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Supporting energy transitions. Project management as a learning device and accompanying professional transitions

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

Abstract:

With the transition to sustainable development, development of experimental programs appear concerning changes in electricity uses associated with the introduction of new technologies. As part of the conduct of an experimental project, we focus on new coordinations established between the project's actors potentially heterogeneous throughout a process of mutual contributions. Using the ergonomics analysis of work activity, we aim to understand how are developed management approaches on the investigated sites by actors. Linked to this context of innovation and to lead to energy efficiency, actors learn « by walking ». Implementations experimental strategies are revealed in dialogue with the situation in which learning is achieved. These spaces of solutions production appear as structuring for both the advancement of the project management and the establishment of new collective working methods.

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 : project management, energy efficiency, experimentation, learning device, professional transitions

1. Introduction

1. 1. Energy production: an industry undergoing change

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.

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

¹ Known as Intelligent Energy Networks.

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

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.

coordinated by the leading French energy producer, is funded by the ADEME, the French national agency for environmental and energy management⁴. We look at the introduction of experiments in the tertiary sector (B2B) and posit new articulations between potentially heterogeneous actors: distributors, retailers, installers, customers of the tertiary and industrial sectors, and so on. In this way we see each of the experiments carried out as a project presenting specific characteristics (from the point of view of the implications and of the actors mobilized). We then apply conceptual frameworks to the project management (Béguin, 2004, 2010; Daniellou 2004), with an analysis of the actors' learning dynamics, in particular.

As Peylet (2014) has shown, "such demonstrator federates teams around projects or cooperation, which prepares them for the technical challenges of experimental programmes". Peylet also notes that the objective of a demonstrator must be "part of a strategy of innovation and profound change to the practices of all the actors (the State, local authorities, and firms), with a view to transition towards sustainable cities". In this context, the aim is to define the most appropriate technology(ies), and to "integrate new demands and ways of operating more collectively, while mobilizing various forms of expertise in the joint construction of the experiments". The implementation of energy solutions efficiency narrows the focus down to those networks in which the new technical device is central, but the actors are situated outside of the organizational boundaries of each of the firms concerned (energy producers, installers, maintenance technicians, customers and employees in the service sector).

1.2. An experimental approach seen as a learning device

We think however that we also need to understand the dynamics at play in these experiments from the point of view of the work and activities of the employees involved. In design stage, the pursuit of a given objective gives rise to new problems that cause the actors to revise their initial objectives, based on what they have learned. From this perspective, we think that the experiments should be seen as learning devices that are produced by the actors in and by their action, and that are faced with the multiple and singular realities constituting each of the experimental sites. Thus, each experiment can be seen as a "dialogue with the situation", as Schön (1983) understands it: with their sights set on a goal and a project, the designers project ideas and knowledge, but the "situation" "answers" them by presenting unexpected resistances that produce learning. In our case, running an experimental project is therefore a matter of pursuing an objective linked to a particular situation that, starting from an initial state, will result in a more favourable situation from an energy efficiency point of view. That process will consist of multiple tests, tuning and adjustments, and will involve the actors of the project. In this paper our aim is to analyze the experiments as learning systems, the management of which can produce inter-related learning between various actor networks.

From a scientific point of view, the aim is to further our understanding of the evolving dynamics of the work concerned, throughout the experimental period. The question is then how to organize, define and stage the intermediate results of the design (here, experiments), so as to articulate better the knowledge acquired by some through the experiments carried out by others. Starting out from the distinction between regular design and innovative design proposed by Le Masson and Coll. (2006), we can assume that the implementation of Intelligent Energy networks is an innovation that will require changes in the cognitive and procedural framework currently applied in work. When a design is regular, the performance criteria are known, the success criteria are stabilized, the expertise is identified and the procedures are running smoothly. The actors in the process learn knowledge that serves them to deal with the singularity of a given transformation or project. But this learning takes place by exploiting the resources available in a stabilized framework, and this cognitive and procedural stability may be challenged if it is no longer appropriate. It is then necessary to get rid of the former framework and to develop new resources that are better suited to the needs and constraints of the new objectives. Finally, alongside the societal implications of the development of these new technologies related to the optimization of electricity consumption, we think that the quest for greater energy efficiency is going to be concentrated in the tertiary sector, through changes in the work processes of the various actors concerned.

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.

2. Method

Our methodology combines a longitudinal research protocol based on three cases (based reasoning, Yin, 1994). We use the Ergonomic Analysis of Work (Gu erin & 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 understand how the project actors design their energy efficiency management strategies. Based on the personalized diagnoses carried out on the sites by the various actors, appropriate instruments are then developed for meeting specific goals and objectives.

