LSE Research Online

THE LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE

Saadi Lahlou

# Observing cognitive work in offices

## Book section

**Original citation:**
Lahlou, Saadi (1999) *Observing cognitive work in offices.* In: Streitz, Norbert and Siegel, J and Hartkopf, V and Konomi, S, (eds.) Cooperative buildings. integrating information, organizations, and architecture. Lecture notes in computer science (1670). Springer, Berlin, pp. 150-163. ISBN 9783540665960
© 1999 Springer

This version available at: http://eprints.lse.ac.uk/28998/
Available in LSE Research Online: March 2011

LSE has developed LSE Research Online so that users may access research output of the School. Copyright © and Moral Rights for the papers on this site are retained by the individual authors and/or other copyright owners. Users may download and/or print one copy of any article(s) in LSE Research Online to facilitate their private study or for non-commercial research. You may not engage in further distribution of the material or use it for any profit-making activities or any commercial gain. You may freely distribute the URL (http://eprints.lse.ac.uk) of the LSE Research Online website.

This document is the author's submitted version of the book section. There may be differences between this version and the published version. You are advised to consult the publisher's version if you wish to cite from it.

http://eprints.lse.ac.uk

LAHLOU, Saadi (1999). Observing Cognitive Work in Offices. In N. Streitz, J. Siegel, V. Hartkopf, S. Konomi. (eds). C*ooperative Buildings. Integrating Information, Organizations and Architecture*. Heidelberg: Springer, Lecture Notes in Computer Science, 1670. pp. 150-163.

# Observing cognitive work in offices

Saadi Lahlou

EDF R&D Division
1, Ave du Gal. de Gaulle. 92141 Clamart Cedex FRANCE
Email: saadi.lahlou@edf.fr

**Abstract.** The information revolution has a deep impact on office work. To create better environments for cognitive workers, we designed two observation tools recording office activity. The Subcam (subjective camera) is a miniature, wearable, wide angle video camera, clipped on a pair of glasses ; it records individual activity from a subjective point of view, wherever the user goes. The Offsat (office satellite) takes a picture every minute from the ceiling, showing long term evolution in the spatial distribution of information artifacts (piles, etc.), and measuring the distribution of gross activity (meetings, stand alone computing, etc.). We currently use these tool in a series of new furniture and information artifact design experiments.

**Keywords.** observation, specification, evaluation, cognitive work, video, furniture, design, office, white collar.

## 1 Context

The nature of work, its distribution between Humans and Artifacts, is deeply changing in connection with Information Technology. Work settings have to be redesigned for this new deal. More specifically, some offices are settings where important decisions are taken when navigating in a rich information world ; they should be designed with the same care as aircraft cockpits.

But while information production and flow increased, the human cognitive process of giving meaning to it and taking decisions hasn't yet been augmented. A simple visit in any office building will convince that the cockpit-office is not yet a reality. And indeed users complain of cognitive overflow: too much information to process, not enough time. Information overload [Hiltz & Turoff, 1985], Information Shock Syndrome [Lea, 1987] ; information overflow [Ljungberg, 1996], Information Fatigue Syndrome [Lewis, 1996], Cognitive Overflow Syndrome (« COS ») [Lahlou et al., 1997], infoglut etc. all are symptoms which stress the inadequacy of present work environment to actual cognitive work requirements.

Obviously, we need better information environments, to improve decision, provide users with clear overall vision of tasks and priorities. At EDF R&D Division, conscious that cognitive work is a critical issue for competitiveness, we started in 1993 a research program to improve cognitive workers' comfort and efficiency [Lahlou, 1994, 1998b ; Fischler & Lahlou, 1995 ; Autissier et al, 1997 ; Lahlou 1999]. This means understanding the present problems encountered by users, their needs, specifying and testing new environments to empower and augment cognitive workers, and finally evaluating these environments. We consider here not only the « knowledge workers », but all those whose work mainly consists in processing information (e.g. secretaries).

For this we need a good description of cognitive workers' activity. This paper describes two tools we designed for that purpose, and which we are currently using.

## 2 Observation problems

Various studies have shown how office work is a series of complex activities, involving many actors and objects in decision processes, relying on the context and setting, and specially on information artifacts [Simon, 1957, 1964 ; Mintzberg, 1973 ; Suchman, 1983 ; Malone, 1983 ; Norman, 1991, Heath & Luff, 1991 ; Sébillote, 1992].

