Simulation training debriefing as a work activity analysis tool: the case of nuclear reactors pilots and civil aircraft pilots

Philippe Fauquet-Alekhine[1,2]; Marc Labrucherie [3]
[1] Nuclear Power Plant of Chinon, Head Management Department, BP80 – 37420 Avoine, France
[2] Lab. for Research in Sc. of Energy, 86200 Montagret (Nueil\Faye), France
[3] NML Consulting, Cassis, France
email: philippe.fauquet-alekhine@edf.fr [1], larsen.sciences@yahoo.fr [2], malabrucherie@gmail.com [3]

Fauquet-Alekhine, Ph.; Labrucherie, M. (2012) Simulation training debriefing as a work activity analysis tool: the case of nuclear reactors pilots and civil aircraft pilots. *In* Fauquet-Alekhine, Ph. (eds) *Socio-Organizational Factors for Safe Nuclear Operation*, Montagret: Larsen Science Ed., 1, 79-83 (*)
http//hayka-kultura.com/larsen.html

Abstract

Pilots of civil aircraft of Air France, as pilots of nuclear reactors of EDF, are training on full scale simulators. In both cases, training generally consists of briefing, work on simulator, and debriefing (Fauquet, 2007). Articulation and structure of these three stages introduce fundamental differences, partly given by the specificities of jobs.

Comparison puts in an obvious place a bigger nervous tiredness for the pilots of planes than for the pilots of reactors on simulator. This notably comes from the kinetics of tasks to be accomplished: in the cockpit of the plane, actions to be put in chains and the answers of the technical system are much quicker than in the control room of the reactor; on the plane, the scale of time is in the order of some seconds in some minutes, while for the reactor, it is counted in dozens minutes or even in hours.

Consequence is directly seen on the actors' decisions: the pilots of planes are led to put in chains decisions in a space of time which is counted in seconds, while the pilots of reactors have several dozens minutes in most cases. At the end of work on simulator (3h30 for the plane, 3h for the reactor), the pilots of planes seem exhausted and express it so: "we are emptied" (in French: "on est vidé"); pilots of reactor do not use such expression.
Then comes the debriefing after a 30 minutes pause. For the pilots of plane, debriefing lasts 1h30 against 3h for the pilots of reactor. Considering the state of the actors at the time of debriefing, we note that the pilots of reactors can be easily engaged in discussions about work practices in simulated situation, for at least two reasons: they are less tired, and verbal exchanges will be proceeded softly as there is more time for this.

Articulation of the two debriefings is therefore accomplished consequently. Approach is directive for the instructor of the pilots of plane when it is didactic for the instructor of the pilots of reactor (Béguin & Pastré, 2002) or analytical (Fauquet, 2007). Study points out that, if pilots' skills are not diminished by directive approach, there is a non-exploited potential which the comparison puts in an obvious place.

1.Introduction

As pointed out by many authors especially in medical training (see for example Northcott, 2002; Brackenreg, 2004), for a long time the focus in the scientific literature as in practice has tended to be on detailed descriptions of the action phase of the simulation training, forgetting how the reflective phase can be facilitated, especially through the debriefing. Our own experience shows that it is unfortunately still the case in numerous training centers disregarding the kind of professions. Yet debriefing appears to be of great importance for any work activity, non-simulated or simulated, which includes the learning process of simulation training. As written by Fanning et al. (2007), "although reflection after a learning experience might occur naturally, it is likely to be unsystematic." Rudolph et al. (2006) points out the importance of analyzing performances within a context of both trainers and trainees; people make then "sense of external stimuli through internal cognitive frames, internal images of external stimuli." Debriefing permits to discuss the non-action which is definitely a part of the real of the activity: "not doing anything, or perhaps better stated, continuing to sit or stand but not moving elsewhere, is itself an action" (Clancey, 2002). It must be understood that without any debriefing, the risk is to bound the simulation session to the realized of the activity which is different from the real of the activity. Non-actions are potential or possible actions not done but which might have been done, and are usually not observed.

