# Operational Crisis Line Management and Teamwork: How Headquarters Counter Uncertainty and Risk to Achieve Resilience

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***Resumen***

*El estudio actual se interesa a las dinámicas de jerarquía de gestión de crisis y de equipos en una organización operativa y de múltiples capas que busca el alcance de la resiliencia en un contexto altamente riesgoso e incierto debido a un peligro natural en las plantas industriales. Aunque la literatura existente sobre los procesos de información del equipo y la toma de decisiones está madura, la investigación sobre la construcción y la coordinación dinámica de una representación colectiva de la situación para los equipos operativos de múltiples capas es escasa. Como el equipo de gestión de crisis central es una entidad operativa ciega, esta contribución investiga la información colectiva y los procesos de acción para alinearse con una sola respuesta operativa para manejar el impulso externo y que amanezca una resiliencia organizacional. Más precisamente, profundizamos los aspectos temporales de la acción del equipo de gestión de la crisis central a través de los procesos de orquestación y encapsulación mediante el análisis de su relación con el equipo de gestión operativa local. Esta investigación se basa en una observación de simulacro de crisis de 36 horas. Contrariamente a los estudios organizacionales sobre la gestión de crisis, esta relación no se caracterizó por el control y la desconfianza de los datos locales, sino por el diálogo y la cooperación, incluido sobre temas claramente atribuidos al papel de una de las dos entidades en los procedimientos internos. Además de este resultado, surgieron fases de acción coordinada para manejar mejor las presiones de las partes interesadas más allá de los aspectos exclusivos de relaciones públicas. Finalmente, se discute los sistemas de información y la comunicación del equipo de gestión de crisis central con el equipo local, ya que hubo pocas órdenes durante sus sesiones informativas, abriendo el camino a nuevas investigaciones sobre dispositivos de comunicación de gestión, como interdictos y requerimientos o lo que llamamos* ***injunctions****.*

***Palabras clave****: crisis, toma de decisiones, información, resiliencia,*

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*sistemas sociotécnicos, desempeño del equipo.*

***Abstract***

*The current study draws on work in the areas of crisis line management and team dynamics in an operational and multi-layered organization looking to achieve resilience in a highly risky and uncertain context due to a natural hazard affecting industrial plants. Although the existing literature on team information processes and decision-making is mature, research investigating the construction and coordination of situation models for multi-layered operational teams is scarce. As the headquarters crisis management team is both out-of-the-field and a central operational entity, this paper investigates how collective information and action processes can align with a single operational response to handle external pressures and achieve resilience. More specifically, the paper looks more closely into the time aspects of team action through orchestrating and encapsulating processes by analyzing how the headquarters operational management team contributes to organizational performance through its relationship with the local operational management team. This investigation is based on observation of a 36-hour crisis drill. Contrary to organizational studies of crisis management, this relationship is not characterized by control and distrust of data but by dialogue and cooperation, including topics clearly attributed to roles in internal procedures. In addition to this result, coordinated action phases emerged to better handle pressure from stakeholders beyond just public relations. Finally, the headquarters crisis management team and local crisis management team information system and communication are discussed, as there were few direct orders during their briefings, opening up the pathway to new investigations on management communication mechanisms such as injunctions.*

***Keywords:*** *crisis, decision-making, information, resilience, socio-technical systems, team performance.*

## Introduction

In the current context of conflict in Ukraine and in the aftermath of the Covid pandemic, both of which have raised a number of issues about governance practices in the face of uncertainty and threatened dire consequences at a global scale, the present contribution looks at multi-level coordination processes that are designed to enhance resilience. I believe that a processual approach to crisis management which deepens the understanding of the crisis phase with all its

technical complexity (Williams, Gruber, Sutcliffe, Shepherd & Zhao, 2017) can provide insightful results for both the co-construction of actions across different hierarchical levels and for remote management to adjust between leaving local autonomy and imposing central control when confronted with extreme events. In this sense, an understanding of how organizations function in crisis situations could prove relevant for fields such as Organization Theory and Information Systems from an informational and operational perspective (Desq, Fallery, Reix & Rodhain, 2016) in their material and socio-technical sense (de Vaujany & Bussy-Socrate, 2018; Bergeron & Cooren, 2012). The point is that crisis situations exacerbate tensions and highlight factors for understanding the way teams work which often go unnoticed in normal times.

The notion of risk is a frontier object (Pesqueux, 2011). The term can cover a set of different realities, according to who defines it. This subjectivism also conditions extreme situation characteristics (Arena, Oriol & Pastorelli, 2013). Organizations like the nuclear industry handle risks whose consequences can be judged unacceptable and lead to major business shutdowns for the entire sector (Rees, 1994; Kim & Chung, 2018). This being so, operation sustainability, but also crisis management and training, remain burning issues. When an unexpected event threatens the safety of a nuclear plant, a crisis management organization is formed from all organizational levels in order to simplify communication and decision-making and to ensure efficient action in the field. In such a context, it is quite surprising to observe that the crisis management literature is often polarized. On the one hand, local crisis management has been largely documented through sense-making lenses to promote a "human and organizational factors" understanding for practical enforcement (Weick, 1990; Geiger et al., 2020). On the other hand, crisis management command is generally documented with respect to public relations (PR) aspects (Guarnelli, Lebraty & Pastorelli, 2011), leadership, and decision-making processes, all of which fall to CEOs and executive boards or to politicians (Wimelius & Engberg, 2015). So the relationship between those two entities is often reduced to an imitation of military command structures as effectiveness needs to be achieved at all costs. With its focus on a crisis management drill in a nuclear plant facing the unexpected, this paper investigates by way of direct observation how a headquarters senior management unit contributes to resilience in its coordination with local levels during a crisis.

This paper is a contribution to the team management literature on High Reliability Organizations (HROs). It highlights the development of a Team Situation Model (TSM) by tracking information and communication processes. This "shared understanding of the current situation developed by team members moment-by-moment, and its impact on team effectiveness" (van der Haar et al., 2015: 50) is particularly innovative as it is derived from the perspective of a headquarters crisis

management team in its interactions with a local crisis management team. The contribution from headquarters—as an operational but out-of-the-field entity—to crisis management remains unclear in the literature but could lie in the team learning process (ibid.). By analyzing the relationship between central and local operational crisis management teams through information systems and communications, the focus here is on how "teams process information in order to create a shared understanding of a dynamic situation and make decisions in response to it" (Uitdewilligen & Waller, 2018: 732) in order to create a "mindful" organization. As defined by Weick and Sutcliffe (2007), mindfulness is a deep awareness and a capacity for action that together facilitate the discovery and management of unexpected events before they escalate into crises and catastrophes. In the present context, this kind of organization would be materialized by an effective crisis management team in terms of its organizational capacities and its relationship with other entities. To provide insight into the way different teams can improve their performance when it comes to regaining control of a runaway situation, we identify communication patterns during the stages of a crisis by which to characterize the "language perlocutionary effect" (Kerbrat-Orecchioni, 2014: 22) in situ; that is, the action triggered by this communication, in its specific situation.

By characterizing the headquarters operational crisis management team's contribution to organizational resilience, this study seeks to advance knowledge about team dynamics and coordination in two important ways. First, by studying the specific information collection and communication stages and the behavioral sequences between two complementary operational teams while making sense of the unfolding flow of information, detailed insight is gained into a collective process leading to agreement on what action is to be taken to handle external pressures and achieve resilience. Second, we develop Uitdewilligen and Waller's perspective on the temporal aspects of team action (Uitdewilligen & Waller, 2018) by providing insight into orchestrating and encapsulating processes between those two entities' actions and representations.

The following sections define the roles of central and local teams and their relationships in the way they confront contingencies together and analyze how such relationships affect organizational performance. The paper then describes the crisis management organization as observed during a major nuclear accident drill and more specifically, a headquarters crisis management team's (H-CMT) functioning and coordination work during its 36-hour operational command. The approach taken is qualitative, grounded, and communication-based, as designed after an exploratory phase deployed during a similar previous drill. This enables us to track the development of the TSM through three crisis-resolution phases and its

impact on achieving resilience. Finally, the paper discusses the results and the implications for future research and practice.

## Literature Review

### Crisis line management organization

Historically, following Perrow's Normal Accidents (NAT) findings in 1984, High Reliability Organization (HRO) studies focused on high-risk industries and studied a number of military operations (Rochlin, 1996). The US Army also uses HRO lenses to assess its own activities like medical care with its Ready Reliable Care (RRC) High Reliability Organization (HRO) Awards Program. This compatibility between HRO lenses and a military organization is of particular interest for us as military doctrine defines senior managers' processes and duties that are supposedly drawn on when confronting difficult situations and even crises. For example, the Army uses four generic processes with which senior managers need to be familiar: command, control, management, and leadership.