Office activity seems harder to describe than physical work. Actions must be understood in the perspective of the actor's intentions, which are seldom openly observable in cognitive work. Also, cognitive workers perform many varied tasks, so systematic codification is difficult (which may explain the success of ethnographic approach). For example, first level managers perform an average of 68 tasks per person per day, 25% of which are interrupted [Autissier et al. 1997]. They are mobile and interact with small and transient « details » (e.g.: alphabetic characters on a screen, colleagues' voice tone, and the like). Therefore, capturing fined grained behavioral data on office workers is necessary to understand what they do and why they do it.

One reason why it is so difficult to study office activity is merely technical: the lack of proper observation techniques. Fixed video yields insufficient results, because many office workers are very mobile, inside and outside their office. For example, engineers, managers or programmers we observed -and whose agendas we checked- were often a third of their time out of their office (for meetings, "on the field", or searching for information). With fixed video, one hardly sees what the subject does when he turns his back to the camera, and a lot of tape show empty office.

Office workers manipulate a wide range of artifacts (paper, etc.), so recording only their computer log, screen, or their telephone conversations is not enough. Monitoring all media turns out difficult, heavy, and multiplies the sources of observation failure ; also, subjects feel « big-brotherized ».

Office workers are hardly aware of their own routines [Simonsen & Kensing, 1997], so, as we could test for ourselves, their reconstruction during interview are not reliable sources for understanding what they *actually* do. And asking them to record their own activity themselves, on the fly, is not realistic: at fine grain level, describing an action may be as long as performing it.

Finally, it is not a person alone who does the job, but a distributed system made of the user and his/her artifacts. White collars in their office are like crew members in an aircraft cockpit described by [Hutchins, 1994, 1995], they perform their job as part of a larger cognitive unit [Lahlou & Fischler, 1996]. It clearly appears (cf. infra) that the cognitive worker is highly environment driven, so observation should capture the setting (displays, affordances, messages etc.) which drives and frames activity.

To sum up, present observation tools, well designed for operators with a single activity in a fixed setting (e.g. on the assembly-line), fail to provide detailed and reliable record of the activity of mobile office workers in the course of their work. This is especially true for cooperation. They also fail to provide long term records (over months) of how the *setting* behaves. So, how can we test if new furniture will improve activity? Or if a new software improves overall information management?

The *Subcam* tries to overcome the first observation problem (following the user's activity at fine grained level) ; the *Offsat* the second (long term observation of office settings). Of course, they do not solve all the problems, but they may help cognitive scientists and designers who want to create better environments and artifacts for cooperative, distributed, cognitive work.

## The Subcam (subjective camera)

The Subcam records data for fine grained analysis of the perception/action loop of users. We use it for exploratory analysis, problem spotting, design tests.

The Subcam is a miniaturized, wide angle, color video camera, with microphone, clipped on a pair of glasses worn by the user. It is a wearable video recorder, capturing the point of view at eye level. The subject wears the glasses, and a jacket or holster which includes a miniature VCR and a control unit. The system has up to 4 hours of autonomy, and provides a continuous record, on Hi-8 or DV tape [Lahlou, 1998a].

The Subcam gives a good account of what the user sees, hears, says and does, even if it doesn't track the eye gaze. It has been demonstrated in CSCW '98 ; a video [Fayard & Lahlou, 1998] is available. As wearable video progresses rapidly [e.g. Mann, 1997], we believe the Subcam or its equivalents will soon be used in many labs.

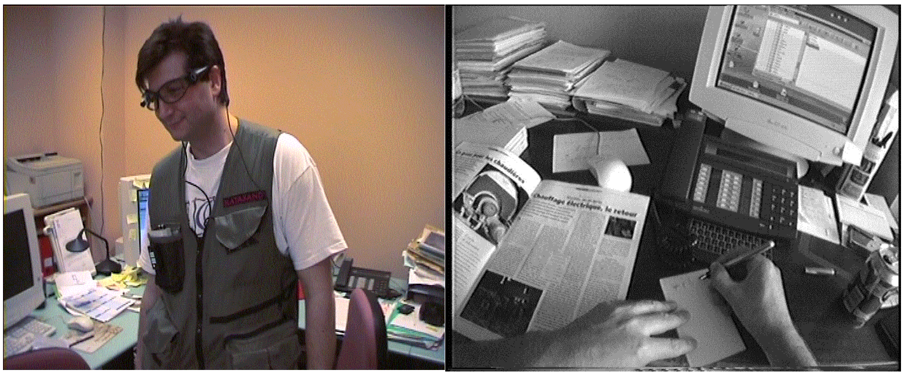

**Fig.1 a & b.** Left, the first version of the Subcam (1997), with which most observations described here were made. The jacket is convenient, but not very aesthetic and heavy ; the newer versions are nicer and lighter. Right, a picture extracted from a Subcam tape: the subcamer is writing a post-it. Present resolution of 400 lines is insufficient to read what is written in font smaller than 16 on paper or screen, although sufficient for subcamers to remember what they were doing, during debriefing.

