Innovation at work, lessons learned from a "design for use - design in use" approach

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Abstract. The action research reported in this article describes the first results of support for innovation by use in a French industrial company. In the first part of the paper we present the theoretical principles of our framework and the five steps of the innovation by use process that we had implemented. We then detail the first results obtained concerning the uses collected by the designers for use and the designers in use. In the last part of the article we discuss the contribution of this approach in constructing workspaces for uses in design, which opens the way to a renewed power to act in innovation projects.

Keywords: design-for-use, design-in-use, innovation.

1   Innovation

In this paper, of the various existing definitions of innovation, we consider the one proposed by Alter (2000) who defines it as the way in which men and women in organizations give meaning to an invention. In order to enrich this first definition we assume that innovation concerns appropriation and includes the process by which the new happens (Couillaud 2018). In other words, invention goes beyond the sociological definitions focused on appropriation (Alter *op.cit*) and the economic ones focused initially on diffusion (Rosenberg 1985). As innovation deals with invention and appropriation, use and design are the two components of the innovation by uses process (Couillaud *op. cit,* Folcher 2003, Folcher 2015).

In our hyper-industrial societies (Veltz 2015), use crystallizes a set of challenges for companies' competitiveness and performance (Kholer & Weisz 2016), as well as human development at work. In this context, digital challenges for society and work situations concern both the relationships between professionals within organizations and relationships with ends users. External and internal connections must be strengthened for a contribution of ergonomics to the design of all kinds of systems, products and services. In their IEA position paper Dul & al. (2012) identified the high potential

of HumanFactors/Ergonomics (HFE) owing to its three fundamental characteristics: a systemic approach; a design driven approach; and a focus on the related outcomes of performance and well-being.

Taking into account the underexploited potential of the discipline, these authors stressed the need for HFE to demonstrate its value more successfully to the main stakeholders of system design. They argued that relationships with the stakeholders of "system experts" and "system decision makers" needed to be developed. We agree, and in our research we address the issue of project management and the role of uses for innovation at work. Defining the project as a dialogic development of artifacts and actors (Beguin 2003, Barcellini & al. 2013), we consider use as a powerful base to strengthen the links between the stakeholders in the projects, that is, the designers and the users.

In Section 2 we set out our definition of use with regard to the concept of activity. We detail in Section 3 theoretical principles of our innovation by use approach as well as the stages of the design for and in use process. In Section 4 we present the first results of a field study. Finally, we discuss the benefits and the limits of our framework for organizational performance and human development.

2 Use and activity

Initially, use was defined as the appropriation of a system, a product or a service in the situated activities of end users (Folcher & Rabardel 2004). This definition needs to be enriched today, considering that use, beyond the mere appropriation of the systems or products designed, attests to the transformation of activities, including developmental ones. According to the Vygostkian definition of human activity proposed by Clot (2008), use is at once a performed activity and a real activity:

- Use is a **performed activity,** showing its results in term of transformation, which may partial or final;
- Use is **real activity,** showing its potential in terms of development: it may consist of difficulties, failures or incomplete achievement in performed activity.

Performed activity and real activity structure human activity that goes on in achieving goals as well as through the part of unrealized but real activity that remains a potential to make something happen in an uncertain future.

If use is as much a question of transformation as of development, the link between designers and users can be strengthened, considering that they are actually designers for use and designers in use (Folcher *op.cit*). Designers for use (D.F.U) are involved in elaborate and concretized future activity situations: decision makers, experts, architects, marketers, designers, workers, maintainers, etc. Designers in use (D.I.U.) are involved in the appropriation of systems, products and services conceived.

In Figure 1 a four-pole diagram illustrates the innovation by uses conceptual framework.

Fig. 1. Innovation by uses conceptual framework
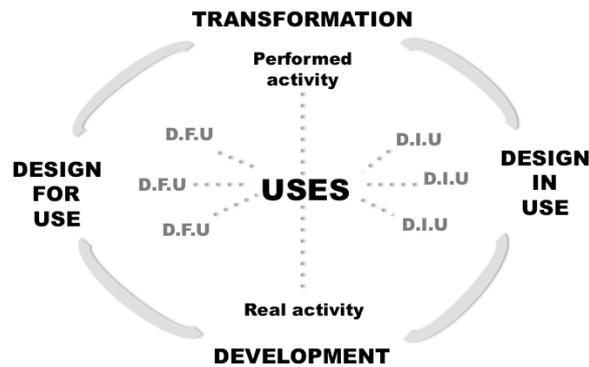
Based upon these theoretical assumptions, this framework structures support for innovation in five main steps. In the following section we detail the work principles and the steps of the innovation by uses that we have implemented.

3 Innovation by uses, work principles

The first principle considers that use, far from being the prerogative of one single actor, is a shared resource that will be mobilized by designers for use and by designers in use in two ways: first, to construct a collect for a shared representation of current uses; and secondly to design for future uses.

The second principle consists in developing with the stakeholders "a work-involvement" more than "a work-explanation". We aim at renewing the power to act of the stakeholders in design projects, and in our accompaniment, at addressing two main issues: "How to design otherwise?", and "How to allow for the development of new innovation capabilities?".

The designers for and in use are equipped with various tools to design differently in a support approach, and workshops enable the progressive development of new innovation capabilities (Couillaud & Folcher 2015).

