The Model of Resilience in Situation: its contribution to the crisis management analysis and improvement

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Abstract: In the context of a study on "Extreme Situations" (ES), we have adapted the Model of Resilience in Situation (MRS) to the analysis of the crisis management organisation which takes place during an event on EDF's nuclear sites. The MRS was created empirically according to observations of emergency operations in full scale simulators and consolidated by the theoretical contribution from the Theory of Social Regulations. In this paper, we describe first our appropriation of the resilience concept from the MRS according to three "dimensions": moment, severity and outcome. Secondly we explain how we extended our approach to resilience that was originally developed for the team in the control room to the crisis management organisation. We consider the organisation as a network of teams in interaction. In our study, that network included the control room team and two other support groups. We have enriched our observations and our analyses with the contribution of cognitive psychology. The first research issue was the need to deepen our understanding of four key concepts of the internal functioning of these groups and the functioning of their interactions: collaboration, cooperation, coordination and sensemaking.

Keywords: Crisis Management, Resilience, Safety Management.

1. INTRODUCTION

The accident at the Fukushima Daiichi power plant in 2011 drastically renewed interest in resilience [1]. Our approach to resilience is driven by the Model of Resilience in Situation (MRS), [2].

This operational approach to resilience is based on two key points:
- the co-existence of two rationalities a priori opposed, the anticipation of the technical and prescriptive rationality on the one hand, the adaptability of the "flexible rationality" of the human groups on the other.
- The dynamic functioning of the operational system where resilience is used to deal with the situation, through the succession of rupture phases, where the system chooses the rules, or adapts operating procedures, and the phases of stabilisation where the system applies them.

The concept of organisational resilience is particularly relevant for extreme situations where an unexpected event beyond the design threatens the organisation. We will describe the extension of the approach to crisis management in extreme situations for a study of EDF crisis management organisation we have performed for the utility.

This approach to resilience focuses on the importance of the collective operation of a network of interacting groups constituted by the operating team in the main control room, the field operators and the supporting crisis teams. The key element of this collective operation is the ability to make sense of an unexpected situation: sense making through cooperation, coordination and both intra and inter-group collaboration, enabling expert decisions. The multidisciplinary approach of resilience combining human reliability and cognitive psychology has allowed the emergence of the favourable or unfavourable characteristics of the factors inherent to the crisis organisation in order to provide options for their adjustment.

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2. OPERATIONAL APPROPRIATION OF THE RESILIENCE CONCEPT

2.1. A consensus: an organisation must anticipate and adapt to manage high-risk situations

In terms of the management of the operational situations of our nuclear reactors, a "situation" is the status of a nuclear site in all its technical and human aspects, at a given time and the culmination of a story (the sequence of preceding situations). This standpoint is used to distinguish the temporality of the anticipation from that of the adaptation.

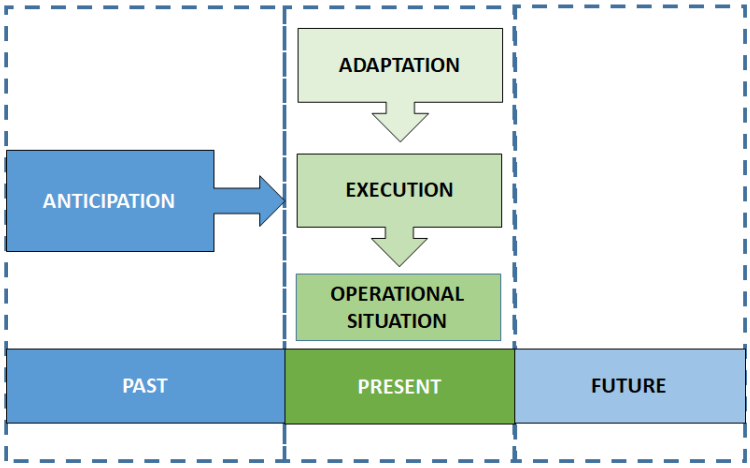

Figure 1. Temporality of the anticipation and adaptation given the current situation.