The recordings provide an insight of the subjective experience of the wearer. It is quite different from the so-called « subjective view » in cinema, because you see the subjects hand's moving, follow head movements, etc. It is a way of getting in the subject's shoes. The Subcam allows understanding better the user's perspective, his own perceived world, his « Umwelt » [Uexküll, 1934] ; and capturing the affordances of the environment [Gibson, 1967, 1979].

On the field, after careful preparation of the social setting, volunteer users are given a Subcam, therefore becoming « subcamers ». Subcamers are left alone by the researchers, and wear the Subcam while performing their usual activities, during half-day sessions. They quickly forget they are wearing the Subcam, which is completely silent[1]. In some cases, several co-workers may each wear a Subcam during the same sessions for collaboration study. Then, the tapes are collected by the research team, for analysis. The « interesting » moments of the tapes are shown to the subcamers in debriefing sessions, where subcamers are invited to comment their subjective view of the situation (intentions, interpretation, feelings etc.). Debriefing is also videotaped.

---

[1] More precisely, subcamers report not to forget the Subcam "completely all the time", but say they act the same way they would without the Subcam, except in few occasions, like when a external visitor comes in and they must explain the experiment. And the tapes look realistic indeed. For this reason, ethical aspects of data collection protocols and analysis, and features of the Subcam itself, have been carefully designed and tested for the sake of subcamers and other colleagues. Because, here as in any video protocol, ethics is a key issue [Mackay, 1991]. See the section on ethics, infra.

Debriefing sessions enable better understanding and testing hypotheses [Lahlou & Fayard, 1998 ; Lahlou 1999]. When viewing their own tapes, subcamers seem to remember quite well their intentions, even weeks after ; in contrast to difficult remembrance during interviews without « subtape » support. Whether this is due to easier (but fallacious) reconstruction, or better remembering because of the availability of a large number of visual and auditory cues identical to lived experience remains to be tested. Anyway, these debriefing sessions are rich for understanding problems « as seen by the user ».

The Subcam is presently used for getting a fine grained record of user's every day life, including « problems ». It is specially useful to get a record of « rare » events, and get a detailed cognitive analysis of it. For instance, our assistant Ms. Fayard extracted 101 « interruption » clips (when the subcamer was interrupted by external event) from some 50 hours of Subcam tapes of 8 subjects. We coded those interruptions, for modeling and statistics which are now been used in a current study aiming at preventing and curing the bad effects of interruptions on cognitive work, in collaboration with David Kirsh and Aaron Cicourel (UCSD).

We also use the Subcam for demonstrating new tools or furniture, and in one occurrence a Subcam visit of a new building during its construction was used for showing the setting to future users, and collecting their opinion for installations. This spared the burden of the visit to many.

Another use, although the Subcam is basically a qualitative instrument, is *quantifying* the cost of various difficulties, an essential prerequisite for design and research funding decisions. Still, now, we only use «valued lost time » as a cost indicator.

Debriefing allows collecting the subcamer's subjective feeling and intentions, and expressing his/her needs. It also helps to understand how actors use or misuse new artifacts, e.g. prototypes under testing. E.g., several subjects became aware, when viewing the tape, that their telephone was not situated in the best place: they had to move a lot, several times a day, and/or could not access their file cabinet or other artifacts when on the phone because of the wire. This revealed they had left the telephone location on their desk (as placed by technician or themselves on their first day) as a « default value » which was inappropriate.

Also, the Subcam made us aware that some tasks are in fact not done as common sense represents them (e.g. when searching for a document on a desk, one often actually uses vision prior to memory - « scanning » the desktop before recalling where it is). This spares time in design by avoiding making misadapted prototypes.

Still, analysis is long, and we do not yet have a good catalog of activities which would enable fine statistical analysis. This is certainly the main limitation of the tool.