In the specific context of current US military doctrine, management refers to planning and general preparation while leadership covers motivational skills in interpersonal relationships. However, the functions of command and control remain center stage and are twin concepts. First, command is "the primary means whereby the vision is imparted to the organization […]. The command process focuses on communicating intent and providing direction" (US Army, 1987: 41). Second, control is a "process used to establish limits and provide structure. Its purpose is to deal with the uncertainties inherent in organizational operations […] to serve primarily as a compensating, correcting device for command" (ibid.: 42). Consequently, as highlighted by Snook who analyzed a normal accident in the US Army using NAT and HRO lenses, there are several types of influence of command and control on individual behavior such as "standard military customs & courtesies, legal framework, mission guidance, rules of engagement, local operating procedures, technical instructions and direct verbal orders" (Snook, 2000: 39).

In both military and civilian industrial spheres, to handle technology thoughtfully, people should have a complex understanding of processes, products, equipment, and controls so they "can intervene at any time and pick up the process or assemble a recovery" (Weick, 1990: 14). Besides, as "analyses of accidents have clearly shown that major accidents are created by the interaction of potential side effects of the performance of several decision-makers during their normal work" (Rasmussen & Svedung, 2000: 50), it is necessary to identify the boundaries of safe operations for each line management level. To do so, one needs to analyze "both the communication among decision-makers within a particular work organization (company, institution) and the communication required for the overall risk

management" (ibid.: 55). That is why, illustrating the operational line management function to ensure safety is so important an issue because the coupling between organizations become tighter due to network enforcement.

As Delatour (2015) showed, operational line management is a function that is somewhat superficially defined in the main safety production models, and especially in crisis management contexts. However, this function still varies greatly with organizational structure, thus limiting potential comparisons across organizations. Besides, industrial safety is intended to be part of a general vision of an organization to ensure its resilience. The main counterpart of this approach is the "lack of focus on intermediate managerial levels" (Delatour, 2015: 244) although each crisis management level has its own administrative structure and operational center.

In crisis management, civilian operational management is embedded in old-established ideas derived from military emergency planning. As depicted by Dynes, "fundamental assumptions can be understood in terms of the 'triple C's'. The first 'C' points to the assumption that an emergency is characterized by CHAOS and the other two 'C's' suggest that the chaos can only be eliminated by COMMAND and CONTROL" (Dynes, 1994: 142). That is why, in a French context, response to emergencies is greatly influenced by the ORSEC model, which also derives from military institutions. An implicit statement in the dominant military-based crisis management model is the necessity for extraordinary efforts to maintain social control for everyone's sake. Among several representational consequences regarding crisis operational management, great attention is paid to anticipating and mitigating antisocial behavior. Following martial law traditions, there is "a reluctance to trust conventional means of communication in an emergency. It is agreed that people cannot be trusted to obtain 'correct' information and this effort is needed to produce and distribute 'official' information" (ibid.: 147). As a consequence, the hierarchical relationship between headquarters and the local level is assumed to be directive, and even intrusive, becoming all the more rigid when dire consequences are at stake in the crisis they are supposed to handle together (Geoffroy, 2019).

To expand on crisis management structure, the Incident Command System (ICS) is the main crisis organization system to have been documented and assessed (Chang, 2017; Jensen & Waugh, 2014). It is organized and scaled around several levels of teams that contribute to organizational bounce-back. This raises several interesting questions regarding the balance between command and control, the distribution of tasks and accountability, and the equilibrium between standardized and customized procedures at all levels. ICS studies follow HROs' first concerns regarding inefficient bureaucracy under emergency conditions. What is more, the

ICS is "a particular approach to assembly and control of the highly reliable temporary organizations employed by many public safety professionals to manage diverse resources at emergency scenes" (Bigley & Roberts, 2001: 1281). So, this organizational form might be likely to "capitalize on the control and efficiency benefits of bureaucracy while avoiding or overcoming its tendencies toward inertia" (ibid.). ICS organization usually has fewer levels and departments than a traditional large structure like a state agency or a big corporation. ICS organizations are inspired by the army command and are highly formalized in terms of responsibilities, duties, and managers' range of control. They are also scalable depending on the event characteristics and size (Chang, 2017). To sum up, the ICS is a standardized, on-scene, all-hazards incident management approach. ICS is also criticized for being too rigid a structure to adapt to multiple situations while networking systems are required to handle large-scale disasters (Dynes, 2000; Quarantelli, 2002). Indeed, "in crisis, adaptive organizational responses require the ability to quickly transform organizational structures and decentralize, rather than relying on hierarchy and centralized autonomy" (Grabowski & Roberts, 2019: 515).

In a French context, Benamrane (2015) describes four levels for crisis line management and local and national contributions to operations. There are the Command of Emergency Operations, the Relief Operations Direction, the Departmental Operations Center that can be reinforced at Prefecture level and, at national level, the Interministerial Crisis Management Operational Centre. The Command of Emergency Operations deals with the real implications of the event by providing the operational response to a crisis. It answers to the Relief Operations Direction with the local mayor at its head but, if the crisis turns out to be of a major amplitude, the Departmental Operations Center takes the lead. The Departmental Operations Center is the main relay of communication and transmission of information from the field to the zonal and national levels. This level is also responsible for coordinating and disseminating information to the public and the media (but public relations matters will not be developed further in this paper). The Interministerial Crisis Management Operational Centre is both a permanent watchdog and the heart of the monitoring and management of emergency and national-level emergency situations. It has the specificity of being in a pivotal position between the operational and political management dimensions, supporting managers in the field by providing coordination and updating the senior government authorities on the way the crisis is developing (Benamrane, 2015). To date, this crisis management level typology is one of the closest studies to what is here termed multi-layered operational crisis management.

Finally, a case study of headquarters' contribution to crisis resolution was developed by Godé et al. (2019) in a comparable professional culture. This fundamental article analyzes decision-making processes in an Information and Command Centre (CIC), an operational center of the French National Police at the department level. The CIC's main mission is emergency management, 24 hours a day, by receiving and processing calls from victims and witnesses of crime, then organizing and coordinating the interventions of field crews. "In this context, police officers are confronted with problems of extremely variable nature and intensity: noise pollution, theft of mobile phones, domestic violence, assault or shootings. Faced with these unstructured problems requiring rapid reaction, they must build meaning in order to assess the urgency of the situation and take appropriate decisions. The unexpected is multifarious and the public safety issues associated with each decision are high" (Godé et al., 2019: 68). Their study examines how data is handled and assembled by police decision-makers in situations corresponding to the concerns of Shattuck and Miller (2006) on natural decision-making models. However, by analyzing CIC management as a daily activity in the face of multiple incidents in a Big Data environment, there is little in the way of development towards resilience because fighting crime remains business as usual in this context.

To put it in a nutshell, what should be noted regarding crisis line management is mainly its modular aspect. Crisis management is intended to address a multi-dimensional event disrupting a general situation. Its purpose is to coordinate a set of specialized processes that form modules and that are dynamic. These modules may be subject to interference from any source or they may be embedded in different time scales, they may be interchanged, may oscillate, and so on. In this unstable context, crisis management is meant to mitigate irreversibleness through robust and mostly standardized data translation procedures (Roubelat & Marchais-Roubelat, 2011), to create situation awareness, to make appropriate decisions, and to combine these modules in specific ways when it comes to implementing action. However, team dynamics partially escape such diagnosis.

**Team resilience in the face of a crisis**

As highlighted by Berger-Sabbatel & Journé, if "risk communication is reduced to formal information transfer to a limited audience, between those who design crisis response plans […] and those who implement them", teamwork and cognitive considerations are generally underestimated (Berger-Sabbatel & Journé, 2018: 33). So, according to Weick and Sutcliffe, "if you want to generate action that is more reliable, resilient, and mindful, then you need to make the five principles involving [preoccupation with] failure, [resistance to] simplification, [sensitivity to] operation, [commitment to] resilience, and [deference to] expertise a higher

priority" (Weick & Sutcliffe, 2007: 139). Scholars analyzing the actions of operational teams in the face of unexpected events, disruptive situations, or even crises have first examined communication, particularly to explain failures and major accidents. In order to develop organizational response to such events, resilience concepts have been borrowed by engineering sciences from physics (material resilience) and psychology (individual resilience) to deepen defense-in-depth principles in a dynamic, complex, and multi-stakeholder environment (Geoffroy, 2019).