The organisational anticipation is proactive: it takes place before the situation occurs. It is a process which has produced methods to manage crisis situations before they occur. The anticipation process cannot anticipate every situation in detail: an anticipated situation is a simplification of a future reality, it is rather a category of situations with the same characteristics. Therefore, the anticipation process concerns all potential situations, before the situation occurs, while providing the execution process with sufficient rules and resources to recognise a situation and interact with the latter, such as:

- Group organisation rules (knowing what to do, with who and who decides, etc):
  Roles, responsibilities and decision-making power of individuals
  Distribution and planning of tasks
  Formation of teams or working groups
  Etc.
- Rules of execution (what should you do, how and with what):
  Procedures
  Know-how acquired through training
  "Sector" basics
  Safety culture
  Etc.
- Methods, tools and resources:
  Interfaces: Commands, signals, information
  Communication equipment
  Current or additional staff
  Etc.

These methods, resources and rules are as stable and sustainable as possible; they allow robust and productive operation. The anticipation process is guaranteed by plant and corporate engineering as well as by different training organisations. It is based on knowledge and know-how produced by scientific studies and feedback to improve their effectiveness.

The adaptation process in crisis management takes place reactively and iteratively in a situation or just before a situation: it potentially provides the same "objects" as the anticipation process but only regarding the situation experienced and only to manage this situation specifically. The groups involved in the management of a situation support this process by establishing, when necessary, ad hoc organisation and execution rules in real time and using them themselves.

Examples of implementation of the adaptation process during accident simulations:

- The operators detect an error in the application of an ongoing procedure and confer to modify locally, and for the ongoing accident, the erroneous rule materialised in the procedure.
- Operators in the control room, in collaboration (or not) with the Local Crisis Team (LCT) or the National Technical Support Team (NTST), decide to elaborate an ad'hoc modus operandi when faced with an unusual situation which is not covered by the procedures.

Most of the time, the adaptation does not take place ex nihilo and reuses what has already been anticipated: for example, stakeholders will modify and/or complement an imprecise procedure impossible to apply in a specific situation.

To operate our reactors safely, there is the question of where to focus efforts: is it better to anticipate or to rely on the adaptation in real time? At-risk organisations have long been faced with the choice between these two organisational strategies.

2.2. The dilemma of anticipation and adaptation

An organisation based on anticipation only will be robust in the situations it has planned but i t will not be as autonomous when dealing with situations it has not anticipated.

An organisation may look to anticipate everything but it will very quickly be faced with a dilemma: simplifying the handling of rare undesired situations, denying their possible occurrence or complicating the procedures and organisation for these rare situations to the detriment of the productivity or usability of the prevention devices.

At operational level, if the anticipation is claimed as the one and only approach to safety it may result in dangerous messages: "everything is anticipated in the procedures", "all responses to situations are calculated before they occur". In this context, operational execution is restricted to applying the procedures strictly. Therefore, these messages may leave operators distressed when an unexpected event occurs such as during the Three Mile Island accident in 1979 (breakage of the pressurizer, an incident for which the procedure arrived a week too late on the site, and for which the operators were not trained), or allow them to believe that "zero risk" was reached and to induce a detrimental increase of overconfidence to a healthy attitude of permanent doubt (for example the false confidence in the protection of French territory by the inviolability of the fortifications of the Maginot line before the German offensive of 1940).

This limit of anticipation without adaptation is often called organisational brittleness.

Unlike an organisation only focusing on anticipation, an organisation can focus on "permanent adaptation". Start-ups operate in this way by necessity in order to be able to innovate quickly, not starting with any pre-established rules except the training and the professional acts of the stakeholders. In addition, generally, members of the start-up are managers and operators at the same time and the operation is not "Taylored". The challenge is the speed and agility of implementing an idea in a quickly evolving environment without any process being clearly organised within the group, at least at the start of the operation. Improvisation and autonomy are needed, in an emergency and by trial/error.

For organisations managing continuing processes such as the nuclear production of electricity, the tolerance limit for failure is obviously very low and non-standard execution is unprofitable in the short and medium-term. The Chernobyl accident in 1986 where stakeholders took unsafe initiatives in an

unexpected test situation shows the dangers of giving too much unmonitored independence to the stakeholders.

