the **vertical handover** between several WWAN media. We use an extended WLAN around the vehicle to get access to these WWAN media. One of **the WWAN media is a crisis one: DMR** to transfer data between Information System and handheld devices. We implement **Mobile IP NEMO** (Network Mobility). We rely on the **Advanced Metering Infrastructure** (AMI) implemented in MENOFIS to get access to the central information using the WWAN deployed between it and the secondary substation. The **IP infrastructure connecting the secondary substations** between them, the AP Wifi and the IP KPA (metering and network data concentrator) installed in the secondary substation allow the field worker getting access to the network distributed data.
- To enhance the performance of the mobile workstation: **a smart phone and a Tablet PC** and **an operation vehicle**. The vertical handover and the integration of a crisis media (DMR) contribute also to cover this requirement.

The platform MENOFIS implements some smart grid functionality and mobility is a part of these.

CONCLUSION

Thanks to these modern tools and this innovative approach, ERDF is expecting:
- **immediate benefits** from Tamaris in field costs reduction, customer satisfaction improvement, vehicle costs reduction, paper cost reduction...
- **a vision for the future** from SWAN initiative, given the rapid changes in technology and ways of working in the new context of smart grids.

Nevertheless, some risks have to be mitigated:
- Mobile technologies are changing faster than application development,
- Mass market mobile technology imply mass market services, thus non professional services in a professional context,
- Change management remains a main issue to succeed in the delivery of a new way of working with those new technologies.