Indeed, everyone who had the opportunity to observe such a debriefing will admit that the simulation training debriefing gives the opportunity to discuss together of what have been done by the collective and what has not been done individually and collectively. This is not possible without debriefing: in case of no debriefing, thinking the work proceeds of a reflection which is just

(*) This work has been presented at the *Symp. Activity2008 - Activity analyses for developing work*, Helsinki, Finland, May 12-14, 2008, and the abstract has been printed under the title "Debriefing as an analysis of simulated situations: comparison between nuclear reactors operators and civil aircraft pilot" in the *Proceedings Activity2008*, 33

individual. According to the clinical analysis of the work activity academic stream (Clot, 1999; Fauquet & Ceccaldi, 2004; Fauquet, 2006), in case of absence of debriefing, only the professional style reflecting the individual know-how and skills is concerned by the transformation process of training. But the professional genre, reflecting these professional aspects from a collective standpoint in terms of art of the trade, is not worked out. Thus, a part of the transformation / adaptation / integration of professional practices is not done if we consider that the collective or collaborative activity is as much important as the individual one.

Nevertheless, it appears that simulation training debriefings including these individual and collective reflection works about the work cannot always be done despite the trainers' will. This paper aims to expose the possible causes through the comparison of two training cases: i) civil aircraft pilots, and ii) nuclear reactor pilots.

2.Methods

In both cases, observations were done for simulated and non-simulated work situations, and interviews were conducted with trainers and trainees.

2.1.Civil aircraft pilots' training

Pilots of a French company have been observed during simulation training sessions and during short and long flights aboard an Airbus A320 and a Boeing B747-400 respectively. In addition, observations have been done during Crew Resource Management trainings which are classroom trainings gathering a bit more than ten pilots mainly to exchange about Human Factors items concerning their profession.

The simulators are full scale type, reproducing the real cockpit. Views through the cockpit windows are simulated by LCD screens and physical feelings inside the cockpit are reproduced by the mean of hydraulic motion. For example, air turbulence due to specific flight conditions can be felt by the pilots, as well as sensations concerning take off and land on.

The actors of the simulation training are the trainer and two pilots. The actors of the non-simulated situation are two pilots (within a team of 3 pilots for the long flight).

Simulation training sessions are made of several days distributed one by one over several month. It means that between two training sessions, there can be several weeks.

2.2.Nuclear reactor pilots' training

Pilots of the French company operating nuclear power plants have been observed in simulated and non-simulated work situations, and interviews were conducted with trainers and trainees. The teams observed were operating a 900 MWe water pressurized reactor type.

The simulator is full scale type, reproducing the real control room.

The actors of the simulation training are one or two trainers and a team of pilots which is usually composed of two operators, one chief-supervisor, a team manager, and sometimes a safety expert. The actors of the non-simulated situation are the team of pilots and co-workers according to the on-going work activities.

Simulation training sessions are made of several days distributed over several month but gathered in two or three consecutive days.

3.Results and discussion

3.1.The case of civil aircraft pilots

The simulation training session is composed of a briefing (more than 1h), 4h of simulation run with a mean time break of 15 minutes, and a debriefing of 1h30.

During the briefing, the trainer presents the scenario to be run during the training session. The briefing is mainly directive. Thus, most of the specific points are discussed even shortly before the simulator run. During the briefing, the trainer asks the pilots about the way they might deal with these points. This method could be surprising from the pedagogical standpoint and suggests questions concerning the learning process. But this aims to re-summon the know-how to be more efficient, and contributes to make possible a larger technical overview.

