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Analysing professional transitions underway in an experimental project on energy efficiency

Anthony Rosier, Corinne Gotteland, Pascal Béguin, Valérie Pueyo
CREA-EVS UMR5600, Université Lumière Lyon 2, France

Abstract

With the transition to sustainable development, we are witnessing today in the development of experimental programs concerning changes in electricity uses. As part of an experimental project on tertiary sites, new managements energy consumption appear, bringing project actors to move towards a common purpose: the Demand Side Management (DSM). Thus, we are interested in new forms of cooperation and linkages between stakeholders in the management of energy consumption of the sites, which may lead to professional transitions. For ergonomics analysis of work activity, we look for highlighting, from the approach to professional worlds of the actors, the conditions for changes in work practices identified in the project. These changes are necessary to consider in order to incorporate new requirements and collective ways to do more to achieve the goals for energy efficiency.

Practitioner summary

Human factors/ergonomics (HFE) has much to offer by addressing activity at work for change and development. This paper focuses on change in energy sector in the context of efficiency and sustainability, emphasising key elements in terms of project management and activity development.

Keywords: Demand Side Management, experimentation, energy efficiency, professional world, professional transitions.

1. Introduction

1.1. An evolving electricity industry

The energy production sector is currently undergoing profound change due to the shift towards sustainable development. In this regard, French electricity production has to meet its national and European commitments concerning energy efficiency and optimal consumption. In order to meet these challenges, French electricity producers and especially Electricité de France are currently running experimental programmes on the introduction of new technologies¹. The implementation of these technologies implies the development of innovative services adapted to consumers' energy saving needs, and the design of new "technical-organizational" systems that meet today's energy challenges.

Until now, most of the research programmes in the industry have concerned energy production. Today, the main issue is energy efficiency². The aim of the experimental programmes is to reduce energy costs by enabling users to steer their own local consumption. In this paper we focus on the question of the distribution and consumption of electricity.

¹ Known as Intelligent Energy Networks.

² Energy efficiency can be defined as the reduction of consumption related to changes in behaviours and uses.

In particular, we examine the Smart Electric Lyon (SEL) demonstrator, a large experimental programme³ concerning changes in electricity uses. The project, initiated in the city of Lyon (France) and coordinated by the leading French energy producer, is funded by the ADEME⁴, the French national agency for environmental and energy management.

Our study focuses on the development of the experiments in the tertiary sector (Business to Business - BtoB). And specifically on professional transitions they entail and imply.

1.2. Professional transitions underway within an energy efficiency project

With the current trend towards sustainable development, the implementation of Intelligent Electricity Networks implies the development of innovative services adapted to consumers' needs for energy savings, as well as the design of new "technico-organizational" systems to meet new energy-related challenges. The functioning of these networks requires: i) guaranteed interoperability between technical systems; and ii) coordination between the professionals working *with* and *on* them.

We think that, in view of the challenges and trends that this demonstrator underpins (production of new knowledge, arrival of new actors, appearance of new technical objects, etc.), it calls for a change in the "frames of work".

These changes stem from encounters between several professional worlds (Béguin, 2005) – worlds defined by the values and principles as well as the know-how applied by operators (in their activity) to meet their objectives. From this point of view, each actor marks out operative divisions, with which ways of doing, thinking and acting are associated. We could also imagine that, through these encounters, the professional worlds concerned are likely to evolve in order to collaborate better with one another, and thus attain new energy efficiency objectives. In this paper we argue that new articulations related to experimental processes are likely to lead to professional transitions – that is, to the evolution of existing professional worlds – or even to the emergence of new professional worlds in the energy industry.

We therefore think that as a result of the improvement of energy efficiency via the management of electricity consumption, the actors tend towards a common objective: mastering the energy demand (MED). Their actions aim to optimize the energy consumption of the sites investigated, in relation to use of the buildings. In the service sector these changes tend to be concretized in transformations in the work processes of the participants in the project.

The aim of this text is therefore, based on the actors' approach to professional worlds, to highlight the conditions of changes in the professional practices identified within the SEL project. In so doing, we envisage the appearance of professional transitions related to the experimental process.