Subcam tapes analysis gave the feeling that the activity of subjects was heavily context driven, just as in other activities [Suchman, 1987 ; Lave, 1988]. Often, the context seemed to divert them from their initial intentions (e.g. post-its on their desks or agendas reminding them to do other things), or even forcing them into activities (telephone calls, incoming colleagues). More generally, the context appeared full of inscriptions which are action triggers, attractors [Lahlou, 1999], some of which have been set up by the subject himself to program his own activity in the future (agendas, post-its, piles etc.). Therefore the office appears as a control panel where decisions are taken and actions performed through inscriptions on information artifacts [Lahlou, 1996, 1998b]. This is coherent with interview studies conducted on similar fields [Malone, 1983 ; Fischler & Lahlou, 1995 ; Fischler & Therrien, 1998].

These findings orient our design directions to « clarify » office setting ; transforming present scattered and disruptive stimuli, so that affordances and display of information artifacts provide users with synthetic views of activity.

## 3 The Offsat (Office satellite)

As the office is an action unit, where the display of information artifacts is part of the cognitive processing, we wanted to study the office (room) as a behavioral unit. What happens in an office in ethologic terms? Are there specific zones for different activities? These questions have been investigated by Proxemics (Hall, 1966) ; but quantification and precise zoning are necessary for design. What are exactly the relevant zones and their limits? We also wanted a rough breakdown of activity ; in order to evaluate the impact of changes on office life, and artifact distribution. For instance: do new file cabinets change the organization of paper stacks on desktops : do new desks enhance collaboration?

The Office Satellite (Offsat), a video camera fixed on the ceiling upon the desk, offers us an aerial view on the office which can help us to understand the global organization and its evolution. Moreover, the Offsat provides middle term and long term information: at a rate of one picture every 2 seconds, the Offsat films clearly show the activity zones during a day. At a rate of one picture every 30 seconds, they show the life of piles and the drifts of large artifacts. Compared to the Subcam, the Offsat offers complementary views on the office spatial organization, on its evolution and on the subject interactions with it.

Technically, the Offsat is based on a wide angle version of the Axis Neteye™ web camera: a video camera combined with a RISC CPU compression chip and web server, all in one small body (500 grams, 4 by 12,5 by 15,5 cm). It is combined with a software for image analysis, Offsatmap, developed for us by FCI. Connected on the local IP network with standard RJ-45 cable, the Offsat sends jpeg pictures of the observed office to a distant hard disk, at specified intervals (e.g. 30 seconds).

Installation is easy: it only needs a standard power plug and a standard Ethernet network plug, which are now available in most modern offices (technically, one does just plug it in parallel with the local computer). The Offsat has its own IP address, and does not use any local resource other than standard 220V AC current. As most offices in our setting use standard 60x60 cm false ceiling cover plates, we made a few platforms of similar dimensions in a stronger material, with the web camera attached to it, so we just have to climb on a stall and substitute the Offsat to any plate in the ceiling. Therefore, the Offsat location can be chosen easily, wires go in the false ceiling, installation is quick, the office is left intact after experiment ; and all looks « clean ». The Offsat is autonomous, silent, can be monitored with remote settings, and does not need film replacement. It can be instantly stopped by the user just by cutting power on the wire, and restarts automatically when reconnected. This solution was developed with Yann Guyonvarc'h (FCI), in order to overcome the problems encountered during a first trial using classical video on a high tripod [Conein & Jacopin, 1996], and evaluations of using 35mm camera at fixed intervals, which both were costly in film, manpower, and technically bothersome. An observation device should not be a burden to users, especially if we want them to accept it for months. We now have the device running since august 1997, and encountered amazingly few problems, except for storing the flow of data, which have to be transferred quickly from the hard disk to other media, so as to leave free space for incoming pictures (we had to stop observation during some holidays for that reason).

Present maximum resolution of images produced is 704x576 pixels, but we mainly use 352x288 (from 30k to 50k each), which proved sufficient. Images are compressed on the fly and sent directly by the Offsat through the network to a remote hard disk which is collected with delay. Ethical rules are the following: the room where the images go is locked ; images are only used for research and never shown to anyone without authorization ; before connecting « live » to the camera, the researcher must call by phone the user for authorization ; any set of images (e.g. « last week » will be destroyed on demand of the user (this actually happened once, for a period of one day, on a total of 52 man/month of observations). The Offsat URL is protected by password, so that only the subject and the researcher can have on-line access, through a standard web browser.

Images are cropped weekly and undergo two kinds of processing. The first is just aggregating them into mpeg movies. One then gets an accelerated view of what happened in the office. At a rate of 1 image every 30 seconds, one day (13 hours, we don't record from 20:00 to 7:00) becomes 1560 images, producing about 1 minute of film (62 s). One can then easily watch a month of activity in half an hour. Pile drift, artifact move, and general activity (e.g. stand alone computing, meeting...) are easily seen.

