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Extreme Environment and Management Situations

This chapter endeavors to provide a precise definition of what is meant by "extreme environment". An analysis of management science literature reveals in effect a recent trend toward a better comprehension and deeper integration of the role played by such contexts in managerial dynamics. Even so, the works on the subject remain heterogeneous. They resort to, and even amalgamate, various notions such as uncertainty [WEI 07], volatility [BOU 89, WIR 07], surprise [CUN 06], extreme situations [LIE 09] or crisis [ROU 07, RER 09], struggling to provide a rigorous and commonly accepted definition of what an extreme environment is.

The developments that follow propose a general characterization of the extreme environment and proceed with a clarification of the nature of various management situations that are part of it.

1.1. The extreme environment: what is it about?

An environment qualifies as extreme if it is simultaneously marked by evolutivity, uncertainty and risk [GOD 15, BOU 12, AUB 10]. These three criteria clarify, respectively, the nature of changes the participants are faced with, their probability of occurrence and impact:

– The nature of changes relates to the notion of evolutivity. It emphasizes the rapid, dynamic and discontinuous aspects of the changes that individuals experience (for example, [BOU 89] and [WIR 07]), while stressing dynamic differences in comparison with the previous operating mode. The pace of

change differs depending on situation. Some situations involve real-time pressure and urgent implementation of collective action [KLE 06]; others, on the contrary, do not require immediate action, thus allowing participants more time for decision-making (they can, for example, take the time to meet and discuss the event that is a matter of concern for them).

– The probability of occurrence of change is characterized by the uncertainty criterion. Uncertainty suggests that a situation can be more or less expected (and therefore more or less "foreseeable"), depending on the predictability level at the respective moment and on the event modes. Some situations may well emerge in a totally unpredictable manner, to the great surprise of participants who need to rapidly adapt [CUN 06, WEI 07].

– Finally, the impact of change can be assessed depending on the type of risk the participants are exposed to [LIE 09]. Understood as potential damage inherent to a situation, risk can be physical, media-related, symbolic, financial, legal, material, etc. Risk affects the organization, its groups and members.

There are numerous work environments where teams operate under extreme conditions. In the public sector, this is, for example, the case in emergency medicine, internal security or the military organizations this work focuses on. Companies in the private sector may be under similar constraints. For example, teams of market traders make decisions in situations marked by the volatility of the markets they operate in, the uncertainty related to when and how the market values evolve and the risks, mainly financial and legal, incurred by the investment bank on behalf of which they operate.

Drawing on examples from the military, Table 1.1 illustrates the three characteristics of an extreme environment.

1.2. Various management situations in the extreme environment

The extreme environment consists of various management situations: routine, unexpected and crisis situations. They form an articulate continuum and the main challenge for teams is to control the shift from one situation to the next.

Three criteria of change in the extreme environment	Examples from the military environment
Evolutivity Nature of change	Weather conditions, tactical context, quantity and quality of enemy armament, and reliability of tactical information
Uncertainty Probability of occurrence of change	Bird strike, engine stop, armament failure, radio/communication system failure and enemy attacks
Risk Impact of change	Vital, material, media, political, budgetary, symbolic, etc.

Table 1.1. *Characteristics of the extreme environment: illustrations*

1.2.1. *Routine activities, unexpected events and crises: a typology of management situations in the extreme environment*

A management situation gathers "participants […] who must accomplish, in a determined time, a collective action leading to a result submitted to an external evaluation" [GIR 11]. It is defined through continuous group interactions within a specific space–time context. As mentioned by Journé and Raulet-Croset [JOU 08], emphasis is being placed on the collective, spatial and diachronic dimensions of the situation, while stressing results and performance. The management situation relies on the interactionist (for example, [GID 84]) and pragmatist (for example, [DEW 38]) approaches, according to which the emergent nature of a situation is the result of subjective participant interpretations [JOU 08].

As represented in Figure 1.1, the extreme environment consists of three distinct management situations:

– Routine situations relate to a repetitive and standardized team operating model [FEL 03, WEI 07].