2. Method

Our methodology combines a longitudinal research protocol based on three cases (based reasoning, Yin, 1994). We use the Ergonomic Analysis of Work (Guérin & Coll., 1997; St. Vincent & Coll., 2012) to combine the data collection and analyses of: (i) the working documents; (ii) observations in situ of the work of the employees concerned by the experiments and of the B2B steering team; (iii) "traces" of these different actors' activity; and (iv) interviews on periods of observation and during self-confrontations (Mollo, 2004). We also draw on video and audio recordings of events. This analytical approach is implemented both on experimental sites and in the B2B steering team.

Associated with this approach we have attended technical steering team meetings to observe how the actors of the steering group revolve about their common object (actions of Demand Side Management - DSM) but also how such trade puts "in motion" their respective professional world. In order to better characterize professional work transitions, we focused on two key actors that are energy specialist and project integrator. We aim to identify changes in the objects of their action and the associated principles and

³ Fifty sites in the tertiary sector and about sixty participants in the residential sector are running experiments to reduce energy consumption during winter periods 2012-2013 to 2015-2016, a period of 4 years for the project.

⁴ ADEME (*Agence De l'Environnement et de la Maîtrise de l'Energie*) is under the authority of the French ministries responsible for the environment, industry and research, and participates in the implementation of public policies concerning the environment, energy, and sustainable development.

values. Similarly, we sought to identify the tools and "objects" mobilized in their practices that allow them to develop solutions throughout the process of experimentation.

3. Results

In the tertiary sector, the experiments require the "custom". Because to get to the scenarios and tests of reducing energy consumption it is necessary to integrate characteristics related to:

- Sites (commercial business, industrial or tertiary)
- Electrical equipment,
- Energy use in buildings.

In fact, these scenarios of reducing energy consumption:

- Are set up from the uses of "consumers"
- Aim to reduce the power used on electrical equipment on hourly periods (eg between 11am and 13am for hot air curtains at the entrance of a supermarket)
- Must minimize the impact of these cuts for the "users" (in terms of thermal discomfort or use of equipment at work for example).

The hypothesis of the project is that these reducing energy consumption programmed during periods of « Great Cold »⁵, may i) to generate significant reductions in local power consumption; ii) to provide and the flexibility to the grid during peak consumption.

But our analysis shows that these tests reducing energy consumption are not an end in itself for project supporting actors. These aim energy efficiency. To achieve this, we must, in a first step they spot and initiate DSM actions that could improve the energy performance of equipments by working with sites stakeholders. In a second step, once the action conducted, they develop and test singular reducing energy consumption scenarios on each site before validating them site actors.

3.1. From actions concerning the management of the energy demand to reduced energy consumption scenarios: an original approach

It is therefore clear from our observations that the energy performance is rarely optimal when the actors arrive on sites. This is one of the basic elements to achieve energy efficiency. Therefore, actors BtoB steering group first launch DSM actions. And they do it by practicing "active management". This is to reprogram (via Building Management System - BMS) piloting buildings equipment consuming electrical energy (eg boiler, air conditioning). Through this approach, the goal is to optimize the use of existing equipment using their maximum technical capacity.

Active management requires to consider and to find a balance between different variables:

- Electrical equipment : nature (central air treatment, heat pump, operation, condition (wear, obsolescence) settings. These variables are essential to determine the potential of "energy steering".
- The use of buildings (sales work, production, office ...).
- The building configurations (architecture, nature of buildings, facades orientation) to be considered to optimize the programming of existing equipment,
- The energy behavior of the link building with the weather. The diagnosis of this variable is made using measuring instruments installed in the building (eg temperature sensors, probes) that provide particular temperature data (internal vs. external)
- The environment (weather conditions)
- Periods of use (time slots, season).

Once active management implementation and DSM actions taken and integrated into the steering energy management of the building, the project actors develop scenarios of reducing energy consumption. And they test them on several days of great cold before being validated with stakeholders sites.

⁵ It is a winter set in France between November and March, when the minimum daily temperature felt drops below -5 ° C. Indeed, we are witnessing in these days of Great Cold, an increase in electricity consumption in France.

This approach, unique and singular for each site presents a new framework for all stakeholders involved in the project. It assumes that the actors are based around a new object: energy efficiency. It leads to transformations of professional worlds involved.