The second is mapping activity zones and analyzing gross activity. Images are compared in series by the software, which yields a map of zones where movement occurs. Images are then sorted by zone of activity, and statistics can be calculated (e.g. time spent in stand alone computing, number of accesses to a specific artifact, etc.)

Our design program for cognitive work, in collaboration with François Jegou and Tanguy Lemoing from Dàlt design company, used the Offsat to test the impact of some new artifacts for augmented cognitive work.

Figure 2 shows the office of two volunteers, C1 and C2, « before » (left) and « after » (right) implementing experimental furniture. Figure 3 shows the activity zones in the office corresponding to « before » and after ».


**Fig.2.** Scenes from Offsat show same office before (left) and after (right) implementing new experimental furniture (Offsat position unchanged). The camera field covers about 80% of the office surface. C1 is seen on both pictures. His colleague C2 lives in the right of the office, and is hardly seen on the picture (one of his hands appears on left picture, by his keyboard). On the right image, where C1 works with a visitor, the refurbished office clearly exhibits more free space. The new « double-deck » desks (designed by Dàlt based on users' ideas) are smaller in ground surface but have two levels, and the LCD screens are shorter. A new pile-display artifact (the « rangepile » also designed with Dàlt, not visible on picture) cleared the floor for human activity. The file cabinet moved from the left wall (left picture) to the back wall (right picture).

C1's office was monitored with the Offsat from October 1998 to march 1999, covering the period of implementation of new furniture and information artifacts (December 1998). The Offsat was untouched, so as to compare aerial views of the office arranged as different settings. Zoning before and after was compared by analyzing two sets of 24000 pictures, before and after changes (November, and February, once new routines were installed).

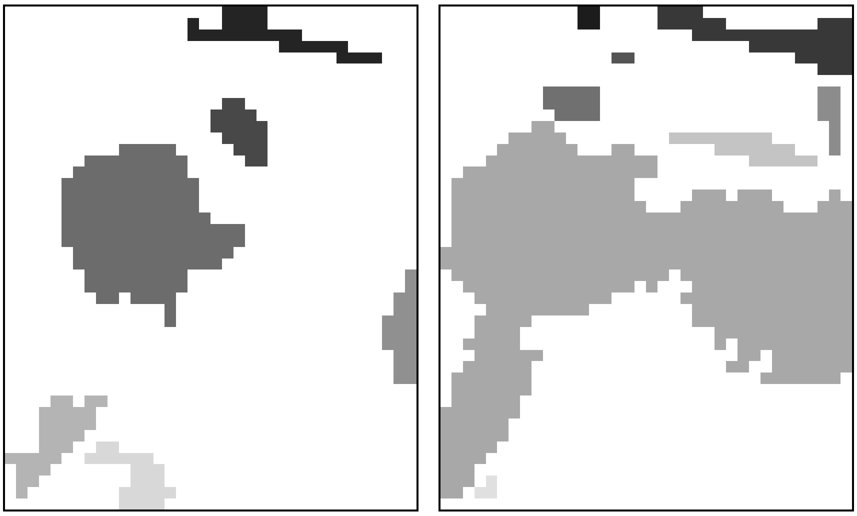

**Fig. 3.** Offsatmap outputs: zones of same office (as in Fig. 1) « before » (left) and « after » (right) implementing new experimental furniture (same projections as pictures in Fig. 1). The darker the zone, the more movement in it. The darkest zone on both pictures (up right) is an artifact: the window curtains move all the time because of the air conditioner. Then come small dark zones which are the computer's screens. In the center are the human life zones (left side of office for C1, and right side for C2). Bottom left is the room doorway, a crucial interface with the corridor. Increase of « live space » after implementation of the new furniture is easily noticeable.

Notice, « after » (right image) the much larger central zone, which corresponds to the proximal zones of C1 and C2 when seated, also melted with one doorstep zone. Detailed analysis showed significant increase of visits, of collaborative work, and of physical movements, probably due to increased available space. Whether this positively impacted production has not been evaluated, but the users incline to think so. Also the new configuration with reflection-free flat LCD screens enabled better lighting of the room. The resulting « look and feel » of the office completely changed at ground level, due to more space and light. Users expressed strong satisfaction[2]. Some neighboring colleagues started lobbying as "me too" volunteers for the test program. One must of course be careful of test users appreciation (« Hawthorne effect » ), and it must be mentioned that one of the subjects (C1) was member of the user participative group which led to designing one of the prototypes tested here. Still, these testers proved in other testing occasions a strong critical capacity. Also, the

[2] This brought unexpected problems as, while the test equipment was supposed to move to another office for another test, these users expressed strong desire to « test longer » the equipment, and reluctance to go back to their initial setting ; finally a solution was found so that they could keep at least some of the new equipment.

other tester (C2) who was at first reluctant to the experiment proved to be the more satisfied (understandable when we see the zones on Fig. 2).