During the simulator run, the team has to maintain a high level of attention due to cumulative technical problems, and this in a continuous manner. In a cumulative technical problems context, pilots to make most of their decisions within a short time (from a few seconds to a few minutes). This is due to the fast kinetic of the flight parameters. After 2h, the time break is welcome. A team noticed: "after the 4h simulator run, we are emptied". Despite the work environment and the pilots' solicitations are less numerous than in non-simulated situations, they are yet permanent during the 4h run; in real flights, they are punctual. A trainer confirmed this feeling and explained that after these 4h, it becomes difficult to obtain active participation of the pilots during the debriefing. A pilot added: "the simulator runs are exhausting physically, mentally, psychologically. However, the length will change from 4 to 3 hours. Two hours […] would have been too short: we need to be warmed up; we need to know the co-worker [as most of the time, pilots meet them for the first time and will likely not meet him anymore]…; twice 1h30, it is good." After the simulation training session, "we are looking for a rest as soon as possible."

This is why the debriefing is also mainly directive. This last period of the training session consist a technical part (about 30 minutes) followed by chronological description of the simulator run (1h). The examined points are chosen by the trainer, and the chronological description is done by him too. Questions ask by the pilots are thus mostly concerning these points and the solutions are suggested most of the time by the trainer.

For example, the trainer says : “when you get the pack-off check-list, you say : ‘no I shall do it later’. No, do it now, you’ve got it under your eyes, it is not worth to keep work for later, because after you must come back to it, and you just go here and there.” The pilot acquiesces. Crew Resource Management trainings try to compensate these aspects by the reflexive work done within a 15 pilots group.

Despites all the constrains, trainers try to produce a real exchange between all the actors of the session: they try to make it a "interactive analysis" (Labrucherie, 2011). In this perspective, trainers are sensitive to make possible the expression of each. They also manage the time during which each will speak and sometimes suggest an order which will lead the most experienced or the one at the highest hierarchical position to speak after the others.

Furthermore, the debriefing is a special moment to deal with stress. For the profession, stress is an important parameter. According to the trainee’s level of stress, his performance can be either improved or deteriorated. Sometimes, it gives rise to surprising reactions whose trainees are even not aware (see similar findings in medical field: Geeraerts & Trabold, 2011). Trainees must be led to speak about the stress, while taking care to avoid a consecutive loss of self-confidence in them or their teammates. It is important especially to allow the trainees to identify the stress, to talk about it, and build with the trainer the conditions which will allow to lower stress levels towards acceptable conditions. The debriefing is the designated space for this, and the rationalization of the living situation which is allowed here helps the trainees to better manage it the next time and perhaps helps to develop a kind of meta-knowledge.

Providing such "interactive analysis" helps the trainees to gain access to a process of co-analysis that helps to put in discussion personal professional styles and sometimes the professional genre which is collective. It helps to develop the power to act. During this co-analysis called “cross-confrontation” (developed in section 3.2), the elements of discussion usually unnoticed in daily work life are maintained more clearly to allow their re-work. This is part of the role of the trainer in charge of the debriefing. In a Piagetist perspective, seeking to promote the taking of consciousness (Piaget, 1974), the trainer must make saying rather than expose which is not so easy to deal with taking into account all the constrains that make the debriefing mostly directive.

3.2.The case of nuclear reactor pilots

Several kinds of training sessions are available for the pilots (see description in Fauquet-Alekhine & Maridonneau, 2011; Fauquet-Alekhine, 2012). The training chosen here to be compared to the previous aircraft case is the so-called “situation involving” training; it is done on 3 days, each day broken down into a briefing, a run on the simulator, and a debriefing session in classroom. The briefing lasts less than 30 minutes. The run refers to the actual work activity on simulator (or simulated situation, with a time length of 2h30 to 3h). The debriefing session lasts 2h30. The existence of a time of integration between two sessions (from one day to another) is a real advantage from the learning standpoint: it is a time to think and learn unconsciously.

The briefing time placed just before the session on simulator helps anchoring of new practices thought during the debriefing of the previous day. This briefing is beneficial for all learning. The production of the previous session remains present in the minds of the trainees and is reactivated by the trainers at this particular time. This re-activates the attention of pilots on the items selected in the debriefing of the day before.