Originally, system resilience was defined as "the intrinsic ability of a system to adjust its functioning prior to, during, or following changes and disturbances, so that it can sustain required operations under both expected and unexpected conditions" (Hollnagel & Fujita, 2013: 13). As a system asset that implies control with a combination of open and closed loops, resilience requires four capacities (Pariès, 2017). There is first the capacity to react in real time; the capacity to monitor, that is, "to know 'what to watch' to detect potential threats, monitor its own internal state, the state of its processes, and its environment, in order to maintain the necessary regulations to fluctuations, and to detect destabilizations that require a change of functioning mode" (ibid.: 50); the capacity to anticipate and predict threats or opportunities; and the capacity to learn from all kinds of strategic experience. Current works on organizational resilience conceptualize it as a framework connecting capacities at all management and stakeholder levels so that "effective crisis management is strengthening and utilizing these capacities" (Dückers, 2017: 182).

As highlighted by Raetze et al. (2021), it is still largely unclear how organizational resilience functions at different levels of analysis in organizations and how these various levels interact, particularly with respect to team resilience. A team can be defined as a basic organizational unit composing a firm. In multi-level contexts, teams generally conduct their work over distance using a combination of telecommunications and information technologies to accomplish an organizational task, like a virtual organization in an ephemeral context (Grabowski & Roberts, 2019). Now, team resilience capacity, such as its capacity to bounce back from adversities or setbacks, is increasingly valuable in today's complex business environment (Brykman & King, 2021).

During a crisis, risk management involves specific tasks, starting with collecting and evaluating information with which to make timely and pertinent decisions as the crisis unfolds. But information analysis necessitates a deep understanding of the system and adaptive leadership. "If decision makers are unversed with the system they are dealing with, information can be misunderstood and needless time can be spent on bringing the decision makers up to speed regarding the matter

being considered. Clearly defined roles with solid leadership is an effective way to reach a timely, correct decision; in addition, many decisions would need to be made in a decentralized mode" (Engemann, 2018: 3).

Team interaction patterns are sets of observable behavior that evolve sequentially and occur at certain time intervals (Hoogeboom & Wilderom, 2020). When decisions are made in a crisis, teams should effectively process and filter "raw" data, apply individual expertise, communicate relevant information, and make recommendations to other team members (Reader, 2017). In this context, team resilience is an emergent state that results from interactions at both individual, team (Hartmann et al., 2020; Bowers, Cannon-Bowers & Lamb, 2017) and organizational levels (Stoverink, Kirkman, Mistry & Rosen, 2020). Team resilience is a "dynamic, psychosocial process that protects a group of individuals from the potential negative effect of stressors they collectively encounter. It is composed of processes whereby team members use their individual and collective resources to positively adapt when experiencing adversity" (Morgan et al., 2013: 552).

Team decision-making involves three types of decisions: operational decisions with short-term effects that can be made under time pressure, uncertainty, and role combination; tactical decisions with moderate effect on business which can be data-based, rely on options, and broaden debate; and strategic decisions (Reader, 2017) that are made by operational management teams when facing a crisis. Key findings in psychology reveal numerous determinants of effective decision-making such as identity, relationships, and stress (Brown, 2000). It can also be noted that team positivity, team satisfaction, and coordination all influence team outcomes depending on team members' experience with one another. Team members with some experience together develop cohesion primarily because past challenges make them confident, rather than just optimistic, that they are capable of dealing with setbacks and bouncing back (West, Patera & Carsten, 2009). Moreover, teams also make decisions using a similarity-based criterion and such heuristics can allow adaptive responses that can be both grounded in the managerial context and more easily switched with training (Artinger et al., 2015).

Research on team resilience (Morgan et al., 2013) is ongoing with systematic efforts to investigate and understand the construct (Hollnagel et al., 2019). In this context, senior management plays an active role during a crisis in animating and guiding organizational interpretation between strategic and front-line levels. More specifically, this unit tends to "surface conflicting rumors and elicit exposure of information tidbits from multiple sources, facilitate the exchange of explanations of rare events that come from numerous sources, blend amended explanations of rare events received from others in the organization, and synthesize the strategic

evaluations with the operational evaluations of rare events" (Beck & Plowman, 2009: 913).

Finally, one should note new developments in the literature on team situation mindfulness. Team situation mindfulness underpins effective decision-making as gathering and sharing accurate interpretations of a situation is a necessary stage in crisis resolution. But, "arguably, research has not fully demonstrated the mechanisms that mediate the relationship between team cognition […] and team decision making" (Reader, 2017: 284). So the concept of Team Situation Model (TSM) as "a shared understanding of the current situation developed by team members' moment by moment, and its impact on team effectiveness" (van der Haar et al., 2015: 50) could be a lead. In this sense, this paper analyzes the relationship between central and local operational crisis management teams, which might add focus on how "teams process information in order to create a shared understanding of a dynamic situation and make decisions in response to it" (Uitdewilligen & Waller, 2018: 732).

## Method

### Crisis management context

We address our research question by way of a single qualitative case study. Inductive qualitative research is particularly appropriate for developing theory on processes. As Geiger et al. (2020) illustrated, stimulating findings can be obtained when analyzing a single organization that relies heavily on routines and safety-designed resources in its execution of tasks and for which time plays a critical role in resolving a crisis. To extend knowledge of headquarters level's contribution to operations, we sampled a central crisis management team in charge of nuclear operations called the Headquarters Crisis Management Team (H-CMT) facing a virtual natural hazard with major consequences in a Crew Resource Management (CRM) program (Tena-Chollet et al., 2017).

Two major categories of accidents can be distinguished. The first category is the "classic" accident. It is a familiar event and its effects are of a magnitude that can be handled through the organization's resources, plans, and procedures. The second category is the "major" accident, the effects of which—like those of major risks—extend beyond the usual scales of manageability in terms of stakes, consequences, and organizational capacity to cope with them using existing procedures. This research focuses on the second category, on what some commentators call an extreme event. This type of event "may exceed the organization's capacity to prevent [accidents] and result in an extensive and intolerable magnitude of physical, psychological, or material consequences to organization members" (Hannah, Uhl-Bien, Avolio & Cavarretta, 2009: 897). It

generally follows a sequence narrative composed of phases of pre-crisis, emergency planning, crisis (or event, incident), crisis management, inquiry, and change (Hällgren, Rouleau & De Rond, 2018).

Crisis drills are conducted to "pinpoint vulnerabilities, dependencies within the organization and improve adaptation to the disruption. These exercises test the effectiveness of the teams, the adequacy of the given roles for the probable events and the operational responses" (Geoffroy, 2019: 54). They are primarily designed to strengthen coordination in order to provide a better chance of achieving resilience. Drills are particularly relevant for documenting managerial work rather than actors' conflicts and tend to assess performance on the use of procedures, risk management, decision-making, situation awareness, teamwork, and general coordination. As a scenario-based major nuclear crisis drill is observed here, the definition of performance includes both effectiveness and organizational design for handling various types of uncertainty. To perform resilience by activating system abilities to adapt to or follow major changes (Hollnagel & Fujita, 2013), teams are expected to detect and alert, mobilize and staff up, aid, protect and secure, understand and control the situation, inform, cooperate, and communicate, and prepare post-event management (Kim, 2015).

**Access and data collection**

This investigation was launched due to previous observations by the researcher, who was also a member of the Headquarters Health, Safety, and Environment department. The research protocol used in this contribution was designed after a mission to support this department's crisis management team (Njå & Rake, 2008). Before the case study presented in this contribution, the researcher helped this team to set up and run a first crisis management drill of major scope. Going into the wild to address multi-actor in-action team reflexivity in tightly coupled systems facing extreme events (Maynard et al., 2018), the researcher was located in a separate room and followed live audio-visual feed from the 24/7 headquarters senior management unit (H-CMT) control room. The researcher was considered as a back-up resource for the crisis drill organizing committee which was orchestrating this CRM training for the entire enterprise. In the course of that first drill—that became exploratory research de facto—, certain events regarding the use of communications between headquarters and local crisis management teams aroused curiosity, which nurtured the present investigation. In order to better document how H-CMT as an operational tier runs crisis management, particularly with respect to its relationship with operational managers in the field (L-CMT) with team antecedents, the researcher took the opportunity to attend a second drill set up a year later with a defined research protocol.