Technically, zone identification is based on movement analysis, by comparing each image with previous and next image in the Offsat flow. It is a difficult problem, for technical reasons which are too long to describe here in detail, and the presence of some artifactual classes (e.g. the « curtain » zone) shows they are not completely solved: of course, lighting changes a lot, so do colors, etc.

Counting movements in zones is another issue for which another software has been developed ; and scene analysis is under development. We hope this will help us evaluate the impact of new artifacts on office work.

## Ethics and field preparation

These tools are powerful, and easy to plug on. But they must be used with caution, and need careful preparation and monitoring of the field. Field preparation and ethical aspects are linked. They both aim at building *trust* between the researchers and the participants, and preserving it.

At first, many people are reluctant to be observed by (any) video devices. They fear being big brotherized, they are afraid of showing “bad” behavior in some way. Technically, those fears are mostly unfounded. The Offsat view hardly allows to recognize people unless you know who might be on the picture ; there is no way of actually knowing what people precisely do (no sound, highly accelerated films). For the Subcam, the subcamer is heard on the tape, but his face is never seen, only parts of his body (hands, …). And of course both devices can be very easily and instantly turned off: “subjects” have full control all the time. The only sensitive aspect is that the social and interaction styles of subcamers are clearly exposed, and that the duration of presence in office may be known through the Offsat (but being outside the office doesn’t mean you are not working !). Almost all the material collected turns out completely innocuous to users, although it may in some instances evidence big failures in the design of their environment.

Unfortunately, participants do not know this until they have actually experienced the device, and viewed some tapes ; then they relax. So it is crucial to get a first set of influential volunteers. Once people are acquainted with the devices, things go smooth. With time, it gets easier and easier to find volunteers on the same field, as people see that their colleagues did it and that no problem occurred. We now have no problems getting volunteers, and they act very naturally with the Subcam and completely naturally with the Offsat[3].

[3] In fact, it is quite difficult not to act « naturally », because action is heavily environment driven. The fact that people feel at ease is especially important for social interaction.

Ethical issues were recognized as a key issue very early, and we set up sophisticated rules for protecting individuals from any possible kind of misuse of their image or of the collected data. This has to aspects: ex ante, and ex post.

Ex ante: to avoid collecting embarrassing data (e.g. unusually aggressive gossip, private discussions, going to the toilet etc.) the subcamers are given the opportunity to turn off sound and/or image with a big, simple, clearly labeled switch. This is signaled by bright colored LED's on the front of the jacket so that other participants can also know whether they are recorded or not, and ask the subcamer to be "off record". In our experience, this does not happen often with the Subcam, and is very rare with the Offsat, except for some external visitors.

Ex post, once data are collected, the subcamers keep them first and preview them before the researchers. They always keep the possibility to destroy part or all of the recordings, with no time limit. Until now, no subcamer used this privilege. But we know that most of them only viewed a small piece of their tape, enough to realize it was innocuous, got bored at the first long sequence without strong action (e.g. long stand alone computing session) and gave us the tape.

No image is shown whatsoever without the previous informed consent of the people who may be seen or heard on the tape. If the same tape is shown to different audiences (e.g. . presentation in a symposium of a tape for which we already had informed consent for projection to an internal audience) informed consent is asked again. The procedure is very heavy and impairing for the researchers, but it does build trust on strong bases, and ethical awareness becomes a natural reflex for the researcher.

It would be too long to describe here the ethical protocol. Anyway our opinion is that although an ethical protocol is essential, it is not sufficient and will never cover all cases. The real issue is *trust*, not ethics. There is no single secret: building trust takes time. The researchers must a real sympathy for the participants, respect them, remember that *the participants' work* is more important than our research, and that observation must not be a burden for them ; having an everyday care of their interests *and also* showing it (e.g. always asking them for informed consent even for "small" occasions). It also necessitates that participants really know what is done with the tapes and why. All this is progressively built, socially, by a sum of details. We benefited of the wise advice of A. Cicourel in that field preparation. The fact that in many occasions participants could see how that the researchers really cared about the ethics ; the fact that the project is aimed at improving efficiency *and comfort* of workers, and that they could see actual outcomes in the form of prototypes ; the fact that the head of the program is an insider of the Division and that his activity could be traced long back ; that he was seen experimenting himself first all the devices, and showed widely his own tapes ; were some of the parameters that allowed building trust on the field. Also, this was a long experiment, started mid-97 and still on going. Visitors are a specific problem, as they are not warned in the same way as « locals », and always show some surprise or anxiety at first. Subcamers and people with Offsats in their office solve the problem case by case ; sometimes they just turn the device off.

