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Toward a resilient organization: The management of unexpected hazard on the polar traverse

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ABSTRACT

The aim of this research is to understand the organizational resilience through the safety management when unexpected events occurred, on an atypical transport environment, the polar traverse. Three polar traverses were studied, one of which being a detailed case study. Thus, ethnological observations over 3 year periods from 2012 to 2015 (to understand the traverse logic, functioning through unexpected event) and all-day interviews during a traverse (to understand actions and strategies of organizational resilience to cope unforeseen events) were collected. The main results, from quantitative and qualitative analysis, indicated (1) mechanical, organizational and both interventions allowed to face unexpected incidents on the traverse, (2) great possibilities to take actions on the convoy organization enabled to develop a pro-active management of the safety in alternation with reactive adjustments; (3) the importance was to preserve the machines functionality even if operators have to face environment hostility to repair; and (4) the variation of the convoy organization was permanent in its whole even if the incidents concerned only one road track. The strategies of organizational resilience building will be discussed in this article, around the proactive–reactive management, the organizational dynamic, the risk evaluation, and the risk taken to preserve the room manoeuver.

1. Introduction

The term « resilience » can sometimes, in certain cases, be reserved for the management of unexpected disturbances « which exceed the anticipated areas of adaptation » (Lundberg and Johansson, 2006, 2007; Woods, 2006, 2009). A system is resilient if workers adapt themselves by understanding the context in which adaptation takes place. Adjustments are thus constantly made by individuals and organization, even if they are more often approximate rather than exact (Hollnagel, 2012). Every organization is stretched to operate at its full capacity and, to be resilient, a system needs to be able to anticipate whatever may happen, monitor what is going on, respond effectively when something happens, and learn from past experiences (Hollnagel, 2009; Woods and Cook, 2002; Woods and Hollnagel, 2006). Consequently, the organizational resilience strategies are questioned to understand how a system could adjust itself to disturbances or unexpected hazard.

One of the main objective of researches focused on the strategies of organizational resilience is to understand the organizational preconditions conducive to a safe performance (Pidgeon and O'Leary, 2000). Some studies emphasized the need for proactive measures in safety management, while proactive manner invested in safety and resource allocations to safety improvement are key factors in ensuring a resilient organization (Dekker et al., 2008). Reactive adjustments are, by far, the most common ones. Short terms responses are not enough to guarantee a system's safety and survivability. One reason for this is that the system can only be prepared to respond to a limited set of events or conditions and over a limited period of time. The reactive approach quickly appears too restrictive (Daniellou et al., 2009; Hale and Heijer, 2006), as this new way of conceiving safety is of little interest if it only reacts to events and does not anticipate them (Dekker, 2006; Hollnagel and Woods, 2006; Westrum, 2006). Consequently, the proactive vision of resilience is therefore essential when aimed at the prevention and adaptation of a system to changing conditions prior to the occurrence of undesirable events (Hollnagel, 2006, 2008, 2009; Leveson et al., 2006; Morel et al., 2008; Westrum, 2006; Woods and Hollnagel, 2006). Proactive adjustments, however, mean that the system can change from a state of normal operation to a state of readiness before something

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happens. In this case, resources are allocated to match the requirements of the expected event and special functions may be activated. The Safety Management System (SMS) is interested in this problematic, considering the fact that organizational and management factors have to be taken into account to understand human contribution to major accidents (Hale and Hovden, 1998). SMS is the most efficient way of allocative resources for safety regarding which organization plays a major role. Supplementary resources are mobilized and local strategies are deployed to cope with disturbances. This is « opportunistic bricolage » which is a way to offset the disturbances and maintain the functioning of the system at the lowest possible level of risk. It is a safety measure deployed by human expertise, as well as the use of specific individual and collective skills in real time, as previous studies in polar context have already shown (Villemain and Lémonie, 2014; Villemain and Godon, 2015).

Studies focused on extreme situation at work are poor in the ergonomics approach, and even more so in polar context. Few researches in polar conditions have been led in a logistics thematic in arctic (Lièvre, 2007). At the present time, only our researches on working conditions in the Antarctic context working are being carried out with an ergonomics approach (Villemain and Lémonie, 2014; Villemain and Godon, 2015). To conduct research in such conditions requires a specific methodology to collect data because of the harsh conditions. Subsequently, the ethnographical method is the most appropriate to the ground constraints (Rix-Lièvre and Lièvre, 2010). These authors used this kind of method in order to study ski polar expeditions in arctic through ethnological observations and interviews.