The run on simulator then lasts 2h30. It always begins with a transfer of information between the trainers and the operating team. This will contain a brief overview of the simulated installation state (current production level, eventually unavailable materials) and the work program provided for each simulated job (change in production to come, planned interventions, periodic testing). The term "short" is crucial, because it focuses on a first difference with the real operation situation: the 5-10 minutes thus with trainers are supposed to replace the minimum of 30 minutes devoted to an exchange with the shift team leaving the place and the one arriving, bringing together about fifteen persons concerned through a team briefing. At the outset, this first step contributes to that trainees do not forget they are on simulator and not in a real operating situation. Perhaps this is why very often, the trainees explain that they are "here to manage a failure which is to come." They therefore start by watch out the control room for the slightest clue in order to detect the earliest this hypothetical failure. Thus, we can sometimes observe trainees in simulated situation focusing on what seems to be such clue, for example, an indicator of level slightly more than normal.

In this simulation situation, the trainer’s place is not neutral. This place is both enveloping and inserted in the situation. It is enveloping through the distant observer position which will be essential in the managing of the debriefing.
It is enveloping because the trainer has full control of the scenario, by stabilizing or by adjusting the parameters of the simulator. The trainer also provides answers to reactor pilots based on the role s/he is led to play (only the head of the operating team is trained on simulator: for any hardware simulated intervention, pilots use the telephone to exchange with the maintenance technician, or a field worker for example, role played by the trainer): this is another form of adjustment of parameters of the scenario.
The place of the trainer is also inserted precisely because these contributions take place in the history of the temporal interval inside the simulated situation. The trainer may take the role of a field worker of the operating team, that of a maintenance worker, or voluntarily the disturbing role of any worker in the process.

Physical phenomena are rarely of fast kinetic: their variation usually takes several minutes, even for accidental situations during which specific procedures are applied, and during which the piloting team will involve 5 persons at a first stage, and a lot of supporting teams at a second stage.

After the simulator run, the team has half an hour time break. After that, they are ready for a several hour debriefing. This part of the training session is specifically hard if the session begins at 6:30 am: it means that the people will have to work until 01:00 pm. Usually, they bring some food and non alcohol drinks for the time break.

The debriefing, proceeding of a retrodiction (see Béguin & Pastré, 2002; Fauquet-Alekhine & Maridonneau, 2011) elaborates an analysis of what happened in a non linear way.

Based on the conceptual approach proposed by one of the French psychology theoretical streams, the clinical analysis of the work activity (Clot, 1999; Clot et al., 2002), we can highlight the importance of implementing the discussion of the workers' action by themselves (see Fauquet, 2006 and 2007; Fauquet-Alekhine, 2012). They are asked to explain what they are doing beyond of what is a priori agreed, to re-formulate – as in a more classical self-confrontation analysis (Theureau, 1992; Mollo & Falzon, 2004) – but also to understand the way in which each one is approaching the situation beyond what is agreed a priori and can remain implicit. The debriefing, seen in this framework, aims to extend the implementation discussion beyond the implicit within the story, suggesting that the development activity is governed by conflicts between concurrent activities that may be incurred for a same task to achieve but with different costs (Clot, 1999), which is a specific of the crossed self-confrontation practiced in the clinical activity. Must be put under discussion the carried out activity, but also suspended activities, thwarted or affected, and even including of counter-activities. In relying on the collective development of the story, the analysis highlights for the workers a lived and shared history of what has built the situation. During this phase of collective discussion, is implementing the "cross-confrontation" for a necessary comparison of the "personal styles" through the "professional genre" and make them to evolve. It is therefore a co-analyse in the collective debriefing which re-examine the professional genre. The shared rules of the professional genre are both constraints and resource for workers insofar as the rules are not fixed, but can be re-examined and processed. The professional genre performs a psychological function for each worker through a transpersonal dimension (Clot et al., 2002). This process is shaped by using the professional style of each, and by confronting each other within the professional genre, redefining it through the transpersonal memory (within the meaning of Bannon, 2000).

