Developing knowledge codification to learn from rare and complex experiences: the case of Fukushima nuclear accident

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Purpose

Learning from rare and complex experiences, such as accidents, is a challenging process. While prior work suggests that organizations respond to this challenge in a variety of ways, (Christianson et al., 2009; Madsen, 2009; Kim et al., 2009; Lampel et al., 2009), little is known about how this learning can deliberately occur. Yet, scholars outlined the utility of implementing deliberate learning processes in order to learn from **rare experiences** (Zollo and winter 2002; Lampel et al., 2009; Zollo, 2009); these learning processes are mainly based on **knowledge codification** (Zollo and winter 2002). According to these scholars, the more the heterogeneity of experience increases, the more knowledge codification is necessary to learn from experience (Zollo and Winter, 2002). Surprisingly, little research studies **the role of codification in learning from rare experience.**

This paper responds to this gap by bridging two literature fields: organizational learning from rare experience and knowledge codification.

Literature review

Rare experiences challenge traditional approaches of organizational learning based on progressive improvement and replication. Indeed, recognizing, interpreting and analyzing rare experiences require the development of new conceptual categories (Garud et al., 2011). In addition, facing rare events with strong causal ambiguity increases the risk of superstitious learning. As noted by Zollo (2009), individuals and organizations tend to develop future aspirations by retrospectively interpreting rare experiences from the past. These retrospective interpretations may be selective and biased, and induce superstitious learning. Finally, a rare experience is never repeated in exactly the same way. Reusing knowledge generated by a rare experience raises the problem of recognizing a suitable level of similarity between the present experience and a prior rare experience (Zollo and Reuer, 2010). In sum, learning involves as March (2010) asserts "*transforming the ambiguities and complexities into a form that is elaborate enough to elicit interest, simple enough to be understood, and credible enough to be accepted"* (March 2010. P.45).

In this line, past research showed the positive role of knowledge codification in deliberate learning from experiences such as mergers, acquisitions or alliances (Zollo and Winter, 2002; Zollo and Singh, 2004; Kale and Singh, 2007).To face these problems, Knowledge codification helps companies "*see through the fog*" of causal ambiguity associated with heterogeneous or rare experiences by facilitating the identification of causal relationships that explain performance outcomes (Zollo and Winter, 2002; Heimeriks et al., 2012). Zollo and Winter (2002) argue that in order to generate beneficial effects, codification must be **"well-performed,"** but they did not specify how to achieve it. To date, few studies in management science have addressed the codification process in context (Bingham et al., 2015). Finally, it is still unclear whether the problem is the knowledge codification or how it is performed.

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Our research proposes that a key to this conundrum lies in considering contributions from the knowledge management literature. This literature suggests, three research avenues can enrich our understanding of the codification process:

- The first one suggests considering the objective of codification (Boisot and li, 2005);
- The second proposes to focus on the appropriate level of abstraction (Boisot et al., 2005, Bingham et al., 2015);
- The third examines the relevant scope of knowledge codification: breadth which refers to the relational complexity of the phenomena to codify versus deep which refers to depth complexity of the phenomena to codify (Wang and Tunzelmann, 2000).

Thus, various codification strategies may exist within the same organization. This research tries to answer this question: **How the implementation of appropriate codification strategies can promote learning in the case of rare experiences?**

Design/methodology/approach

Through an abductive explanatory case study (Avenier and Thomas 2015; Wyn and Williams 2012), conducted in a French Technical Safety Organization (TSO), we propose a deep understanding of the codification process implemented by the TSO to learn from the Fukushima nuclear accident.
The TSO is the French public expert on nuclear and radiological risks. This research setting is suitable to our research question because it offers us the opportunity to study a sector where learning from experience is vital and experiences are rare.

We collected data from 12 semi-structured interviews (either 230 pages of transcript) realized with people involved in the codification process and second data based on an internal documentation (+1000 pages).
Our analysis followed two main steps (Wyn and Williams 2012):
- First, we accurately describe the flow of events, the environmental context and the organizational structures that support these events.
- Second, we identify the underlying mechanisms that are responsible for the events and patterns of events observed, as well as the manner by which these generative mechanisms are contingently activated that explain the occurrence of observed events. S(Bhaskar, 1978; Tsoukas, 1989; Wyn and Williams 2012).

History of the Accident

After the Fukushima nuclear accident occurred March 11, 2011, in Japan, an emergency situation has been triggered worldwide. A deliberate learning process has been implemented within the French TSO to learn from the Fukushima accident. The TSO proposed an innovative concept labeled the "**Hard core**", which renews the safety policy. It is being deployed in all French nuclear plants. "**Hard core**" consists of designing and implementing a bunkered system of material and organizational elements which will help to prevent or manage a serious accident, even in the case of an extraordinary external hazard.

This research studies the implementation of this deliberate learning and the codification process which carried it within the French TSO.

Findings

After an accurate description of the flow of events, we were able to build an emerging model (see Figure 1) which reveals two contrast phases of the codification process. Each phase produces different knowledge forms.

- ***The First Phase***

The first phase immediately succeeded the Fukushima accident in an environmental context characterized by a **strong pressure** caused **by a major shock,** a nuclear accident. This important shock triggers **a learning objective** within the members of the TSO. This learning objective was facilitated by the implementation of an **ad hoc, simple, and dedicated organizational structure** which combines a diverse range of skills (experts from different domains) required to analyze the accident.