With the aim of determining more globally what is favourable or unfavourable for the experimental project, we seek to identify: (i) the actors in the B2B team and on each of the sites (key role, competences, and the modalities of their articulation); (ii) the timeframes within this project, divided into the following three phases: recruitment of sites; instrumentation; experimentation; (iii) the existing or newly-created tools or objects used to facilitate articulation between the actors in the running of the project; and (iv) the blocks resulting from emerging events in the field and requiring that solutions be devised if the experiments are to be continued. This methodology enables us to trace the interactions within a network of interdependent actors by identifying: (i) the difficulties encountered by the various players in their work; and (ii) the technical or organizational solutions to blocks throughout the experimental process.

3. Results

Our first results highlight two noteworthy elements. The first is related to singularity: experiments in the service sector require customized work to take into account the diversity of the sites as regards not only the buildings but also the markets they house (shopping centres, industries, offices, etc.) and the equipment, uses and processes involved. The second element relates to the collaborative work on each site, involving a network of singular actors in a work situation. From these two elements stem three characteristics of the experimental process, detailed below.

3.1. Three characteristics of the experimental process

3.1.1. A diversity of actors

Our analyses on the different sites show that there are two groups of actors. The first is the B2B SEL project steering team. Its function is to monitor the experiments and to coordinate the expertise needed to equip and the sites and reduce their energy consumption. The second group of actors belongs specifically to each site. It depends on the organization of the site and the experts working there (e.g. the energy manager, the maintenance manager), the types of activity on the site (tertiary or industrial), the ecosystems found there, and the way in which energy is managed (the issues of the demand side management).

3.1.2. Multiples time frames

Our results show that the time structuring of the experiment on each of the sites enables the steering team and the actors on site to advance step-by-step with the experiments. The phasing of the experiments (recruitment, instrumentation, reducing energy consumption) defined theoretically at the beginning of the project applies differently to the various sites investigated. The three steps of the experimental process are applied on the sites according to (i) their arrival in the project, (ii) the diagnosis performed at the outset and the site's needs for instrumentation, depending on the targeted uses (heating, lighting, air conditioning, etc.), and (iii) tests to validate the energy consumption reduction scenarios. For example, Site 1 instrumented in

2012 had not yet reached the phase of validation of the energy consumption reduction scenarios when Site 3, that had joined the project in 2013, was ready for its energy consumption to be reduced.

3.1.3. Structuring blocks for the project's progress

We found blocks related to the characteristics of each site, requiring that solutions be found. These proved to be structuring for the advancement of the experiments. For example, on Site 3, the energy manager had to regulate the heat pump himself, according to the hour of the day, using the instruments installed for that purpose under the project. This however generated error messages for the steering team. All the actors then cooperated to avoid disruptions to the experiment.

3.2. The experiment: a process of mutual contributions

Our results attest to a dynamic inherent in the experiment, represented graphically in Figure 1 below.