3.3.Comparative key points

From the ergonomic standpoint, one of the strengths of the configuration of the nuclear reactor simulator is that trainers are separated physically from the pilots, are sitting at a table big enough to receive control computers as notebooks. It is not the case of aircraft trainers who sit just behind the pilots. The physical separation allows an exchange of views in real time between trainers. Furthermore, it fosters an involvement of trainees in the situation and a dialogue between trainers without disruption or interference with the members of the team. Two other advantages for nuclear pilots concern the number of trainers (2 while 1 for aircraft team) and the continuous character of the training (2 or 3 days following while one punctually for aircraft team). The first advantage allows more relevant observations shared in real time and increases the debriefing quality, and the second helps anchoring of new practices thought during the debriefing of the previous day.

From the profession standpoint, comparison puts in an obvious place a bigger nervous tiredness for the pilots of planes than for the pilots of reactors on simulator. This notably comes from the kinetics of tasks to be accomplished: in the cockpit of the plane, actions to be put in chains and the answers of the technical system are much quicker than in the control room of the reactor; on the plane, the scale of time is in the order of some seconds in some minutes, while for the reactor, it is counted in dozens minutes or even in hours. Consequence is directly seen on the actors' decision making: the pilots of planes are led to put in chains decisions in a space of time which is counted in seconds, while the pilots of reactors have several dozen minutes in most cases. Furthermore, while aircraft pilots deal with problems within their bounded team (2 persons), the reactor pilots trespass this bound and have the benefit of supporting teams.

The debriefing for these two professions is therefore structured consequently. Approach is directive for the trainer of the aircraft pilots when it is didactic for the trainer of the reactor pilots (Béguin & Pastré, 2002) or analytical (Fauquet, 2007). Concerning the aforementioned debriefing quality due to the presence of two trainers for reactor teams, it must be noticed that what can be done for the reactor team is possible due to the possible time length of the debriefing. As the aircraft teams have directive debriefing, the benefit of two trainers is not so evident.

In addition, study points out that, if pilots' skills are not diminished by directive approach, there is nevertheless a non-exploited potential which the comparison puts in an obvious place. More recent observations have been done within the flight fighters training center of the French Air Force Army. Here, after about 1h flight simulator, the debriefing does not last more than 15 minutes, and it is not more than a feedback of the session from the trainer to the trainee. Both of them agree that after such training, the pilot is not mentally available to do more.

4.Conclusion

This comparative study has shown that the debriefing for a simulation training must take into account the main point concerning the physical and mental state of the trainees after the simulator run.

Although most of the studies show that a didactic approach gives better results than a directive debriefing, the first one being more efficient from a pedagogical standpoint, it is sometimes necessary to perform a directive debriefing because trainees' state does not permit the expectation of a participative exchange.

Nevertheless, even being involved in a directive debriefing, the civil aircraft trainers have shown that tending to the didactic approach could be possible, with less efficient effect than for the nuclear reactor trainers, but anyway actual. This gap may be compensated by other kinds of training sessions: it is the case for the aircraft pilots with the Crew Resource Management (a two days training session) during which pilots exchange about their professional practices. Following these studies, several changes have aoocured. Today (in 2012), simulator runs for aircraft pilots have been reduced to 3h30 which help training to be more efficient. A French fleet manager recently explained: "I realize how in terms of training we have made progress. In fact we work differently during training sessions. We have implemented the ATQP (Alternative Training and Qualification Program). It came from the fact that we realized that the most serious events occurred without technical failure, while we trained the pilots for major or minor malfunctions. There was a gap between what was taught and the 'real life'. We have inserted in our sessions exercises without failure (cases from our operating feedback), but which could generate organizational dysfunction within the crew, and thus could generate stress. The absence of procedure to manage the situation may be very dangerous if the crew is not robust or rather resilient. Feedback is very encouraging. Another innovation concerns the pilots' assessment: now it is done at the beginning of the training session. [..] We work about the weaknesses of each. As two sessions are undertaken by the same instructor, s/he can therefore adapt, in part, the sessions according to the pilots and and their weaknesses."