4 Conducting innovation by uses, field study

Our innovation by uses approach consists of five steps. The first one focuses on identifying the stakeholders to be involved as designers for use and designers in use, and the relevant work settings. HFE/E specialists always conduct it with the actors expressing the initial mandate (step 1). The second step is the collect of uses in selected work settings (step 2). The third is the appropriation and co-diagnosis of current uses (step 3). The fourth is the co-innovation workshop (step 4) and, finally, the fifth step is dedicated to testing (step 5). From step 2 to step 5 the designers for and in use are jointly involved.

We present here the first results of a field study conducted over twelve months in a French company selling thermal comfort solutions[1]. We focus on step 2, the uses collected and we discuss in last section, the benefits of the framework throughout the entire project, and the stakeholders.

4.1 Tooling up the designers for and in-use to collect uses

We received a mandate for supporting innovation in a French company selling thermal comfort solutions. After a thorough understanding of industrial and organizational issues (step 1), a pilot group of designers for and in use were defined and a decision-making groups set up. In the pilot group the actors from the R&D factory, Marketing, Design, Training services and After Sales services had been included as designers for use, and the plumbers-installers as well as the end-users had been included as designers-in-use[2]. The monitoring group included the R&D officers, Innovation service managers, and Strategic marketing managers.

The members of the pilot group were equipped with a Polaroid and a notebook callled "carnet de l'observeur" (Couillaud & Folcher 2015) divided in the following main categories: the situation observed; a description of the situation; frequency; difficulties; and tips.

Uses were collected on Logistics site, Distribution sites, and Installation work situations. Five groups of gatherers collected uses. A short training session was proposed shortly prior to this step.

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[1] Boilers, radiators

[2] The pilot project group included from 8 to 10 stakeholders, and the monitoring group included from 5 to 7 stakeholders. The project manager was a member of both groups.

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Situation observed……………………………………………
Frequency: always - very often – often - rare
Situation description:……………………………………
……………………………………………………………………
Difficulties encountered:……………………………
……………………………………………………………………
……………………………………………………………………
Tips mentioned or used:………………………………
……………………………………………………………………


                insert a visual here
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Fig. 2. The notebook

4.2   Uses collected by designers for and in use

A total of 88 use situations were collected in the notebooks in various situations: reception, storage and handling in Logistics; replacement in Installation; and presentation and sale in Distribution.

Initial analyses of the notebooks show a rich depiction of activities that articulates three main dimensions: the situations, the challenges, and the tips.

The situations reported describe what has to be done, what is being done, and what the sources of problems are, for example: "*estimate the capacity of a product to replace*" in an Installation situation or "*a very heavy administrative workload*" in an After-sale situation.

The difficulties reported affect the problems observed and the proof of potential effects, for example, "*a likely estimation error*" in an Installation situation.

The tips mentioned deal with the solutions or observed strategies and the possible tips, for example: "*create a numeric support for the follow-up of the after sales distributor*" in an After-sales situation.

Furthermore, in some cases the prescribed uses come into direct confrontation with the real uses of the customers, as reported in Figure 3.

Fig. 3. The Plumber-Installer notebook (extract)

Situation observed: Boiler installation in a secondary residence
Frequency: always - very often – often – rare
Situation description: residence inhabited 6 months per year the remaining 6 months the customer cuts the electric power of the residence from the electricity board
Difficulties encountered: the thank is no longer protected; In case of imposed electric current the tank protection is out
Tips mentioned or used: Switch of the electric board and keeping the power of the boiler; Argue with customer about benefits of higher range products.

In this Installation situation, cutting the electric power of the residence from the electricity board cuts the tank's protection of the boiler. This technical constraint conflicts directly with the uses of the owners living in the house six months per year. The tips reported by the observer explore the needs to meet this use requirement and the opportunity to guide the customer towards higher range products.

This short example is congruent with many of the situations reported in the notebooks. When the gatherers are equipped with a structured and situated tool, they become able to collect uses in both dimensions:

- As performed activities, describing precisely what is done, what is or may be a problem;
- As real activities, reporting what could not be done or what could be a difficulty and what could be a solution.

Collecting uses enables an appropriation of the embodied character of activities in the third step of appropriation, which became the main resource to co-innovate for future uses in step 4.

Twenty-six concepts were produced during the co-innovation workshops, expressing solutions for future activities. Eight concepts were selected and finally five concepts were developed as scale-1prototypes. We then conducted the user tests with the designers for and in use. For confidential and ethical reasons, we cannot reveal further the innovation tracks contained in the concepts produced.

Two main issues can be discussed now. The first is about the effects of work involvement on the actors, the second is about the benefits for the project that could be identified.

5   Work involvement and benefits for the project

Tooling up the stakeholders' power to act to identify uses allows them to build an in-depth understanding of current uses. The capabilitiy to design otherwise developed while their collected uses (step 2), leads the stakeholders to consider technical constraints and possibilities in terms of the requirements for future uses, as they engage in appropriation and co-innovation (step 3 & 4).

Involving the actors in the appropriation of their industrial realities establishes a mutual legitimacy: the designers for use become credible as regards use, while designers in use become legitimate as regards design. This legitimacy grounds the success of the intervention.

To conclude, innovation by uses provides a trans-organizational framework thats creates workplaces functionally disconnected from the hierarchical organization. In this way we aim at renewing the power to act of the stakeholders during the project

and beyond. Currently, we have some hindsight and two discussion themes emerge from this research-intervention.

Firstly, our results challenge the possibilities that the actors have to implement some of the work principles in others work settings or other projects: to what extend is it possible and what are the conditions?

Secondly, it also challenges the effects of this trans-organizational framework on the evolution of work practices: what are the long-term effects of the design-for-use and design-in-use experiences during the project?

These issues are part of our future investigations.

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