This 36-hour exercise, held at another plant of similar size, was observed with more systematic data collection and a sequencing approach. The methodological concern was to show the process aspect of performativity to tackle the most up-to-date challenges organizations face (Cabantous & Sergi, 2018). As concerns the drill observed here, the crisis scenario involved slow kinetics to create both immediate and deferred dangers at multiple points of the nuclear plant. This type of drill was particularly interesting because its scenario could be considered as disruptive in terms of social representations of crisis handling as there were no sharp distinctions between the pre-emergency period and the rest of the exercise (Dynes, 1994) and because it emphasized the contribution of coordination and managerial skills to resilience to achieve an accurate and shared Team Situation Model (TSM) (van der Haar, Segers, Jehn, & Van den Bossche, 2015).

During this observation, the researcher enjoyed the same accesses to drill design, execution, and assessment resources, including the hour-by-hour technical scenario, post-crisis interviews, inspectorate comments, internal letters, procedures, and reports. Among all these data, the documents that were most used in this investigation were the crisis drill preparation meeting reports, the CEO's crisis drill framing letter, the crisis drill framing note, the crisis management principles and organization within the firm's procedures, the headquarters crisis management team (H-CMT) organization and resources procedure, H-CMT event planning (38 events in total) within this 36-hour crisis drill, and other debriefings from the embedded researcher's department.

In addition to this instructive material—but that might lack process perspective in the drafting —the researcher recorded all communication calls from H-CMT live, to complete her process-oriented personal notes (42 pages of observations). These 39 recordings were made between 9:58 am on day 1 and 4:29 pm on day 2, lasting from 00:43 seconds to 44:45 minutes. As stressed by Maynard & Gilson (2014), this material was particularly valuable as "regardless of how communication occurs (whether face-to-face or via information communication technology - ICT), team tasks are performed by individuals who need to have a common understanding regarding the requirements of the task and how their work will be coordinated" (ibid.: 4).

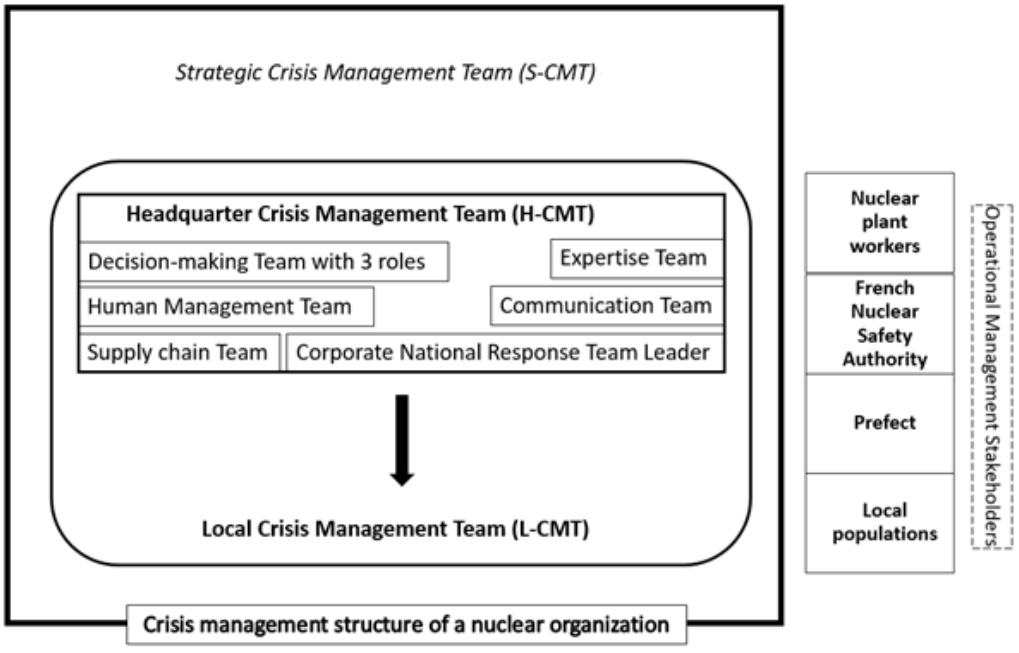
**Data coding**

This study aims to understand how the headquarters crisis management team (H-CMT) contributes to resilience in its coordination with the local level. This analysis focuses on the technical content and the changes in the relationship between H-CMT and L-CMT during the different phases of the crisis. To fulfill the objective of describing "team performance during a specific task and also throughout a team's

lifecycle" (Reader, 2017: 279), decision-making was considered as an output. Consequently, two types of decisions were emphasized: operational decisions with short-term effects that can be made under time pressure, uncertainty, and role combination; and tactical decisions with moderate effect on business, which may be data-based, rely on options, and broaden debate. Attention was also paid to the way action is carried out by people, artefacts, and other entities in a sequence of coordinated actions.

As explained by Langley, "process data collected in real organizational contexts have several characteristics that make them difficult to analyze and manipulate. First, they deal mainly with sequences of 'events': conceptual entities that researchers are less familiar with. Second, they often involve multiple levels and units of analysis whose boundaries are ambiguous. Third, their temporal embeddedness often varies in terms of precision, duration, and relevance. Finally, despite the primary focus on events, process data tend to be eclectic, drawing on phenomena such as changing relationships, thoughts, feelings, and interpretations" (Langley, 1999: 692). These challenging issues constitute dimensions that sensemaking strategies—derived from Weick's (1990) influence in the field—can document to a greater or lesser extent. With highly accurate and fact-based strategies, simplicity and generalization are known to be harder to obtain (ibid.).

*Figure 1. Central crisis management's counterparts and stakeholders*



As the literature review of the Incident Command System (ICS) argued for real-time data to improve our understanding of their key challenges, this study contains scarce cues or details regarding feelings but quite strong ones about the sequence of events, imbrications of multiple levels, time measurements, and regular actors' feedback due to its grounded theory articulation (Gioia, Corley & Hamilton, 2012). The material was coded using four criteria. First, the communication situation was analyzed, targeting technical context issues and relationships among the protagonists around the Headquarters Crisis Management Team entity listed in Table 1. Media pressure or Prime Minister's Crisis Cell pressure is handled not by operations-based H-CMT but by Strategic Crisis Management instead.

Second, communication was investigated and notably the way it was defined among actors and the terms and conditions on which it took place. Third, a detailed understanding was gained of the institutional relationships between communication stakeholders, analyzing the official subject matter of communications but also the interplay of putative responsibilities, arguments, and the main crisis management procedures for mobilizing operational teams. Fourth, observations were made of the effectiveness of actions over time and the way operational teams dealt with the unknown, uncertainty, and their own resources as there were three shifts involved in dealing with the simulated crisis. Effectiveness was assessed according to the success of a specific operation, the contribution of this specific operation to resilience by its capacity to resolve, partially or fully, one of the issues identified by crisis management teams, its compliance with schedule (relationship to delay), and irreversibility avoidance. As in Van der Harr et al.'s (2015) Team Situation Model (TSM), the quality of actions, the attainment of goals, and the occurrence of errors were all observed.

Data were coded using a two-step coding scheme (Gioia, Corley & Hamilton, 2012). Following the example of Geiger et al. (2020), a case narrative was written around the technical scenario and the full observation of crisis management. Then, many details were documented to provide a rich description of the entire crisis process. Plotting clock and event times was also important to contextualize each H-CMT conversation and the emergence of each TSM. Coding focused the analysis on the temporal boundaries that were enacted at the turning points of crisis management phases. The coding was structured and alternative explanations of the data were provided to improve the quality of theorizing. Some second-order themes were aggregated, leading to the results.