2.3. How to reconcile anticipation and adaptation: resilience in situation

Sociotechnical systems such as nuclear power plants empirically develop, by necessity, the organisational provisions aiming to favour resilience.

The most obvious organisational provisions are:

- Significant anticipation: studies, guiding procedures, training.
- Development of the autonomy of stakeholders: simulator training, expertise of the stakeholders.
- System tolerance and margins: redundancy of the roles, Symptom Based Procedures during accident management, as implemented by EDF.

Anticipation and adaptation relate to two paradoxical but simultaneously necessary rationales. This dilemma is reflected in the prescriptions themselves and in the way in which they are resolved. As an example, we ask operators for a "reliable and effective" application of the procedures and the paradox is managed in situation by the organisation of the team allowing adaptation in real time, when necessary, of prescriptions, objectives, priorities, etc.

More specifically, we learn from incidents with the EDF fleet as well as severe accidents such as Three Mile Island [3], and we observe on simulators, that the resolution of the paradox between anticipation and adaptation is done dynamically in situation by the alternation between processes of execution and adaptation, which allows resilience.

Firstly, the resilience of the organisation is obtained through the resilience of each of its organisational stakeholders: the working groups. A group manages a situation interacting with the measures and resources provided by the organisation: this is a distributed cognitive operating system which executes and adapts.

At operational level, the resilience of a system is its capacity to combine robustness and autonomy in the management of a situation by alternating execution and adaptation of the rules. The adapted rule becomes an effective rule applied by the group. It is this capacity which will allow the system to operate according to the rules anticipated and the resources planned but which will also allow it to act and adapt when faced with change.

Resilience may be observed during two key moments presented in Figure 2.

- Stable operation (or stability): the group follows the effective rules set (execution).
- Ruptures of this stable operation are transitional periods triggered to end, at least partially, ongoing actions (reconfiguration):
  - Either the objectives have been achieved and they need to be redefined,
  - Or ongoing operating rules do not allow the objectives to be achieved in the situation regardless of the methods and resources implemented, therefore the operating rules applied must be modified or changed,
  - Or the objectives appear to be unattainable regardless of the operating rules available because the means and resources available are insufficient, so the objectives must be modified or changed.

During the Rupture period, the system begins an adaptation phase to set new rules relevant to the new situation and any new objectives. If these objectives involve a renouncement or even a "sacrifice", we can then talk about crisis situations (for example, stopping production or using equipment in degraded conditions at the risk of damaging it).

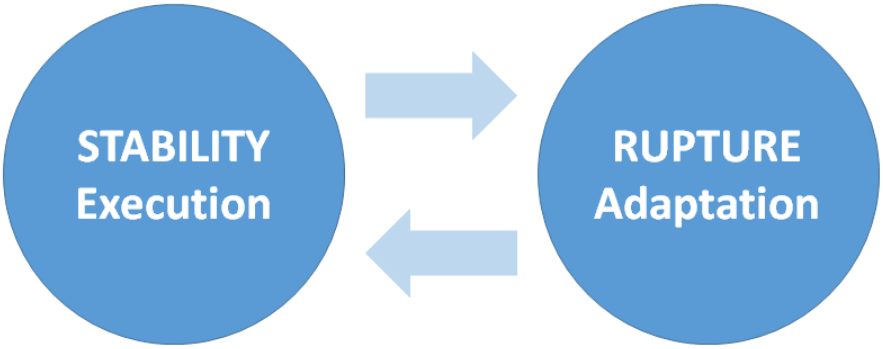

Figure 2. Resilience dynamic

2.4. Our resilience approach

Three dimensions of resilience

To specify our approach, we suggest characterising it according to three "dimensions" proposed by Louise Comfort & al. [4], by applying it to the crisis at a nuclear production site.

> First dimension "MOMENT": what "moment" for resilience, before, during or after a major crisis?
> Second dimension "SEVERITY": what degree of severity for discussing resilience? Should we consider disturbances to "routine" or just serious events?
> Third dimension "OUTCOME": What allows resilience after a crisis? A return to an identical, better or acceptable state?