Our experience with subcamers on other fields outside the R&D division shows that if trust between the researcher and the subcamer preexists, no other specific field preparation is necessary: The subcamer will use his own trust capital with his local social environment.

But ethics is not simply a way of building trust. Some of the material collected shows crudely the social style of subcamers, or may uncover embarrassing implicits. People *do* act very naturally, and sometimes they appear inefficient, overloaded, failing, or funny. This is why the researchers must be very careful, because, when taken out of their context, some tape extracts might be embarrassing ; however demonstrative or interesting these extracts might be for scientific purposes, those extracts will of course never shown or described. The author himself, after having viewed hours of his own tapes, and having realized how highly inefficient or socially unpleasant he appears on some extracts has become extremely benevolent and tolerant in analyzing other people's tapes. And the best guarantee of the subjects interest is that the researchers are fully aware that any use of the data which would put, directly or not, any participant in an embarrassing situation, would harm people, destroy trust, and finally end a very interesting and productive observation program.

## Conclusions

Developing new environments which will help and augment cognitive workers is a great challenge for organizations. Developing good solutions is only possible with the active help of users, and a first hand knowledge of the actual usability conditions.

Solving problems is costly, so funding organizations usually want to evaluate the costs of problems, and possible benefits of new solutions. They also need evaluations of which solution is best after testing. Although this is known of everyone, appropriate methods for cognitive work investigation, cognitive environment design, and evaluation, are still few. One reason is that research funding is usually aimed at designing solutions, not designing tools to help design solutions.

We designed two complementary tools, the Subcam and the Offsat, to understand better how workers interact with their workspace. They may be handy for observing the use of experimental settings in cooperative buildings of rooms. For instance, the Offsat may be used to measure the use of "roomware" such as invented by Streitz et al (1998), the Subcam could give a realistic first-person view of the look-and-feel of settings like the ambientROOM (Wisneski et al., 1998). More generally, the two tools, especially in connection, can be used to understand better how people use buildings, because they allow monitoring places, but also individuals moving from place to place.

These tools proved useful in our practice, in their present form, giving us access to new insights of distributed cognitive processes. Still, one must underline that many progresses have to be made. The devices themselves could be better: e.g. eye tracking, and higher resolution on the Subcam. Gathering good data requires a careful field preparation and a constant attention to ethical aspects. Finally, methods for systematic analysis long corpuses of video have to be developed.