*Table 1. Specimen coding scheme*

| Data examples | First-order codes | Second-order codes | Aggregate dimension |
|---|---|---|---|
| "As an event occurred for 2 hours during a transfer operation, the internal emergency plan was activated preventively. That's what I know for now." (H-CMT Leader to his team)<br>"I ask you all to wear your armbands" (ibid.)<br>"Please identify yourself and, as a reminder, we will go around the table so that everyone identifies themselves and specifies what their role is" (ibid.) | Explaining H-CMT gathering to its members<br><br>Setting up H-CMT functioning<br><br>Role definition and scope clarification | Setting up H-CMT according to crisis management procedures<br>1. Crisis management principles and organization within the firm procedure<br>2. Headquarters crisis management team (H-CMT) organization and resources procedure | Crisis management routine performance |
| "Exercise, exercise, H-CMT, we take stock with you about the situation?" (L-CMT Leader)<br>"Yes, exercise, exercise, here H-CMT. We let you take stock and we will ask you the questions afterwards. Thank you" (H-CMT Leader)<br>"OK. So we are between Pool X and Pool Y (pool identification anonymized). We have a pool transfer, etc. [*L-CMT description of the current transfer difficulty*]. | Specify that this conversation is part of a crisis drill to avoid any panic<br>Establish communication between the two operational crisis management teams<br>Knowledge sharing about the current situation | Setting up H-CMT and L-CMT dialogue according to crisis management procedure | |

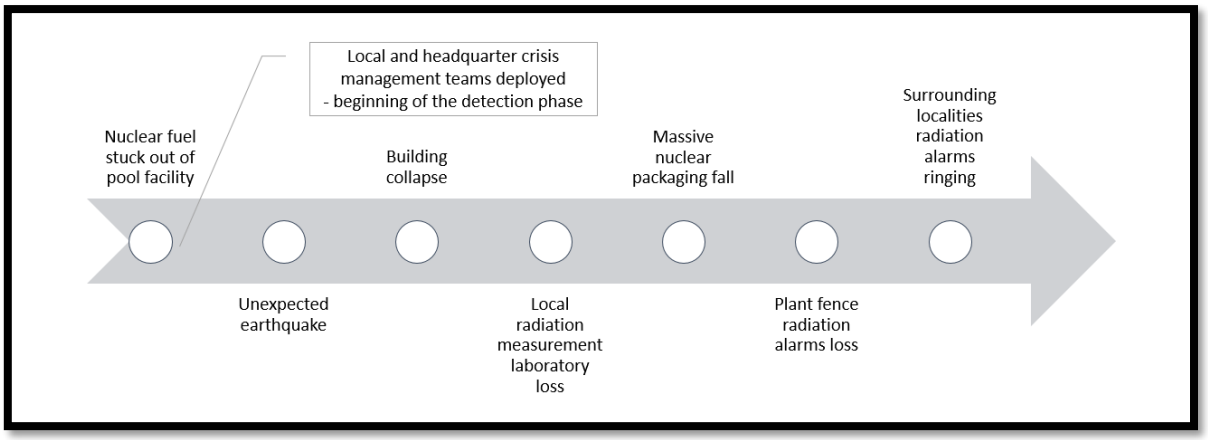
As can be imagined, nuclear crisis management drills are particularly complex, so getting a good overview of the process can be challenging. In order to balance our coding results to strengthen a little our data interpretation on multi-level coordination issues, a word frequency search was also made on central and local communications with NVIVO 12 to double-check what was really important for the actors and avoid research-biased interpretations that might lead researchers to see only what they might unconsciously want to see.

## Results

The aim of this crisis management drill involving more than two hundred people at several locations was to demonstrate the robustness of the operator's approach to safety with respect to exceptional aspects: cumulated losses, extreme events,

and total losses regarding critical equipment, in line with feedback from Fukushima (Gac & Sidaner, 2012). This case involved a plant accident compounded by a natural hazard—an earthquake—, leading to protracted radiation emissions. As specified by the firm's CEO, the simulated event was planned to affect several facilities in a fuel-recycling plant. In total, 350 crisis team members were involved, 50 people managed crisis drill animation, and 58 people represented the Corporate National Response Team (CNRT) to intervene in the fuel-recycling plant. It required the development of robust physical and organizational arrangements to prevent accidents, mitigate consequences, and enable crisis management operational performance; and the use of an intervention force—which is a sort of fire brigade specialized in nuclear and radiation protection issues. In this particular case, after some concerns about radiation containment due to multiple failures at a storage pool facility, a powerful earthquake triggered uncertainties about the plant's overall condition. Therefore, H-CMT had to activate an internal emergency plan to map all facility casualties and malfunctions caused by the earthquake.

*Figure 2. Crisis drill technical scenario*




To sum up the technical scenario of the drill, a first event occurred in the first recycling facility, with nuclear fuel locked out of the pool, leading to a risk of overheating and the spread of radiation. Then, an earthquake not only worsened the pool facility event but also caused a building to collapse, creating potential radiation leaks and impeding access to the radiation measurement laboratory. In addition to that, massive nuclear packaging fell, killing and injuring staff, and creating uncertainties as to containment integrity in the old nuclear fuel recycling factory building. Finally, while plant fence alarms were out-of-order because of the earthquake, radiation alarms well outside the plant perimeter were sounding in localities to the north and east, creating further doubts about radiation contamination spreading outside the plant, threatening neighboring communities.

## Facing uncertainty together: interactions of central and local operational teams

In this sub-section, we focus on a time- and phase-based action analysis, starting with the pre-event situation, followed by the detection phase and team decision-making.

Pre-event phase and H-CMT formation

On day 1 at 7:35 am, a motor failure and mechanical breakdown occurred during the transfer of nine uranium-enriched rods in a pool building in a nuclear fuel recycling plant (pools are used to cool uranium-enriched rods before recycling). In the nuclear operator's headquarters, the first senior management crisis team (H-CMT) members gathered within the hour in their crisis cell to handle the event.

H-CMT was composed of a Decision-Making Team (three main roles), a Human Management Team, an Expertise Team (Safety and Environment, Security and Protection, Law, Risk and Insurance), a Communication Team (coordination of Public Relations), a Supply Chain Team mainly managing the shared electronic register, and a CNRT Leader (see Figure 1. Central crisis management's counterparts and stakeholders). H-CMT was mostly composed of French men aged 45–63 years most of whom had participated in the first equivalent drill. During the crisis management drill, the tone of communications was reasonably calm and formal; all communications started with the announcement "exercise, exercise" to avoid any confusion with a real event. The Decision-Making Team comprised three members who were responsible for making decisions essential to managing the event. The H-CMT Leader was the director of the affected Business Group and organized responsibilities and tasks on the team. The H-CMT On-call Officer assisted the H-CMT Leader with his missions. This role ensures continuity during crisis management operations. Last, the Operational Deputy made his operational knowledge available to facilitate the understanding of events. In research on knowledge-intensive teams, "many scholars have found that accurate recognition of expert members can increase team performance [as their influence] improves decision quality and enhances the performance of intellective tasks" (Hong et al., 2019: 746). As H-CMT was located at the firm's headquarters, this Operational Deputy was an ex-plant director who was also Health Safety and Environment (HSE) director at that time.

At 8:58 am, the H-CMT Leader presented the current crisis context with the pool facility event, the main crisis management procedures, and the role of each team member around the table. In the meantime, the Operational Deputy very quickly found the internal emergency plan of the impacted nuclear plant and the main risks associated with a fuel transfer failure in the pool facility. These risks were,

namely, air tightness and external radiological contamination, and a rise in temperature of the radioactive filters. After the central crisis management team's first (4-minute long) internal meeting ended, the H-CMT Leader reported to the CEO's Strategic Management Team. Then, central and local crisis management teams set up a conference call at 9:13 am to assess the situation and to share information and knowledge. For example, the Operational Deputy's questions to the local senior management crisis team (L-CMT) Leader were particularly helpful for understanding the situation and its technical difficulties.

> OD: Have you considered drowning the pool to submerge and cool the uranium fuel bars stuck in the basket, despite the system breakdown?
>
> L-CMT Leader: No. No. We are at the very top of the basin. The tray is stuck at the highest point of the rotation between the pool and the NPH (that is to say, the load point).

Then, the H-CMT Leader insisted on the necessity of reporting in the shared electronic register, and set the next call time. During this meeting, the local team proposed two historically-inspired plans to get out of this dangerous situation using sprinkler devices and ventilation systems to cool the rods. The H-CMT Leader agreed to test these solutions in accordance with heating issues but enjoined them not to take unnecessary risks as an error could cause the building to dislocate and contamination to spread (the opposite of the defense-in-depth goal which is to contain danger inside the plant's walls). As the reliability literature has shown, this organization decision-making approach based on similarity heuristics is considered to be one of the most efficient ways to deal with complex environments characterized by time pressure and irreversibility (Le Bris et al., 2019; Artinger et al., 2015). Also, the local crisis management team (L-CMT) Leader invited the H-CMT Leader to his first conference with the French Nuclear Safety Authority. Finally, the Operational Deputy checked a number of technical elements to make sure of his technical understanding of fuel oil storage, heat and ventilation, to validate the part of the pool facility concerned by the local team's intervention plan and, finally, exclude the equipment sabotage hypothesis to get ahead of time (Geiger et al., 2020).