Our focus

Is resilience observed during severe crisis management episodes? Or before, during incident management to avoid the crisis? Or even during production (preventing the hazard from becoming an incident). Although each research stream tends to privilege this or that focal point, for theoretical as well as methodological reasons, like the precision offered by the observations on the full-scale simulator, it is necessary to consider that these different phases participate in the resilience of the whole organisation.

For us, from the point of view of the stakeholders, resilience begins when the operators detect that what takes place doesn't suit or no longer suits. Thus, knowing how to interrupt and reconfigure (in terms of objectives, resources, or use of resources) is a resilient behaviour. This resilient behaviour must be potentially invoked without knowing if a crisis will occur and, if there is a crisis, without knowing its severity. Therefore, we size our definition of resilience for a broader area than only crisis management itself.

We suppose that all stakeholders consider resilience at all times of the operation (MOMENT) and regardless of the severity of the proven or potential disturbance (SEVERITY). The resilience of an organisation is an ability invoked before, during and after a disturbance to the "routine" operation in case of serious events. Resilience is a permanent capacity, present and developed dynamically on a daily basis. It is not a latent capacity which reveals spontaneously itself during crises. In addition, organisations are dynamic and learn from "micro incidents" every day outside of crisis situations which allows them to have this adaptive capacity [5].

What outcome can a resilient organisation expect? The level of potential outcome depends in fact on the severity of the event and the temporality considered. For a "benign" disturbance during normal operation, we expect an organisation to resume its normal operation in the very short term, and at longer

term that it improves by learning from the event (technical feedback and learning of the stakeholders). However, in case of a severe accident, we cannot expect to put the facility back into service in its pre-event state in the short term. The priority is to avoid the release of radioactive effluents and the return to a normal state can only occur a long time afterwards.

Remember that our issue is the management of crises on a nuclear production site. We will focus on a short-term timescale covering the critical period between the occurrence of the initiating event of a crisis until the control of the reactor through its return to an acceptable state (RESULT), where we can consider that the crisis is over, even if formally it can be prolonged with the mobilisation of the crisis management organisation.

Safety is based, as we have seen previously, on a permanent doubt as to the necessity of adapting or not and the resulting stress. The resilience of the organisation solves this paradox: it is required continuously from normal operation to crisis management. It makes it possible to manage the different modus operandi by adjusting the operating rules or, if necessary, lowering the objectives according to the deterioration of the situation (production, integrity of the safety barriers, containment of the effluents, limitation of the releases), until renouncing priority goals or preserving materials.

3. EXTENSION OF OUR APPROACH TO CRISIS MANAGEMENT

3.1. Extension of the MRS

The MRS was initially constructed to describe the resilience of the operation team in the main control room. How can this model functionally describe the crisis organisation by considering teams or groups not directly operational, such as the National Technical Support Team (NTST) and the National Command Team, which support the operation team?

In our study we simulated an Extreme Situation where the environment conditions prevent local support team to join the plant after the accident has been initiated. The crisis management organisation is reduced to one group on each accidented reactor control room and two support groups in Paris, with one communication channel as presented in Figure 3.