Combined with the learning objective, two key mechanisms have played an important role in the first phase. On the one hand, the will to decontextualize i.e. to find a general solution applicable to all nuclear power plants in France. On the other hand, the need to capture relational **complexity** underlying the phenomenon to codify. Indeed, the members of the ad-hoc structure, put in place a transverse analysis method to understand the main interactions between the different knowledge areas required to analyze the accident.

- ***The second phase***

The second phase, started from 2014 to now. It concerns mainly the technical studies to deploy the concept of "hard core" in all French nuclear plants. The objective of this phase is to ensure the **operational safety** of nuclear plants by deploying the "Hard core". This is also to avoid any risk of destabilization of the existing installations with the concrete implementation of the "Hard core". Very detailed studies are then carried to take into account the specificities of each nuclear plant. These studies raise the problem of the adaptation of the Hard Core approach to each concrete technical situation. Hence this phase increases the need of developing **contextualized knowledge**.

This need of contextualization mobilizes sophisticated knowledge to capture the **technical complexities** (depth complexity) of building a concrete "hard core". Exchanges between each nuclear plant and TSO are highly technical and involve **sophisticated knowledge** in a particular field of expertise.

It should be stressed that this second phase take place in an environment characterized by a **lower environmental pressure** in a damping position of the shock of the accident. This phase is also characterized by a return to the traditional structure of the TSO, a structure organized by centers of expertise. The combination of a **low environmental pressure** and an **organizational structure with centers of expertise** enable the activation of three combined generative mechanisms: Operational safety objectives, need of contextualization, capture of complexity in depth.

<u>Contributions/Originality/ value</u>

By highlighting the generative mechanisms underlying the codification process and their activation patterns in different contexts, this research contributes to deepen our understanding of knowledge codification and organizational learning.

Few studies have analyzed the concrete implementation of a codification process. Thus, we contribute to enriching literature on the role of codification in the development of deliberate learning, especially those of Zollo and Winter (2002), Heimriks et al. (2012, 2014). **Our main contribution** is to identify the three generative mechanisms of knowledge codification, how they are combined and activated according to the environment and the organizational structure. These three mechanisms relate to: **Objective, the degree of abstraction and codification scope (breadth or depth)**. Some recent works (Bingham et al. 2015) identified the role of abstraction. We complement this approach by including two key dimensions, the objective and the scope, and by showing how these three dimensions are combined.

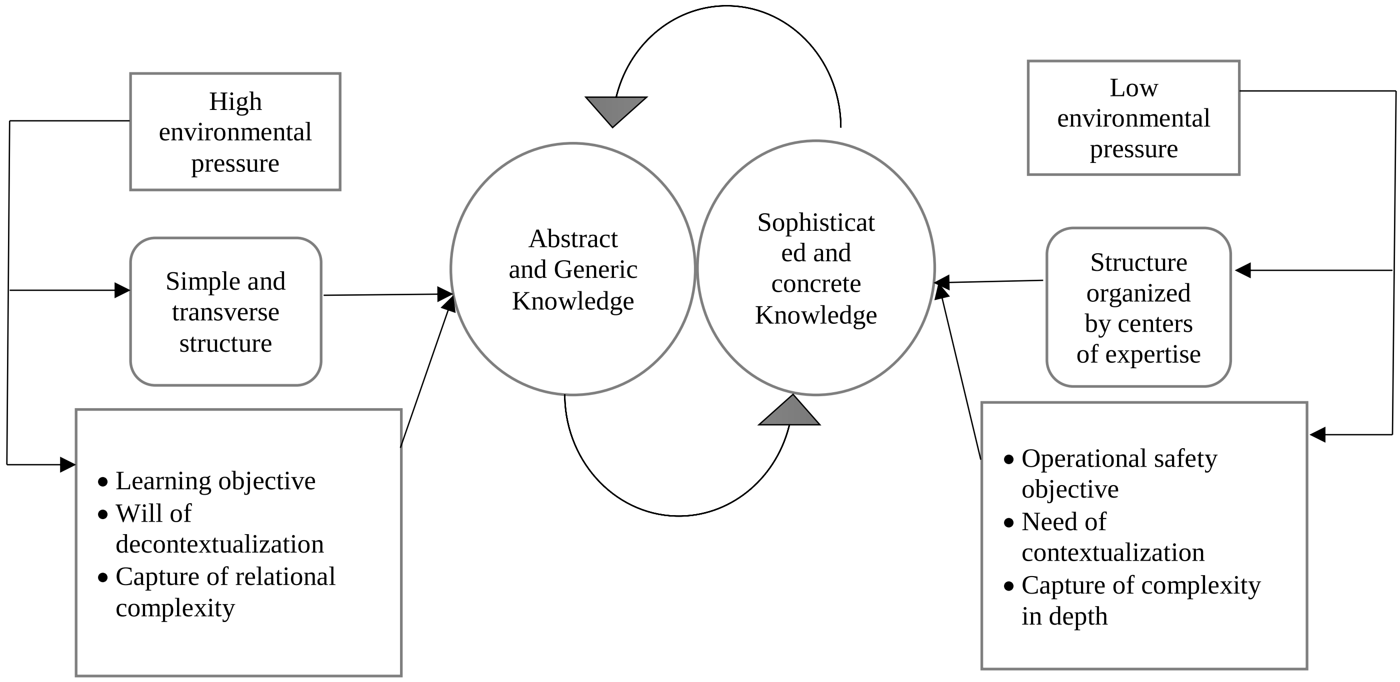

Figure 1: knowledge codification model

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