3.2. New interactions between diverse actors

3.2.1. An actor network at the service of the B2B project

Our observations on the three sites show a network of interdependent actors consisting of two groups of actors. First group, the actors involved in the steering of BtoB project: a project manager, an energy specialist, an project integrator and a technical sales driver. Formally this group follow up and coordinate experiments on the sites. The second group includes actors site. They vary according to the business organization (eg technical manager, service ensuring the operation of the building) and the existing energy management (maintenance manager).

These actors have objects, objectives, instruments, discourse and constraints of their own work activity. Yet in the state, to achieve energy efficiency, they must be organized around this main object (energy efficiency) and these prerequisites: DSM actions and active management. These are waypoints to move towards this common goal. This articulation about a new object of the action for some and an object of their action revisited for others (eg energy spécialiste) will lead to a transformation of the professional worlds involved. We will examine this evolution by looking at key pairs within the group BtoB : the energy specialist and the project integrator.

3.2.2. A key twosome but two different professional worlds: energy and planning

The energy specialist is an expert in the regulation of fluid made from materials and uses of a building. After analyzing the energy consumption of various equipment (up and dependent uses of the site), he offers technical improvement or management to optimize energy systems in place and reduce the customer's energy bill. For example, the coefficient of performance of a heat pump, powered by electricity is greater than that of a gas boiler. Therefore, the energy company may recommend to use electricity instead of gas for rising temperature of the building in the early morning before hosting the first users. This solution advocated by the energy company and will reduce the energy consumption of the building due to better energy efficiency of the heat pump from the boiler.

The integrator is an expert decryption computer programs integrated into Building Management Systems (BMS) for each site. From its automation skills, integrating the pilot operation of existing equipment (heating or cooling) on the sites.

Experimentation leads them to establish an operational energy audit to found DSM actions and then experiment. The dialogue between these two worlds is here essential. DSM actions constitute a common first object of the action.

For the energy spécialiste, his action is to develop diagnosis for customers. Once the diagnosis, the customer decides to implement (or not) for energy saving solutions recommended. Today, in the SEL project, of equipment optimization (which are given in the diagnosis) must necessarily be made for the purposes of the experiment. He goes from diagnosis and recommendations to an operational phase of DSM actions. This one requires the implantation of complementary instruments (sensors, probes). However, it emerged from our observations that the energy specialist does not have all the skills to program the BMS.

For the project integrator, his intervention is to install and maintain the BMS of the sites. The purpose of the work is then to program it in order to ensure control of these devices (ie heating, boiler), to provide the building users a certain level of comfort. His goal is to maintain a satisfactory level building operating the client but without considering the possible gains in terms of energy consumption of the site. But in the SEL project, the project integrator is responsible for the implementation of the recommendations of the energy specialist. It may well be necessary to update the BMS by reprogramming. It also monitor the installation of additional instruments prescribed by his colleague to meet the needs of the experiment.

By consequence, we see that each world has blind points to reach the new object of the action: it is by dialoguing on variables multitude around the active management and by mobilizing various concepts and instruments that the pair can do it (see Figure 1 below).

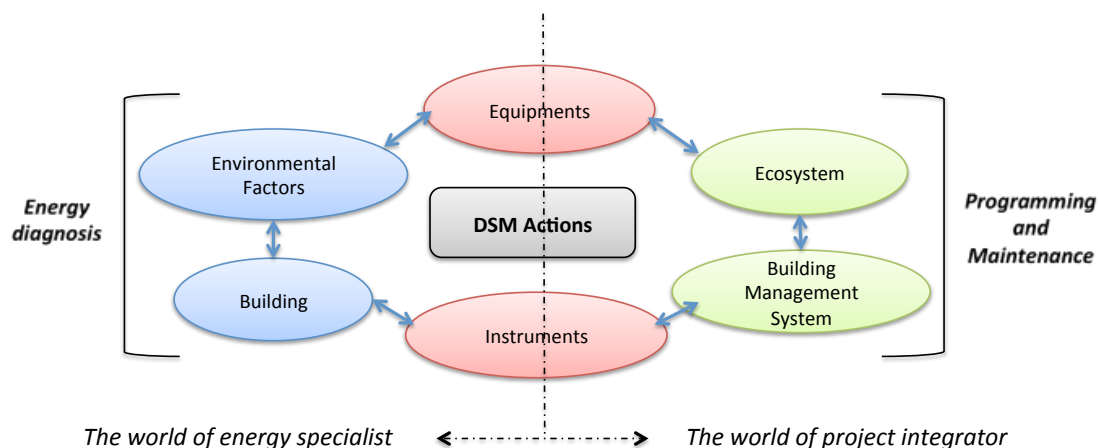


Figure 1 : Meet professionals worlds of energy specialist and project integrator around DSM actions