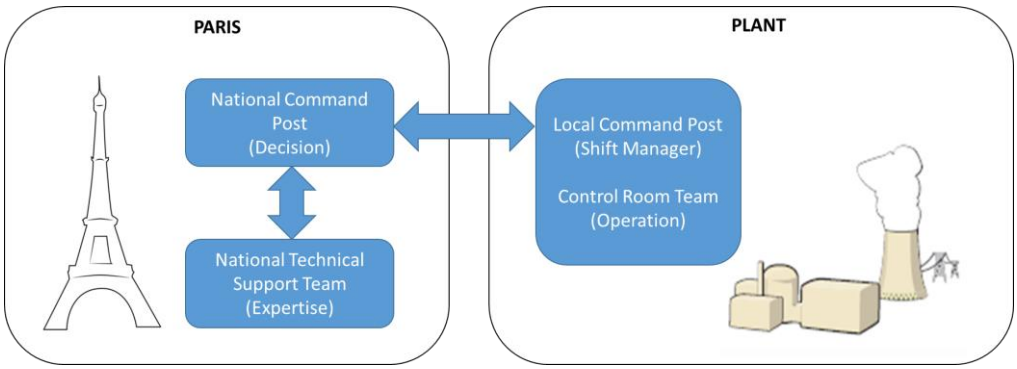

Figure 3. Crisis organisation in ES simulation

These support groups contribute to the operations in more or less deferred temporality, with the control room team dealing with the situation in real time. They deal with either the past (for example the diagnosis given its time of development uses a vision of the "late" situation compared to the present), or the future short-term of the present situation.

This raises the question of the functioning of the support groups which constitute a network focused on one or more control rooms where the operations are carried out. To understand what is at stake we have deepened these points with the aid of ergonomics and the approach of cognitive psychology. We are

going to detail in the following parts the contributions from these two disciplines describing the essential notions of decision making, sensemaking and collective operation in terms of cooperation, collaboration and coordination, contributing to the resilience of the crisis organisation.

3.2. The importance of the collective operation of a network of groups

By definition, crisis management cannot be an individual activity. In fact, in crisis situations, the collective operation of teams and groups is more important that the “technical prowess” [6]. With this in mind, suitable collective operation is a prerequisite of this resilience.

In the context of crisis management in extreme situations, i.e. accidental situations similar to Fukushima, which we have studied [7], collective operation commits two groups from EDF’s corporate entities in crisis management - the NTST and the National Command Post, as well as operations teams at site level. To manage the crisis as effectively as possible, these groups interact and communicate face-to-face and remotely to obtain information, share a diagnosis or a recommendation, make a decision, ask for help, reconfigure, etc.

These exchanges, these communications are those which allow the sharing of essential information, making sense of a situation, understanding that the current strategy is no longer adapted and to make a decision towards a new objective. Therefore, sensemaking, and in particular the fact of making sense of an unknown situation for example cannot take place if the joint operation is not effective.

3.3. Transitory groups formed for the crisis: a network of groups of decision-makers, experts and operators activated temporarily

The crisis organisation studied here, as other crisis organisations, is characterised by the fact that it is joint work in which "transitory" groups are formed occasionally when facing an "extraordinary" situation, and then "de-constitute" at the end of the crisis and return to their usual activities. The only group that is partly stable is the management team, with the two operators who are permanently in the control room.

The framework for the collective operation of these groups was set earlier in this paper, and even though they train together, for example during crisis exercises, it is only in the action that the collective operation can be observed and studied since this is the result of constructions of modus operandi during the training or in the current situation. Indeed, "There is collective activity whenever the execution of a task involves the coordinated intervention of several operators" [8] and in the case studied "of several groups". This means that there is interdependency between the stakeholders and groups who “must” work together.

Thus, when these groups become active, a network of interactions both within groups and between groups is set up. This is a complex network characterised by remote and publicised communications based on various methods available or not (telephones with distinct technologies, IT system, fax, etc.). These communications are induced by both pre-established rules and the requirements of the situation and the type of communication is relatively prescribed and passes through an "operational" language [9] specific to the nuclear environment and the management of the crisis. Each group gathers information necessary for its activity and shares all or part of this information with stakeholders from other groups, mainly through telephone conference calls. The various tools, rules and information technologies are thus intended to facilitate and underlie the collective work, i.e. coordination and cooperation, being a source of "distributed cognition". This notion of distributed cognition has the following dimensions: physical, mental and also social. It is a key concept here because the distributed cognition stream is concerned with the structure of knowledge (representations) and its transformation. Distributed cognition approaches [10] stand out from traditional cognitive science approaches in that cognition is no longer reduced to a local process of information processing, it is no longer analysed solely from the point of view of individual cognition. However, it is considered as involving processes of cooperation and collaboration between humans and their physical and social environment. Research on distributed

cognition assume that the cognitive phenomena exceed the individual processing of information to integrate interactions between individuals (human and social environment) and material resources including information technologies (physical environment) [11]. This physical environment includes Emergency Operations Procedures, crisis management rules, integrating the knowledge elements from Operating Experience on crises. Temporal distribution is also considered according to which the elements from previous events experienced by each of the groups are likely to influence subsequent events. Therefore, cognition is both contextual and dynamic and, as a result, the network of group considered complex.