The context and motivations of this research are particular and require to be specified. The French polar traverse, initiated in 1993, was followed by the creation of the scientific French–Italian station on the Antarctic continent called Concordia (situated to 1150 km from the French station Dumont D'Urville (DDU) and opened in 2005). At that time, the objective was to design a freight and material transport mode, in order to build the station, from DDU (carried by boat until this station) to Concordia. Thus, the issue then was a technical, material, technological, logistical and economical challenge. The traverse has been explored more from a technical point of view than a safety aspect, only guided by an experiential or empirical observation. In Antarctica, the environment hostility does not facilitate human activities, more particularly when those take place outside such as mechanical task to repair machines. During the traverse, temperatures can be below −50 °C in February. Thus, in this context, the smallest incident, if not managed immediately, can bear heavy consequences and become dramatic due to a limited medical assistance and the isolation. The vital prognostic is quickly engaged.

The polar traverse could be defined as a set of vehicles in movement in the polar continent, with a total autonomy. Eleven days are necessary to reach Concordia from DDU. Three return-trips DDU–Concordia are organized during the austral summer (between November and February). The convoy is composed with about ten persons, with a minimum of seven mechanics and one doctor, three (snow trains), seven machines, three levelling machines, and loads are consisting of fuel tanks and containers (see Diagram 1). The logistical traverse has to carry freight to Concordia with both quantitative and qualitative criteria, as quickly as possible and consuming as little fuel as possible. Today, twenty-two years after the first traverse, no human loss has been reported since the traverse was set up.

During about twenty-three days for a return trip, traversers will cross the white-ice desert living in a caravan and driving eleven hours per day. The traverse will be punctuated with mechanical incidents considered as unexpected events. All raiders know that incidents will happen during the traverse. Thus, in that way, we can consider that such situations are not unforeseen. It is however impossible to determine which kind of incident, when (in bad weather conditions), neither how and which consequence such situations will entail (pieces to repair or not? Know-how or experience to face the event?) nor where exactly in the convoy, which material, etc. In this regard, such events can be considered as unforeseen… Everybody knows that this will have incidents, but nobody knows exactly which ones. The real risk rests more in the incident conditions per se than concerning the unforeseen event in its current form.

Thus, in this context, the goal of the research deals with the system capabilities to withstand shocks or unexpected events, and to face harsh conditions every year, in order to answer the question regarding strategies of organizational resilience used to ensure the safety in a productive system. In the case of the traverse, "unforeseen" can be considered as a risky situation, jeopardizing the traverse group during a limited period of time, thus calling on the resilience abilities of this system. What is the nature of the unforeseen situations on the traverse? What solutions can be found? What strategies of organizational resilience can be deployed? To investigate these questions, we rely on the operative logic to manage risks during the traverses when unexpected events occurred. An explanatory study was conducted over three complete traverses (return trips) from which we gathered in situ data in real and dynamic situation to understand how the unforeseen events were managed, ensuring the organizational resilience of the system. Firstly, an analysis of the unforeseen events will be presented, as well as the solutions offered. Secondly, a single traverse will be used to present a case study to understand the role of the operators and the organization to act in the management of unexpected events and strategies deployed.

2. Method

2.1. Tools and procedure

The methodology used was, firstly, aimed at describing and characterizing the unforeseen events on the polar traverse and, secondly, at conducting ergonomic analysis of operators' activities when the unforeseen situation occurred in particular. The methodology chosen was to analyze immediately operators' activity in unforeseen and natural situation during the traverse and their interventions by means of observations in so far as, in such situations, the event is not necessarily known and neither are the technicians who are likely to intervene. As mentioned by De La Garza (2000), troubleshooting activities, by nature unannounced, make it impossible to define accurate observation conditions. Consequently, the ergonomic analysis of operators' interventions only concerned the three polar traverses studied. Nevertheless, particular attention was paid, whenever possible, to the potential transfer of this methodology to other risky environments.

Using both à quantitative and a qualitative approach, data were gathered over a 3-year period from 2012 to 2015. Participating ethnological observations were carried out from immersion work (note taking, films, photos). On board the outward and return trips of the convoys, the goal was to experience the traverse from the inside, (a) to understand exactly what unforeseen event referred to (the nature of unforeseen events), (b) to access proposed solutions without hindering the work in progress and (c) to understand the various actions undertaken during the traverse which could impact the management of unforeseen events and strategies of organizational resilience employed by operators. The methods used were the following: (1) firstly, objective and quantitative data relating to the unforeseen events encountered were identified, in order to proceed to a categorization of events (Amalberti, 1996).

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