Contrary to what could be considered at the beginning of the project, the new DSM practices result for all actors project profound transformations which take place at two levels. The first refers to the transformation of the professional worlds of some actors. The second (is related to the first one) concerns the necessary coordination of collective actions to ensure the progress of experiments.

4. Discussion

In this context of an energy efficiency project, the actors develop original solutions to optimize the existing systems on the various sites. They implement MED actions involving cooperation that did not previously exist between certain actors. These necessary interactions between actors without previous communication cause *their practices "to evolve" through a more collective approach, to attain the energy efficiency objectives.*

4.1. Articulation between professional worlds within an experimental project

The implementation of the project implies however that new synergies or arrangements are constructed within the network of actors, to meet energy efficiency objectives. New articulations prove necessary to develop satisfactory technical solutions. We thus witness the encounter of professional worlds (Béguin, 2005), each of which mobilizes knowledge, criteria, variables, competences and instruments of a common object. As we have seen, the energy specialist and the integrator do not have the same function. This common object requires stages and points in the debate, for example around energy management or active management.

For instance, the establishment of active management required the actors of the energy sector to adopt new ways of interacting and positioning themselves in relation to one another, whereas until then they had not needed to cooperate. As an energy specialist explained: *"We are busy mixing worlds that were not used to communicating with each other"*. In this context, the experiments require interaction and different ways of acting, as well as the establishment of new ways of doing things in each world.

The project actors moreover develop their activities with a constructive aim. In the framework of the SEL demonstrator, the actors find themselves simultaneously in a process both of adjustments and of development, through which the experimentation is built. Following this dynamic, a project actor such as the energy specialist is situated in a dialectic that, while maintaining the internal coherence of his or her professional world, aims (i) to find solutions to energy management problems on each site, based on his/her own expertise; (ii) collectively to build scenarios of efficient energy consumption reduction based on "new

cooperation"; (iii) while meeting the constraints of the SEL experimental process. The same applies to the integrator and, more broadly, all the other actors taking part in the project.

4.2. Professional transitions related to the innovation process

More broadly, and in relation to the question of professional transitions, our results have shown that during the changeover to the Intelligent Electricity Networks Technology, the actors of the B2B project were partly the designers of their own work situation. The choice of resources mobilized was determined by their own experience – both past and acquired in the course of the experiment. A process of reflection in individual as well as collective action was thus initiated, where the network of interdependent actors interpreted the situation (via MED actions) and found new solutions to meet energy efficiency challenges (energy consumption reduction scenarios). Moreover, the evolution of each professional world took place in interaction with the other worlds. We can say that within this project, the collective mobilizes each individual in so far as everyone is situated in relation to the others' actions. In this dynamic, the different actors evolve towards a new frame of work.

We find, moreover, that the demonstrator is gradually specified according to the MED actions and the tests carried out. The range of the various actors' actions is therefore redefined. These innovation problematics thus lead to the construction of new modalities of interaction between the project actors, not unlike the exploratory partnerships described by Segrestin (2003). In these partnerships the actors who collaborate are not yet fully aware of their individual and common interest, as the identity of the object to design is still largely unstable. The new partnerships established by these experiments transform not only the configurations relating to a given profession, but also the professional worlds of the different project actors.

Hence, the profound changes in professional practices, linked to the use of existing or co-constructed tools, can be envisaged. In this sense, these innovations have to be well thought out in terms of changes to be made and of evolving practices, knowledge and shifts to be integrated (Peylet, 2014). These transformations define the outline of an innovation in terms of professional transitions. They prove to be necessary to integrate new demands as well as more collective approaches at the service of a shared construction of sustainable development.

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