To better determine the resilience of this organisation, it is useful to describe this collective operation by distinguishing between its different types: cooperation, coordination and collaboration. In fact, the latter take various forms and have specific characteristics in crisis situations involving, as seen previously, several groups in a complex and transitory network.

3.4. Cooperation, coordination and collaboration: the foundations for sensemaking

This collective operation is grasped here according to the capacity of groups to make sense of an unexpected or unknown situation: *sensemaking* and the three types of collective work favouring this capacity of a sociotechnical system: cooperation, coordination and collaboration.

Sensemaking

There is an intrinsic link between sensemaking and cooperation/collaboration in crisis management. In fact, collective operation is the foundations for sensemaking, i.e. of the capacity of groups to recreate links between the events and different elements of a new situation. Groups must be able to cooperate and collaborate to make sense of a crisis situation, to reconstruct its meaning. This applies to groups and teams involved in crisis management to permanently make sense of the reality experienced and the actions that the stakeholders carry out. Stakeholders must permanently update their perceptions of their experiences of the situation, make them coherent, link them to the actions carried out and the joint objectives, and share this construction.
The exchange of information is a key step in the sensemaking process which allows all stakeholders involved in the management of the situation to have a joint representation adapted to their points of view and respective objectives. In this sense, the acquisition of information (by control) and its sharing are very important for the resilience of organisations.

Cooperation

According to the dictionary, cooperation is “the action of participating in a joint task”. Here, “the joint task” has the common goal of “controlling the damaged reactor(s)”. As a result, the operation is a finalised activity, that is to say aimed at the achievement of an objective common to the various groups working together. This common objective necessarily coexists with many goals inherent to the activity of each of the stakeholders and each of the groups, more or less set out in the group, and likely to strengthen or weaken the performance of the joint task.

Cooperation results from the prescribed framework in terms of division of work, missions and tasks allocated to each stakeholder as well as to each group. As in many work situations, cooperation is a requirement to be able to implement everyone’s missions resulting from a division of the work. This implementation commits the stakeholders, the groups in the performance of distinct but dependent tasks [12] [13]. The work is both individual and collective in the sense that each stakeholder performs specific tasks individually or in pairs but the end result must be collective.

This effective collective activity involves a sharing of the work based on the missions and roles set out by the organisation as well as the knowledge and skills of each stakeholder and each group, human resources available, the understanding of the situation at a given moment, immediate requirements of the work. In the situations studied here, the collective activities are characterised by a significant mental

component (construction of a diagnosis, decision making, problem solving, prognosis). However, the physical component may also be present in the case of a working group of field operators who must do some of the work together, such as moving or installing equipment.

In the case of crisis management, cooperation must be reinforced in situations which cannot be dealt with according to the framework set out (unexpected situation, beyond design basis situation for example). Therefore, new types of cooperation may be required during crisis management.

Collaboration

Collaboration aims to "co-elaborate" a common reference, share and update it, between the stakeholders and/or groups who have a priori distinct immediate objectives with a view to solving a problem, making a decision, coping with the unexpected.

The main difficulty with cooperation lies in the fact that each group or team acts according to their own objectives, their own constraints, which may weaken the collective operation. Collaboration, just like cooperation, may be intra-or inter-groups and teams. In the situations observed, we can note that collaboration is one of the significant characteristics of interactions between the NTST and other experts for co-developing a recommendation by validating parameters and expected states of the reactor. As an example, interactions have taken place within the NTST to co-develop one or more hypotheses on which to base a severe prognosis taking in hypothesis a degraded situation. Between the NTST and the site, there is collaboration to help the site by responding to requests from the site and setting out recommendations.

Cooperation and collaboration require temporal availability of the stakeholders and groups concerned as well as coordination.