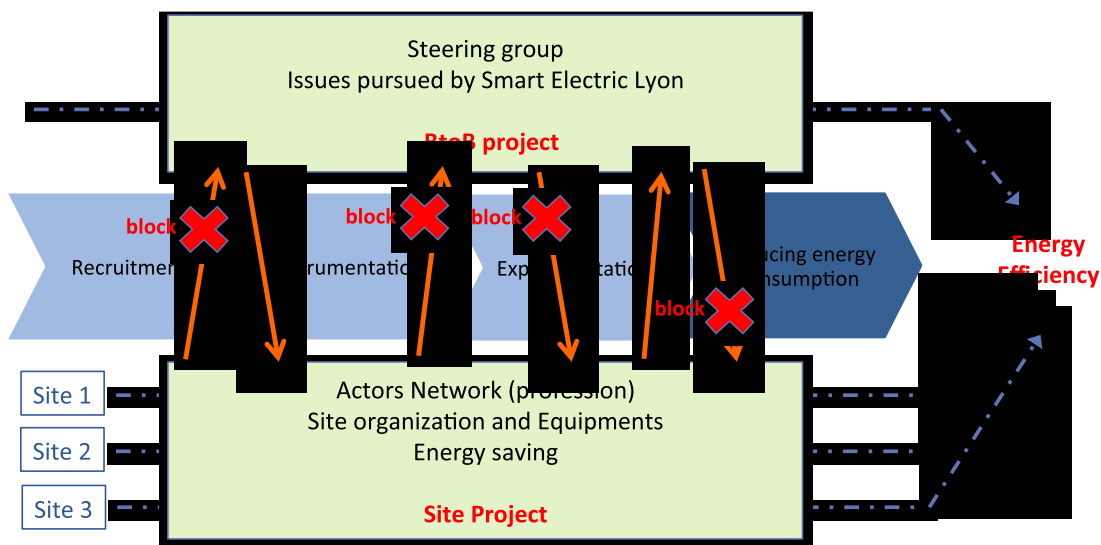


Figure 1. The B2B project, a learning device

As we have just seen, emerging events force the steering team to interact with the actors of each site to devise ad hoc solutions to blocks, in order to progress step-by-step in running the experiment. The site projects feed into and participate in the development of the BtoB project, and reciprocally the individual learning and the learning produced within the collective of the steering team on a site help in the running of the experiments on all the sites involved. At those steering team meetings that we attended, the actors discussed the blocks encountered, site by site. The differing points of view on problems were discussed in a collaborative and coordinated way, to jointly devise solutions. Thus, these technical meetings are ideal places where the actors “play” the project and where new forms of organization are structured with a view to meeting the challenges of the experiment.

This space of production of solutions thus appears as structuring, both for the advancement of the project (solving blocks) and for the implementation of new collective working methods (drafting working documents). We consider it to be an inter-related learning device for meeting the energy efficiency objectives targeted.

3.3. *New challenges and means of coordination*

The goals pursued, the singularity of the sites, along with the complexity of the actor networks involved in the experiments, reveal new challenges relating not only to cooperation but also to the production of new resources within the collective.

3.3.1. *New competences within the steering team*

The findings from our interviews show that the steering team is organized internally. Following the instrumentation of the first sites during the first experimental period (2012-2013), it was shown to be necessary to improve efficiency from the recruitment phase, by way of an energy diagnosis that could be used to draw up terms of reference for the instrumentation phase. In this respect, the appearance of a new expert in the team, an energy specialist, proved to be a strategic choice in running the experiments. Moreover, after diagnosing new sites, it turned out that the disparity of the ecosystems in the tertiary sector, as well as the diversity of buildings, required the team to collaborate with many energy managers using a variety of programming languages for technical building management⁵. To communicate with these energy managers, it was necessary to bring in an integrator, who acted as an intermediary between the energy specialist and the energy managers. A project integrator was thus recruited mid-term, in May 2014.

Second, to deal with the growing number of sites to recruit (target of 50 sites instrumented for the winter of 2015-16), the steering team is relying on outside participants. For instance: two consultancies that carry out energy diagnoses during the recruitment phase; and industrial partners that cooperate to find technical solutions to optimize the functioning of equipment. These may then be transferred and adapted to other sites. Given its respective activities and competences, all these actors who never needed to cooperate before, now have to coordinate and articulate their work in the interests of the project.

3.3.2. *An evolution of existing and new tools produced to structure the collective*

We found, especially at the technical meetings, that this cooperation involved the use of existing or co-constructed objects. Our first contribution concerned the “Iboard” interface tool⁶ used to foster dialogue between the actors of the sites and the B2B steering team. The energy specialist himself highlighted the usefulness of the Iboard to ensure that everyone “spoke the same language”, as the bottom-up electronic flow of information provided each of the parties with different information relevant to their day-to-day actions. These data showed consumption in KW/H, and provided the energy specialist with indicators of the behaviour of each facility, based on the site’s uses. For customers, the information in Euros enabled them to analyze the costs of the site’s functioning (employees’ hours of work, hours of functioning of the process). This tool facilitated interaction and generated inter-related learning between experts and especially between the integrator and the energy specialist (e.g. the former used this information to explain to the latter the links between the programming of the technical building management and the existing instruments related to the energy consumption reduction scenarios built jointly upstream).

Our second contribution concerns the B2B terms of reference that is a common “object” between all the actors of the project, including the customers and the industrial partners. This “single” document fulfils two distinct roles in this experiment. First, it is a communication tool that evolves from singular solutions envisaged on each site, describing the framework of the site’s experiment for all the project actors (i.e. the energy consumption reduction scenario planned on the sites, as well as the equipment and uses mobilized). Its content enables coordination between the different actors throughout the experiment. Second, for the various experts, it is also a “tool” that structures their actions, because it has all the technical data needed for the instrumentation of the sites (e.g. type of computers, solutions and ecosystems installed, interventions carried out). In the first two years, we found that the content of this document became more refined, in line

⁵ Technical building management systems supervise and control services such as heating, ventilation and air conditioning, ensuring that they function as efficiently and economically as possible. This can be achieved by optimizing the balance between the environmental conditions, the energy uses, and the operational needs.

⁶ Interactive real scorecard accessible to the sites (clients, experts) and to the B2B steering team. It transfers energy consumption figures from the site via an internet interface, to be used to build energy consumption reduction scenarios on the various uses of the building.

with the need for coordination and collaboration between the various actors (e.g. whereas initially the technical data needed to draw up quotes for the instrumentation of a site did not appear, they are now systematically included to provide a link with specialists, such as the electricians). This tool is therefore a “basis for discussions” between the experts of the projects, who all have their own interpretation of the data, depending on their field and competences. Interaction is thus facilitated, which enables each expert to “learn” from the others (e.g. learning between the energy specialist and the electrician, where the former uses information from the terms of reference to explain to the latter the relations between the integrator’s programming of equipment and the measuring instruments newly installed to locally steer the site’s energy consumption).