After this conference call, the Operational Deputy explained to all H-CMT members the issues of the event with technical drawings to ensure a shared understanding of the situation. At 9:43 am, a second conference call between H-CMT and L-CMT went back over the technical points explained before, the relations with the French Nuclear Safety Authority and, as stressed by the Operational Deputy, the preparation of a positioning on the environmental issues raised by the accident. A few moments later, the Prefect decided to launch his ORSEC-based local intervention plan. As a consequence, H-CMT experts and the CNRT were asked to assess the situation while incorporating all new elements they could gather into

the shared electronic register compiled by secretarial staff from local, national, and strategic levels.

Detecting and anticipating together

At 10:30 am, a major twist occurred. The Prime Minister's private secretary called H-CMT to warn them that an earthquake had been recorded in the area of the nuclear plant. At that stage, this information needed to be confirmed by the L-CMT.

To avoid disturbing the L-CMT if this crucial information turned out to be accurate and liable to change the crisis consequences, the H-CMT Leader delegated to his Operational Deputy responsibility for contacting the local network wisely, making recommendations on timing and duration. Concomitantly, the central crisis management team (H-CMT) communications cell began dealing with an increasing number of calls about the earthquake: politicians, firm members, journalists, retired nuclear experts, and customers regarding safety, plant exploitation, timelines, compensation, contract cancellation, and so on. Little by little, local crisis management team counterparts were addressing feedback to their H-CMT's contacts on the Decision-Making Team, Expertise Team, Human Management Team, Communication Team, Supply Chain Team, and to the CNRT Leader.

In order to prepare the next meeting with L-CMT, the H-CMT Leader went around the table with all his crisis management crew to gather information:

> Health expert: Mr. X has life-threatening injuries. He has suffered external and internal contamination due to a massive nuclear packaging fall. His ankle and his head have been injured. There are also 2 cases of serious injury from supplier enterprise Y. They also have been internally and externally contaminated. A third man is to be checked. For the moment, it is unknown whether the families have been notified. Apparently not yet.
>
> Operational Deputy: Our calculation on radiation leakage reaches 0.13 millisievert (mSv) maximum. We are still evaluating the plume with a wind direction towards the Channel Islands. We also have good news regarding the rods heat peak in the pool facility as it has been revised from 6 hours 35 minutes to 8 hours. […]
>
> Legal expert: Several issues are at stake but it is still fuzzy. We just got in touch with supplier enterprise Y regarding employer liability.
>
> CNRT Leader: The Corporate National Response Team is currently focusing on Z facility but wonders about the resources to engage to intervene in zone H.
>
> Operational Deputy: Due to the earthquake, it is also necessary to plan clarifying the current situation on 2 to 5 kilometers around the nuclear plant. Regarding the first event for which we convened, technicians considered a 50-minute delay to fix the pool facility basket system. It should be completed by 3:35 pm […]

At 11:45 am, L-CMT communicated with H-CMT about operators' losses and technical scenarios for the pool building situation, taking into account the time pressure reassessment mentioned by the Operational Deputy. Moreover, as it was calculated that two out of three facilities could withstand the magnitude of the earthquake, several zones could then be considered out-of-danger. The H-CMT Leader communicated a warning from the Strategic Management Team about shifts in wind direction that could exacerbate the spread of radiation contamination (plume) outside the plant perimeter and require a lockdown of the local population. During this crisis management team meeting, a second shift was also planned between 04:00 and 05:00 pm with the Human Management Team.

During the conference call between H-CMT and the external authorities, the local Prefect had little damage to report but emotions in the area were running high. At that stage, some technical information remained blurred. A number of Strategic Crisis Management Team (S-CMT) PR strategy mistakes pressurized H-CMT's work to limit stakeholders' interference with local teams during the technically critical hours. As the Strategic Crisis Management Team (S-CMT) were gathering with the Prime Minister's crisis management cell, the H-CMT Leader addressed the following injunctions to his team: "In 15 minutes, we have requests that will fall on us due to this meeting. Knowing that our meeting with the French Nuclear Safety Authority is at 12:30 pm and that, officially, I need to go back to the S-CMT at 12:45 pm... So, at 11:55 am, we have to meet with L-CMT... It also means that I will go around the table at 11:50 am. From 11:50 am, I ask everyone [from H-CMT], as far as you are concerned, to tell me whether or not you are sure of the accuracy of your information. Thank you."

At noon, H-CMT Decision-Making Team members worked with the French Nuclear Safety Authority and the Prefect on the extent of the lockdown of the local population and the INES classification. These negotiations involved striking a balance between real and potential risks, fear and panic, and logistical support to sustain such radical measures while plant workers had been blocked at assembly points since the beginning of the day.

At 2:20 pm, radiation contamination alarms in eastern localities started ringing. One of the injured workers was in a critical condition but at 3:30 pm, the technical situation began to stabilize. So H-CMT and L-CMT communication and action synergy was improving:

> L-CMT Leader: "Now we are in a safe and stable situation on the old factory site [The plant includes several factories from different periods], for building X, it's the same. We are in a stable situation. No particular increase in nuclear risk but dosimetry remains high. So here we are waiting for the GIE intra [robotic intervention on accidents] intervention. On stripping, at the spectrum level, […] it's a situation that is significant. We detect an

integration per hour at 2.7 mSv at the East fence. A priori, we don't know how to reestablish the confinement of the activity by ourselves. We need electricity to have light. So, the Corporate National Response Team is asked to help us restore electrical power [Note: L-CMT is not commanding this intervention force—it is an H-CMT decision]. That's the situation."

H-CMT Leader: "All right. Did you redeploy the measuring truck eastward?"

L-CMT Leader: "Yes, we deployed 2 trailers. We have a fixed panel that is in the middle of the plume and we have a constant, regular flow of data. So we can see that there is no change in the discharge levels. They are stable."

H-CMT Leader: "Yes, except that we have a continuous radiation flow but that does not decrease. That's the big surprise... so that's the first point. The 2nd point I had on my list is that we will have to start making our statement to the French Nuclear Safety Authority, assessing this accident on the INES scale. I say 'prepare it', because we do not know how much radiation will be emitted in total, so we will have to see this matter together soon. [Note: huge pressure from external stakeholders on the operational crisis management process; H-CMT intend to cooperate with L-CMT on this report writing] Regarding employees' food and lockdown, can you confirm that all employees remained confined or have you evacuated those who were downwind [i.e., under the radiation plume]?"

L-CMT Leader: "Those who were downwind were brought from the evacuation muster stations under the plume to safe locations, under the protection of the radiation protection team."

H-CMT Leader: "OK, so now they could almost go to eat at the company restaurant X with the others."

L-CMT Leader: "No. We can do that but we have considered that we were not going to do things differently between the inside of the plant and the outside world. So, we were rather going to bring meals because the restaurant it is very close to the plume and the East fence of the plant. The restaurant is closed because outside the fence, we are already encroaching on the Prefect's domain [so we want to comply with his doctrine]. We bring meals to the staff and limit movements."

H-CMT Leader: "OK so how many people do you have left confined who cannot be evacuated?"

L-CMT Leader: "We will have to look at it. OK, I'll handle this matter. But in the area of the plume, we have no one else left?"

H-CMT Leader: "All right! That was my question mostly. I fill "plume = nobody anymore" [in the shared crisis management software tool]."

L-CMT Leader: "But, overall, the evacuation gathering on the plant should be checked."

H-CMT Leader: "OK, so we'll have to see eventually. You should put it in the shared crisis management software tool to ensure this question is followed-up."

An H-CMT Safety expert: "Sorry H-CMT leader! L-CMT leader, can you confirm that the 2 restaurants were not in the plume? [Note: cooperation and flexibility go beyond

> headquarters and local levels. Even though they are part of a military-based hierarchy, their team members are empowered.]"
>
> L-CMT Leader: "Yes, yes, they weren't in it."
>
> Operational Deputy: L-CMT Leader, I planned that before 4 pm, we would have the first elements on the possible contamination of the food chain outside, to know if we confirm or not the restrictions on this or that type of food. Do you have an idea on this issue?
>
> L-CMT Leader: "For me, there is no reason not to have them on time. I'll take the matter up [with my crew]."
>
> H-CMT Leader: "With a particular focus on everything that is running water please. It is basically water that we would like to avoid being restricted. If the Prefect pushes on this issue [Note: huge weight of external stakeholders on operational crisis management process], we can ask him to wait a quarter of an hour to decide. So it's true that the sooner we know, the better off we will be… [Note: injunction made to L-CMT].