Coordination

In industrial sociology [14], coordination is constituted by a set of rules which must be applied by the operators in order to link the different tasks allocated to them. These rules set out the nature of tasks, needs of operators and the allocation of these operators to the various tasks. This definition also applies in the context of a focus on a team but needs to be extended to a more macro level considering the groups and teams governed by the crisis organisation. In other words, coordination in this complex and transitory network requires, beyond the rules, "contextual coordination" and accounts for what is really happening at the level of the activity of intra-and inter-group team members.

Coordination corresponds to the actual organisation of behaviours, actions in the control room interacting with the recommendations of the NTST, decisions, audio conferences among experts, "thermohydraulic" audio conferences, with a view to achieving the end goal effectively.

Two dimensions can be used to define the types of coordination between different operations:
- The time dimension, operations are carried out simultaneously or delayed;
- The functional dimension by defining the degree of dependency between these operations.

A third must be added which is the cognitive dimension underpinning the sharing of information with a view to the construction of a common operational reference, its updating and cognitive reconfiguration in case of an unexpected situation with a view to giving meaning to the situation (sense making).

Coordination, from the point of view of temporal and functional dimensions, intrinsically aims to limit redundancy and optimise the linking of tasks so as to act jointly on the temporal aspect and on the use of the organisation's resources. This is also true when it comes to a crisis management situation in which resources may be limited, or even exceeded. It then appears crucial, as we can see from the control room with the management of field actions according to the number of available field operators, to optimise

resources. Here, coordination implies the prioritisation of actions locally, their re-sequencing considering the evolution of the state of the facility and the resources available.

From a cognition point of view, coordination aims to avoid situations in which the stakeholders from one group or various groups are faced with misunderstandings between, for example, a recommendation given by the NTST and the state of the segment and the organisation by the management team. Situations in which there is no possibility of common reference sharing, which leads to dissonance or cognitive distortion, the risk is the loss of meaning for one or more groups. In these situations, via cooperation and collaboration, it is necessary for stakeholders from different groups to be able to "reconfigure" from a cognitive point of view to resynchronise temporally and from the point of view of the representation of the current situation.

In this case, in accordance with [15], cognitive synchronisation by communication must ensure that everyone has knowledge of the facts relating to the state of the facility: sharing of parameters, sharing of difficulties, risk of equipment loss, repair possibilities, etc. and making sure that the various stakeholders share, at a given moment, the same general know-how of the sector: ongoing procedures, other technical rules, knowledge of materials, of the environment, etc.

Therefore, cognitive synchronisation aims to establish a context of mutual knowledge to construct or update a joint operational reference for specific decision making, to "work together" in crisis situations. Cognitive coordination is essential during reconfigurations when facing a loss of meaning and uncertainty.

Sense making and resilience

In the context of resilience as it is considered here, the performance of the groups depends both from the outcome of the activities of each group or team and, specifically, from coordination processes underpinning the cooperation and collaboration. It is an ability to interact effectively with the notion of collective intelligence, i.e. an intelligence more effective than if intelligences were each taken separately and added together. It is by sharing knowledge, by reflecting, by distributing skills that, at macro level, a team develops this collective intelligence, which generates synergies producing results. Then, at a more macro level, the sharing of knowledge and skills between teams and groups involved in the crisis organisation develop this collective intelligence. In this collective performance, it is the notion of "capacity to interact effectively" which is interesting for resilience and not as much results in terms of actions or new rules. What must be reproducible in a future crisis situation is this ability to interact effectively, regardless of the crisis conditions.

In this respect, our current thinking is based on two axes, firstly on models allowing consideration of the collective cognitive activities observed during crisis situation simulations and secondly on types of simulation favouring the development of ad hoc skills.

In terms of decision making and natural problem solving and, more specifically, in risky dynamic environments, our empirical results are based on the theoretical framework of Naturalistic Decision Making (NDM) [16] [17]. By contrast, theoretical approaches on decision making and problem solving are developed with studies carried out in laboratory situations and describe a cognitive process of sequential and very rational decision making.