4. Discussion

4.1. Boundary objects: vectors of learning in a process of experimentation

To characterize better these different actor networks in this process of experimentation, and to understand more fully the forms of organization and coordination at work, the boundary objects of the design appear as resources to facilitate coordination and reveal the transformations of the project.

The introduction and development of Smart Electric Lyon prompted the various actors mentioned above to coordinate in order to be able to collaborate, something that had been neither necessary nor practised before the experiment. In this new context, our findings have highlighted the importance for the project actors to be articulated around boundary objects (e.g. the Iboard interface, the terms of reference) that are truly structuring for their joint action (Vinck, 2009). And they are all the more so when they are taken into account in the collective action throughout the experiment. These common objects, which “evolve” along with the solutions envisaged on the sites, redefine the perimeters of collective action. They enable the actors to “discuss” the blocks, be they technical or organizational, and thus to cooperate and jointly envision solutions by redefining the actions that each one has to carry out. These objects therefore structure the interactions to implement within the actor network (who does what? how? and with whom?) and at the same time “outline” the future organization to be put in place by the steering team to run this experimental project successfully.

This relative flexibility given to the intermediary objects, and which serve to frame collective actions, also reveal the learning of the project actors and create favourable conditions for the success of this kind of project.

As Béguin (2010) and Pueyo (2012) point out, when one studies an innovation in the making, the technique is not already there, as many changes may potentially be made to the initial protocol. More broadly, the learning leads the steering team to formalize to a greater degree the tools used for running the project, with a view to specifying the human, technical and organizational means involved, and to taking more efficient action. This gradual specification will then serve to develop a framework within which the project collective will fit throughout the experimental process. It is nevertheless a framework that is constantly evolving.

By “bringing to the fore” the coordination and cooperation to be set up in the various expert networks, the boundary object is more than a tool for mediation within a social world. It contributes to defining the outlines of a new framework for work in the experimental process.

4.2. “We learn by walking”: the advantages of a demonstrator in innovative design

The framework of the B2B experimental project is that of a demonstrator (Peylet, 2014) which leads to collaboration between a set of actors responsible for articulating their respective know-how and competences in order to produce knowledge and find answers to questions of inter-operability between different technologies (ecosystems). The aim is to test the pilot material, not so as to implement it but rather to evaluate needs and practices with a view to its introduction. The experiment is therefore above all “an observatory” where tests are carried out. From an operational point of view and with reference to the innovative design framework, the main characteristic of an experimental project is, as the B2B project leader pointed out, to “learn by walking”, for the ultimate goal of the experiment is not set in stone from the outset.

To be efficient, the demonstrator implies that certain conditions must be met in the functioning of the collective. First, a degree of reactivity is required from all the actors of the experiment, both on the sites and

within the steering team. This characteristic of the demonstrator is important if it is to be operational, irrespective of the blocks encountered on the sites. Another characteristic of the demonstrator concerns flexibility in the means to be implemented in the instrumentation of the sites, for example, or in the “agreements” signed between the different parties (customer and supplier of electricity). The experimental frame must be flexible enough to enable the actor networks to construct their own conditions of interaction and coordination, in relation to the various situations encountered. Yet the dynamics of the experimental process that make it possible to implement energy efficiency strategies on each of the sites do not seem to be manageable on the scale of small groups of actors. A third characteristic concerning small numbers seems to be essential for meeting demands for reactivity and flexibility. It is understandable that the approach to experimentation as a process is sometimes highly time-consuming, in view of the different configurations of actors encountered on the sites (owners, tenants, maintenance manager, energy manager). The multiplication of actors complexifies the interactions between the various actor networks and the coordination that the steering team is responsible for, with regard to the project’s time constraints. In this context of innovation, the demonstrator, through these characteristics, becomes a tool for deploying an experimental strategy that emerges in dialogue with the situation, and within which learning is produced. In this sense, we can qualify the experimental frame as a learning system.

Consequently, a project such as Smart Electric Lyon remains decisive for defining the outlines of an innovation in terms of professional transitions, for the future of the electricity industry. It illustrates a new “work frame” and the tools that need to be developed for it to reach the energy efficiency objective. Moreover, the new functions (or experts) that appear, as for example integrators, many turn out to take up more and more place in the future. More broadly, we think that this sustainable development context encourages new ways of thinking and doing, by staging a new “value chain”.

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