Reference

Bannon, L. (2000) Towards artificial memories? *Le Travail Humain*, 63, 277-285

Béguin, P., Pastré, P. (sept. 2002). Working, learning and design through simulation. *XI^e Eur. Conf. On Cognitive Ergonomics : cognition, culture and design. Catalina, Italy*. 5-13

Brackenreg, (2004) Issues in reflection and debriefing: how nurse educators structure experiential activities, *Nurse Education in Practice*, 4, 264–270

Clancey, JW. (2002) Simulating activities: Relating motives, deliberation, and attentive coordination, *Cognitive Systems Research* 3 (2002) 471–499

Clot, Y. (1999). *La fonction psychologique du travail*. Ed. PUF, Paris, France, 246p

Clot, Y., Fernandez, G., Carles, L. (2002) Crossed self-confrontation in the clinic of activity. *Proceedings of the 11th Eur. Conf. On Congnitive ergonomics*, Catalina, Italia. 13-18

Fanning, RM.; Gaba, DM. (2007) The Role of Debriefing in Simulation-Based Learning. *Society for Simulation in Healthcare*, 2 (2), Summer 2007, 115-125

Fauquet, Ph. (2006) Confrontation croisée ou analyse collective sur la base de restitutions d'entretiens individuels : deux approches pour l'analyse évènementielle. *Revue électronique @ctivités*, 3 (2), 2-14, http://www.activites.org/v3n2/activites-v3n2.pdf.

Fauquet, Ph. (2007) Développement des pratiques de fiabilisation sur simulateur de pilotage de réacteur nucléaire. *Colloque de l'Ass. Int. des Sociologues de Langue Française : Risques industriels majeurs, Toulouse,France*, 129-135

Fauquet, Ph.; Ceccaldi, Fr. (2004) Importance of decentralized organisations for safety sharing. *Proceedings of the XIe International symposium Loss Prevention, Praha, CZ*, 1378-1381

Fauquet-Alekhine, Ph. (2012) Simulation for training pilots of French nuclear power plants. *In* Fauquet-Alekhine, Ph. (eds) *Socio-Organizational Factors for Safe Nuclear Operation*, Montagret: Larsen Science Ed., 1, 69-74
http//hayka-kultura.com/larsen.html

Fauquet-Alekhine, Ph.; Maridonneau, C. (2011) Le pilotage des réacteurs nucléaires, *In* Fauquet-Alekhine & Pehuet (s/dir). *Améliorer la pratique professionnelle par la simulation*. Toulouse: Ed. Octarès. 37-63

Geeraerts, Th.; Trabold, F. (2011) Le simulateur de situations critiques en Anesthésie, *In* Fauquet-Alekhine & Pehuet (s/dir). *Améliorer la pratique professionnelle par la simulation*. Toulouse: Ed. Octarès. 65-72

Labrucherie, M. (2011) Le pilotage des avions de ligne, *In* Fauquet-Alekhine & Pehuet (s/dir). *Améliorer la pratique professionnelle par la simulation*. Toulouse: Ed. Octarès. 9-36

Mollo, V. & Falzon, P. (2004). Auto- and allo-confrontation as tools for reflective activities. *Applied Ergonomics*, 35 (6), 531–540.

Northcott, N. (2002) Role-Play: proceed with caution! *Nurse Education in Practice* 2, 87–91

Piaget, J, (1974). *La prise de conscience*. Paris : PUF 283p

Rudolph, JW.; Simon, R.; Rivard, P.; Dufresne, RL;. Raemer, DB.; (2006) Debriefing with Good Judgement, *Anesthesiol Clin*., 25(2), 361-376

Theureau, J. (1992). *Le cours d'action : analyse sémio-logique. Essai d'une anthropologie cognitive située.* Bern : Peter Lang. 339p