Decision making in critical situations requires expertise as well as technical and procedural knowledge, expertise based on tacit knowledge and meta-knowledge. Studies within the NDM show that experienced stakeholders use mental models, representations of the situation developed for and by the action, to define what is useful in terms of information and to what extent the stakeholders identify the nature of the situation, with this information making sense, and being retained or not.

Giving meaning to an event is far from a linear process according to which the information present and available must be appropriated to understand the situation. The "insight", i.e. "Inspiration", "overview",

“idea” of a solution occurs through the detection of contradictions and anomalies as well as the identification of connections. Therefore, the mental decision-making process is modelled in the form of a mental simulation called “Recognition-Primed Decision model”. According to this model, recognition is initially based on four dimensions: expectations, plausible goals, relevant indices and actions. A first mental simulation of the action makes an assessment and decides whether or not it will work. If the answer is “no”, this involves seeing if it is possible to recognise or have a new pattern of the situation in a different context. Stakeholders will make a diagnosis of the current situation and try to see what is similar to the known situation, which is different. [18] stresses the absolute entanglement and lack of sequentiality between the top-down and bottom-up processes in constructing the understanding of a situation. This model gives way to the descending mechanisms that will influence the search for information, the selection of data and its interpretation from pre-existing representations and mental models available. It appears, compared with classic cognitivist models, an analysis and explanatory framework is quite relevant to understand how to "get out of the dominant frameworks", i.e. of "what was anticipated" in terms of procedures, techniques, knowledge, organisation.

In an "extraordinary" situation the problem is not so much how the individuals construct operational representations, adequate or not, but how at first they manage to detect a problem of representation” situation, i.e. to detect "framebreakers" to use Klein's term, before being "saturated" from a cognitive point of view by persevering in the wrong direction. Then, secondly, how individuals and groups cope with this new situation. It is not about finding the best option but finding what works in this situation. Knowing that depending on the group concerned, it may perform several mental simulations before decision-making: in this case the NTST has longer time spans to explore a problem.
However, the action, the decision-making, is the result of a process that uses the past - knowledge, experience -, present - indices, plant parameters, measurements, calculations, formal and informal information, intuition, expertise - and the future - prognosis, new modus operandi, new rule, adaptation of a rule. The previous experience serves to suggest goals, modus operandi, methods for developing an improved future experience. It "involves active and reflective testing of reality and our knowledge" [19] and interacting with the environment. Interaction is essential for understanding the experience and making sense of the action. Each experience, in a normal situation, such as in a critical or crisis situation, will require the development of other experiences. This learning by the action and for the action is translated by a constant transformation of the individual and collective experience. The reality is not fixed. This is why we must not systematically make a new experience in a particular situation a rule, a specific modus operandi because it may be that it is not adapted to another similar situation.

4. CONCLUSION

Therefore, the notion of “sense making” (giving or re-giving meaning) is the ability to be able to establish links between new elements or elements known but not expected at this time, to find a link between the elements which are not linked a priori, to establish a new method of reasoning. From a cognitive and collective point of view, expertise and experience are essential elements and development as a process and resource must be favoured by training on crisis management, focusing on the construction of collective intelligence and competence to go beyond the individual and thus reinforce resilience.

But experience and expertise only develop through learning in a situation which is different from training (since training is an anticipation). It is necessary to train crisis teams and operations teams to act and think about various problematic situations, to train them to work together in uncertainty and in the unexpected, which increases their ability to act, to consider common solutions and to enrich their experience with a wider range of possibilities. It is also necessary to practice that the planned organisation may not work, to imagine possible solutions in a collective way, without trying to find the "right" solution, but rather the one that seems to be best suited at a given moment.

In order to be able to manage crises, the resilient organisation must acknowledge the need for stakeholder' autonomy in the face of the unforeseen as much as the need for technical and organisational anticipation, without this autonomy calling into question the fundamentals of the safety. Provisions are

essential (procedures, training, roles, etc.). But technical anticipation must accept margins of initiative. This must be adapted through a collective decision in situation process validating its choices. In conclusion, the organisation must accept improvisation based on the skills of the personnel involved in the crisis, while giving them the means to train them and accepting that there may be failures.

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