Finally, both operational crisis teams were waiting for a measurement body to assess radiation contamination and the risk situation, building by building. Supply chain and practical aspects concerning the plant workers' well-being (food, water) were planned before the next shift change. Finally, a general conference call was made with L-CMT, the French Nuclear Safety Authority, and the Prefect to present crisis-resolution scenarios.

For the H-CMT's second shift, the Decision-Making Team was replaced. This second team abided by the previous shift's decisions about local and CNRT patrols, measurement calculations, and the development of plausible exposure estimations. As night time might quickly limit field action, this H-CMT engaged tactical actions concerning external authorities' stakeholders. For example, they looked for technical points relating to containment to assess the French Nuclear Safety Authority's INES classification or for radiation exposure measurements of water and food supplies (e.g. salads, grass for livestock, and so on) to provide guidance for the Prefect's population lockdown arrangements. But with night coming, PR issues became less prominent, leaving more scope for operations management, technical measures, and evidence-based expertise.

Decision-making and accountability

Around 7 pm, H-CMT and L-CMT intensified their exchanges to weigh up appropriate priorities regarding technical issues, population lockdown, and the evacuation of plant workers. Around 8:15 pm, a map of the risks and damaged facilities was drawn up by L-CMT and monitoring apparatus was set up to collect data overnight (radiation, liquid pressure, heat, etc.). After that, H-CMT debriefed with the Strategic Management Team at 9:09 pm and paused until approximately 6:30 am.

Day 2 started with the return of the first H-CMT team (third shift from 7:00 am to 2:00 pm). H-CMT members shared information before the 7:46 am conference call with the renewed L-CMT (third shift from Day 1 10:00 pm to Day 2 01:00 pm). This call content is technically quite rich and is summarized below.

Communications experts started with the death of the injured plant worker and the way the Plant Director should express condolences and sympathy to his family. The worker's team and the labor inspectorate body had been notified of this worker's death. A psychological support group was set up at 9:30 pm, in agreement with the Prefect and was ready at work until 4:00 pm on the next day. But, as only 150 workers were still in the nuclear plant to operate and handle the crisis while the others had been evacuated, the major question became to deploy the CNRT resources efficiently, in accordance with their dedicated representative (CNRT leader). The H-CMT Leader asked for the opinion of another radiation protection expert about the consumption of water, food, and supplies by local communities (might they present any risk due to potential radiation leaks outside the impacted plant?). After several model simulations to confirm the first simulations made before 4 pm on Day 1, it was confirmed that water was still drinkable without harm in the plant surroundings. As there had been wind but no rain during the crisis time, vegetables could still be eaten if properly washed. Lastly, in order to regain control of leakage from radioactive sources inside the nuclear plant, conclusions from a well-equipped and mobile measurement team were still needed. Risk and insurance experts explained their team strategy to influence the Prefect's decision-making process by sharing a damage and loss file with his team. Following this lead, the H-CMT Leader asked his communications expert to provide support for this strategy to keep control of PR issues (operational, expertise, and PR issues were interwoven with external stakeholders). Simultaneously, security and protection experts focused on the workers' injuries. Finally, the CNRT Leader indicated that his local reports allowed a one-hour intervention on airtight chambers in safe conditions to prevent the risk of radiation contamination spreading, resolving the question of deployment of this resource in the field. The PR expert confirmed that an article about the worker's death while at work had been prepared along with other items to be communicated at a press conference. The H-CMT Leader commented on the urgency of ending the population lockdown to prevent unrest. As the Team Situation Model was now well established, no parallel discussion started between H-CMT members after this point. The headquarters senior management crisis team was now sharing the same picture of the event, its issues and solutions so nobody needed to add any information or to ask further questions before acting.

During the last H-CMT and L-CMT conference, L-CMT analyzed the causes of the worker's death, their team composition and shifts, together with technical issues.

They still needed a number of measurements before any return-to-service in the pool building to prevent secondary accidents. L-CMT proposed H-CMT should also assign this duty to the CNRT once risk-mapping was completed. As this was the second time that L-CMT called on H-CMT to deploy the CNRT, it is now interesting to stress that even the H-CMT prerogative order concerning CNRT deployment is very clear in crisis management procedures; this kind of order is rarely given without consulting L-CMT. L-CMT proposed different strategies for mapping risks accordingly, preparing efficient interventions and avoiding food and supply restrictions. The H-CMT Leader commented on the L-CMT models of proof regarding the question of containment in order to prevent a PR crisis with the French Nuclear Safety Authorities and the Prefect.

Thanks to this debriefing, H-CMT could provide feedback to the authorities on what was being done operationally to get back to normal (resilience), on current measurements, on de-escalating the lockdown of the population and the consumption of supplies. That is why H-CMT paid more attention to the social and material aspects of the crisis (workers' compensation, client policy making), delegating most of execution command to L-CMT until the drill ended. The tasks delegated included mobile measurement team management from 9:30 am to noon, risk-mapping, and CNRT interventions starting at 12:33 pm, and mitigating and cleaning actions by plant workers' and radiation-protection robots in the early afternoon.

Finally, the last conference call between the central and crisis management teams was made at 01:42 pm. Here it can be observed that crisis management teams were reaching organizational resilience, bouncing back to a nearly normal industrial state. Thus H-CMT's work finished at 2:00 pm while L-CMT remained mobilized until 5:00 pm. In the end, the situation was definitively stabilized, no loss or injury was observed among the crisis operations teams, and a date was scheduled for bringing the installations back into service. So, at its own level, the H-CMT efficiently contributed to organizational resilience.

**Discussion**

There are currently calls for more research on "the empirical specificity regarding how adaptation occurs" (Uitdewilligen et al., 2018b: 1123). In this context, observation of the Headquarters Crisis Management Team (H-CMT) reveals that operational crisis management is somewhat different from the dominant crisis management paradigm. Our research overall revealed that multi-layered operational management levels mostly base their action on cooperation with respect to technical issues and the management of relations with external authorities when facing a complex and challenging crisis situation.

## Research implications

One of the key challenges of the research agenda on resilience management is to increase our understanding of responses to crisis management, particularly regarding vertical coordination. Observing headquarters senior management (H-CMT) in action reveals that operational crisis management practices are different from the main theoretical paradigms of crisis management. Not only does H-CMT need to go beyond the vertical coordination of command and control to resolve the crisis but it co-constructs performance by coordinating multi-level organizational skills and even empowers crews.

In team decision-making literature, it is generally admitted that "where the severity of a situation is high, and the experience of a team is low, more directive forms of leadership and decision making are required" (Reader, 2017: 277). This research clearly demonstrates that such an assumption is not valid regarding relations between operational management levels such as in the H-CMT and L-CMT case where dialogue and collaboration prevail. The chaos-command-control paradigm implying a strong hierarchical relationship between operations management layers appears to be of less importance in highly realistic crisis drills. During this crisis, their concern was rather to handle together technical issues and relations with the external authorities. As the earthquake announcement and local confirmation through the Operational Deputy's network showed on Day 1, informal communication could also be a useful managerial tool contributing to organizational performance.

Regarding organizational and team situation model (TSM) emergence, instead of controlling communication to hog its contents and forms (true information production, deviant behavior, and so on), H-CMT's attitude towards action was closer to Reader's definition; "ensuring that teams effectively process and filter 'raw' data, apply individual expertise, communicate relevant information, and (often) make recommendations to other team members [so] team decision making is both a group task [and] an individual task" (Reader, 2017: 278); by using stakeholders' capacities to build resilience. As a consequence, the H-CMT structure is characterized by its modularity (team composition) and, as most of the H-CMT Leader interventions during conference calls with the Local-Crisis Management Team (L-CMT) showed, its ability to monitor operations, confirming that mental representations of decision-makers range from the particular to the general (Guarnelli, Lebraty & Pastorelli, 2016). On the other hand, at first, the H-CMT Operational Deputy and experts' comments were particularly helpful in widening the operational crisis management vision, clarifying the TSM, and anticipating operational mismatches by popularizing technical issues (from approximately 7 am to 2 pm). During a second phase, experts took on more their

functional role to assess decision-making, particularly regarding the relations with the authorities. L-CMT also relied on its own experts, a mobile measurement team and the Corporate National Response Team (CNRT) in the field, that is, numerous resources gathering data and transferring them to national level.