## References


1. Autissier, D, Melkior, R., Lahlou, S. (1997) *Analyse de l'activité quotidienne de 6 chefs de groupes à la DER*. EDF/DER/MMC. Service AGT.
2. Conein, B., Jacopin, E. (1997*). Le Bureau comme espace de travail*. EDF/DER HN51/97004.
3. Fayard, AL ; Lahlou, S (1998). *The Subcam: An Insight Into the Phenomenal Flow of Office Life*. Video,7 min, EDF/DER/IPN, march 1998. CSCW '97 video proceedings.
4. Fischler, C., & Lahlou, S. (1995). *Dossiers, piles d'attente et corbeilles: la digestion quotidienne de l'information dans les bureaux.* EDF/DER. HN5195017.
5. Gibson, J. J. (1967). Notes on affordances. In : E . Reed & R. Jones (eds.). *Reasons for realism. Selected Essays of James J. Gibson*. London : Lawrence Erlbaum Associates, 1982, pp. 401-418.
6. Gibson, J. J. (1979). *The Ecological Approach to Visual Perception*. London: Lawrence Erlbaum Associates, 1986 ($2^{nd}$ ed.).
7. Hall, E.T. (1966). *The Hidden Dimension*. New York: Doubleday.
8. Heath, C. & Luff, P. (1991) Collaborative Activity and Technological Design: Task Coordination in the London Underground Control Rooms. *ECSCW'91*. Kluwer Press.
9. Hiltz, S. R., Turoff, M. (1985). Structuring Computer-Mediated Communication Systems to Avoid Information Overload. *Communications of the ACM* 28 (7): 680-689.
10. Hutchins, E. (1995) *Cognition in the Wild*, Cambridge: MIT Press.
11. Lahlou, S (1996). *Representations and the social co-ordination of action.* 3rd Int. Conference on Social Representations, Aix-en-Provence, 9/1996. & EDF/DER HN5196020.
12. Lahlou, S. (1994). *L'utilisation de l'information dans l'entreprise: quelques réflexions théoriques et une analyse lexicale*. EDF-DER. HN-5194055.
13. Lahlou, S. (1998a). « La caméra subjective, une nouvelle méthode pour l'étude des représentations en contexte ». 4th CIRS. Mexico, août 1998. EDF/DER HN-51/98017.
14. Lahlou, S. (1998b). *Cognitive Overflow Syndrome: le diable est dans le détail.* EDF HN5198018.
15. Lahlou, S. (1999). Les attracteurs cognitifs et le syndrome du débordement. EDF R&D. HN51/99004.
16. Lahlou, S., Fayard, A.L. (1998). Waiting for the Paperless Office: Two Video Tools for Investigating the Paperfull Office of Today. EDF-DER HN5198020.
17. Lahlou, S., Lenay Ch., Gueniffey Y., Zacklad, M. (1997). Le COS (Cognitive Overflow Syndrome). *Bulletin de l'Association pour la Recherche Cognitive*, n° 42, Nov. 1997, p. 39.
18. Lave, J. (1988). *Cognition in Practice*. Cambridge (UK): Cambridge U.P.
19. Lea, G. (1987) *Non-users of Information Services*. Audit Report. Graham Lea & Partners.
20. Lewis, D. (1996) *Dying for Information? An Investigation Into the Effects of Information Overload in the UK and Worldwide.* London, UK: Reuters Business Information.
21. Ljungberg, F. (1996). *An initial exploration of Communication Overflow.* COOP'96, Sophia Antipolis, France. COOP group (eds.) , INRIA, France. pp. 19-36.
22. Mackay, W. (1991) Ethics, Lies and Videotapes. In *Proceedings of CHI'95 (Denver, CO)*.

ACM Press. 138-145
23. Malone, T. W. (1983), How Do People Organize Their Desks? Implications for the Design of Office Information Systems, *ACM Transactions on Office Information Systems*, vol. 1, N°1, 99-112.
24. Mann, S. (1997) " Eudaemonic Eye ": " Personal Imaging " and wearable computing as result of deconstructing HCI; towards greater creativity and self-determination. In *Proceedings of CHI'97 (*Atlanta).
25. Mintzberg, H. (1973). *The nature of Managerial Work.* Engelwood Cliffs, N.J.: Prentice Hall, 2nd ed. 1980.
26. Norman, D.A. (1991) "Cognitive Artifacts". In *Designing Interaction; Psychology at the Human-Computer Interface*, J. M. Carroll (ed.). Cambridge: Cambridge University Press.
27. Simon, H.A., Newell, A. (1972). *Human Problem Solving*. Englewood Cliffs, New Jersey: Prentice-Hall.
28. Simonsen, J., Kensing, F. (1997). Using Ethnography in Contextual Design. *Communications of the ACM*, Jul. 1997, vol. **40**, n°7: 82-88.
29. Streitz, N. A., Geissler, J., Holmer, T. (1998). Roomware for Cooperative Buildings: Integrated design of Architectural Spaces and Information Spaces. In: Proceedings of CoBuild'98. First International Workshop on Cooperative Buildings, Darmstadt. *Lecture Notes in Computer Science 1370*. Springer: Heidelberg, 1998, pp. 4-21.
30. Suchman, L. (1983), Office Procedure as Practical Action: Models of Work and System Design, *ACM Transactions on Office Information Systems*, vol. 1, N°4, 320-328.
31. Suchman, L. (1987) *Plans and Situated Actions*, New York, NY: Cambridge U.P.
32. Uexküll, J. Von (1934) *Mondes animaux et monde humain.* Suivi de *Théorie de la signification*. Paris: Médiations, Gonthier, 1965.
33. Wisneski, C., Ishii, I., Dahley, A., Gorbet, M., Brave, S., Ullmer, P., Yarin, P. (1998). Ambient Displays: Turning Architectural Space into an Interface between People and Technology. In: Proceedings of CoBuild'98. First International Workshop on Cooperative Buildings, Darmstadt. *Lecture Notes in Computer Science 1370*. Springer: Heidelberg, 1998, pp. 22-32.