As concerns representations of crisis management phases, it is interesting to note that pre-event phase conception can be distinct depending on a crisis stakeholder's point of view and that this division into phases is not obviously technically-oriented. "Yet while resilience and crisis management form a logical combination, resilience for its part is depoliticized and naturalizing, whereas crisis management can be controversial and politically intense" (Dückers, 2017: 183). In the drill observed, a distortion was observed between technical and public relations perspectives. Technically, there was first a radiation event at the pool facility before the earthquake; which substantially raised the magnitude of the first event (compound accident) and created other disturbances. However, the simulated French Nuclear Safety Authority decided to read the event as an isolated case in order to improve communication with stakeholders and civil society.

Finally, this research contributes to "establish how team cognition mediates the relationship between group process, teamwork, and team decision making" (Reader, 2017: 289). If we look closely at communication types involved between H-CMT and L-CMT, we observe that, even though H-CMT is supposed to be L-CMT's immediate supervisor, the near-absence of orders is striking. An order is a binding oral or written communication, framed in time and space, from an authority holding a recognized power of control over the addressee and that the addressee must obey. In most cases, this authority is responsible for the consequences arising from the order. Obedience is a matter of balance between dependence and independence. As observed, H-CMT is a blind entity that focuses on monitoring instead of dictating to and controlling the local crisis management level. To put it in a nutshell, monitoring is closer to observation and surveillance as a watchdog, preventing the crisis organization from jamming whereas controlling refers more to commanding or regulating. As such, "it is therefore identified with upline supervision of activity processes" (Falco, 2015: 20).

Furthermore, issuing orders during the detection phase hardly seems feasible and could trigger major mistakes. During the H-CMT and L-CMT conference call, L-CMT had considerable autonomy regarding priority setting though being guided or constrained on specific points or criteria by H-CMT (e.g. H-CMT Leader's agreement and conditions at the Day 1, 9:13 am meeting). In this sense, the concept of injunction is a major contribution here as it is a communication triggering action since the addressee should adapt its behavior to the message. Generally, a command, an order, a demand, an injunction or an enjoinder are

considered as synonyms. However, different analysis of injunction as a concept show that there is indeed a difference regarding the expected behavior of the person addressed. First, the response to an injunction is closer to compliance than obedience (Agulhon, 2018). Second, considering that order and injunction are synonymous fails to account for the fact that people can be enjoined without a hierarchical link, as demonstrated in the audit process between an internal nuclear safety inspectorate and local nuclear plants. While it is quite mandatory to follow this inspectorate's advice, or at least to justify why these concerns are note addressed, injunction does not imply a division of operational responsibility per se (Agulhon, 2016). Third, the complexity of liability issues in multinational enterprises leads to interesting situations in this regard. As authority is delegated from Top Management to local managers, those local managers are largely considered accountable by the law when an incident occurs at their plant. This balances out power issues within the overall organization, and explains the information and communication processes observed in this particular case study between headquarters and local management. So, injunction is a communication issued by an authority which is both binding and reliant on its addressee's subjectivity, status and appreciation of the situation since the addressee is linked to the expected action or to its aim in terms of the criterion of responsibility. That is why, one can now conclude that the use of injunctions can be relevant for operations management because of the potential flexibility in terms of application, if the addressee has both competency, resources and a form of authority to handle a specific situation.

**Limitations and future directions**

Regarding these research results compared to the prevailing crisis management paradigm, not much deviant behavior or unusual behavior was observed, caused by stress requiring substantial efforts by the H-CMT group to control local crews or its own members. This might be because of the case selection, which is also a clear limitation of this work. However, it is interesting to note a few comparisons with the 2014 crisis management drill that served as the exploratory phase.

The main H-CMT Leader in the drill observed had been a deputy H-CMT Leader in the 2014 drill, so data reconciliation can partially be made. As far as could be observed, H-CMT members' interactions were more efficient in this second drill. For instance, communication with L-CMT was improved regarding task assignment and role entitlements were clearer in H-CMT members' Situation Model (e.g. regarding CNRT deployment). Moreover, attention to weak signals was improved compared to the first drill. For example, during the exploratory research, after a 9 hour-shift, the H-CMT team was unable to detect a technical item of information released by three different external actors but among hundreds of other inputs.

Such a situation did not occur in the observed drill because of better functional "sensitivity to operations" (Weick & Sutcliffe, 2007), particularly regarding secretarial input classification, the distribution of H-CMT Team experts input, and because of the earlier change of shift.

From these quasi-results that need further confirmation, there does seem to be a close connection between the modelling of the understanding shared by the team and "team transition patterns in transition and reacquisition adaptation" (Uitdewilligen et al., 2018b: 1114) and it similarly appears that stress factor side-effects over time could also be offset by a shared team experience in overcoming a crisis (West, Patera & Carsten, 2009).

Finally, even though effective teamwork and decision-making is highly specific to the problem being resolved and the skills of the actors involved, the documentation of several types of crisis references from multi-layered operational management and external points of view might develop efficient and origin-diversified similarity-based heuristics, which can lead to adaptable management practices at all organizational and civil society levels (Artinger et al., 2014). For instance, Swedish Civil Defense Directors on County Administrative Boards coordinate all relevant actors (national, municipal, private, and voluntary agencies) during extraordinary events to support multi-center County Governors' operational roles and their local operational teams (Wimelius & Engberg, 2015). In this context, what is considered an operational duty to be handled by multi-layered operational management teams can also be customized in line with a country's vison of governance and democracy.

**Practical implications**

In a nutshell, our major inputs are that crisis management in a multi-level organization is characterized by flexibility, which is illustrated by dialogue and cooperation, including on topics for which there is a clear attribution of role entitlement like the Crisis Management Team dialogue phase illustrated. Conversely, headquarters often communicates through injunctions because there is a need for local adaptation due to the fuzziness of operational representations and situational instability and an imperious need to prevent situations from deteriorating irreversibly.

Multi-level management is generally organized through procedures for attributing missions and apportioning accountability. However, those roles might evolve over time, depending on the level of cohesion of multi-level teams. When exchanges are going well, decisions and responsibilities tend to be shared among all the operational actors involved.

Second, inter-team collaboration in which decisions are not ultimately made together might reflect inexperience, distrust, or bias in a high power-distance culture, possibly affecting the organization's overall performance. It is therefore advisable to provide more training and strong external incentives to overcome these obstacles until cooperation becomes the norm.

Third, multi-level management also shields local operational teams from internal and external pressures. That is why, regarding HR issues, headquarters managers should also be trained in PR and develop their meta-knowledge of their organization to perform this task. Finally, during a crisis, experts take on different roles depending on the action phase in progress. At first, their pedagogical skills contribute greatly to the construction of a shared picture of the situation (TSM) for the decision-making team. Then they assess the impacts and side-effects of the team's decisions. It would therefore be necessary to brief them on the nuances that their function may take on over time so as to improve their readiness and join in a fruitful dialogue with stakeholders and society. In our current European context, these practical points seem all the more significant as we are facing a slow kinetic crisis, creating both immediate and deferred dangers at multiple points of the globe. If not handled properly with wise governance, these crises might trigger economic, political, and institutional, instability worldwide in the long run (though things might be more nuanced on the ecological side).

## Conclusion

As observed in strategic management research, "although coordination studies typically hold managers as central to these processes, especially to elaborate and enforce coordination mechanisms, they do not investigate what managers actually do to achieve coordination on a daily basis" (Bouty & Drucker, 2019: 566). That is why this paper contributes to furthering knowledge of managerial work, especially of coordination aspects by tracking the H-CMT situation and action minute by minute. Based on the results generated by this work, it is found that multi-layered operational crisis management has its own rules for achieving its performance goals, that is, organizational mindfulness and resilience here. By investigating how the Headquarters Crisis Management Team (H-CMT) contributed to resolving a complex and uncertain operational situation caused by a major event, analysis of its interactions with the Local Crisis Management Team (L-CMT) reveals that this relationship is very different from crisis management paradigms regarding control and data distrust, being characterized instead by dialogue and cooperation, including topics clearly attributed to role entitlement and the way actions are directed through communication. Finally, focusing on H-CMT monitoring to ensure that teams process data effectively through the concept of the Team Situation Model, the heuristic use and the changing role of experts through the crisis

resolution phase are also noteworthy. In addition to those team management findings, it is worth noting the major weight given to the opinions of external stakeholders such as the French Nuclear Safety Authority and Prefect administration even though the scope of this research was originally limited to operational and technical management alone, excluding PR issues as they are mainly assigned to the CEO Strategic Management Team level. Finally, further investigations might cover deviant behavior at crisis management level or focus on stress factors involved in command-style management.

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