– Unexpected situations refer to unexpected events or sequences of events that take participants by surprise and force them to adapt and react [WEI 07].

– Finally, crisis evokes a rare emergency situation that exceeds the capacities of participants and structures (for example, [LAG 91]).

Evolutivity, uncertainty and risk criteria weigh differently, depending on the management situation that teams are faced with.
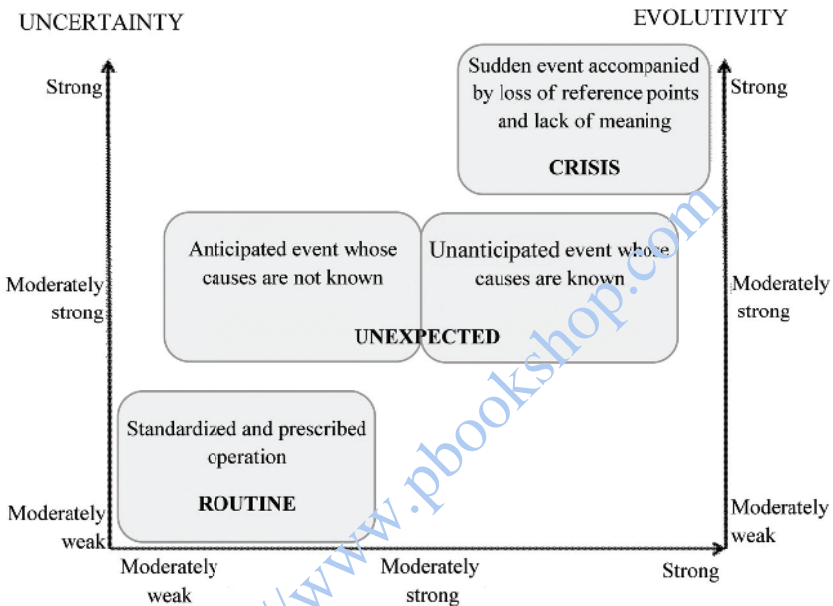

Figure 1.1. *The three management situations in the extreme environment*

1.2.2. Routine, crisis and unexpected situations: a characterization

1.2.2.1. *Routine situations*

In the extreme environment, teams' work has a strong routine dimension. Routines refer to operating guides and procedures (for example, [CYE 63]), stable activities rooted in repetition (for example, [NEL 82]) or more precisely to a "repetitive, recognizable pattern of interdependent actions carried out by multiple actors" [FEL 03].

As Feldman and Pentland [FEL 03] show, routines have a double aspect: ostensive and performative. The ostensive aspect refers to the "abstract" and structured nature of routines, providing rules and procedures that participants follow. In its turn, the performative aspect represents the manner in which routines are implemented by the same participants in a given context. The authors stress the existence of a recursive relation between ostensive routines, which "objectively" guide and standardize the action, and performative routines, which leave room for the interpretation of these standards in their daily implementation. This way, routines simultaneously constrain and enable action.

Thus, groups that operate in the extreme environment are subject to formal operation routines, most often of a (public or private) administrative nature. This leads to high standardization of work procedures by defining, setting limits to, and rigorously prescribing individual and collective actions [ROC 87]. These routines are nevertheless likely to evolve in time, according to their implementation and circumstances. They play a major role in ensuring the safety of operations, as well as follow-up and control. In this sense, they are necessary for the smooth operation of teams in an extreme environment.

A good illustration of the role played by routines is the functioning of military teams, either in military operations or during training. Let us take the example of *Close Air Support* missions – aerial support of special forces operating deep behind enemy lines – conducted by fighter crews of the French Air Force on the theater of operation. When on mission, crews follow highly prescriptive engagement rules, which limit their action patterns and processes. These refer to flight manuals and check-lists of detailed and precise operating procedures (flight planning, Close Air Support Card, etc.) that they rigorously apply in various stages during the mission. Within this formal regulatory framework, various execution stages of the mission are standardized. This is how a pilot having operated in Afghanistan defines the term: "Standardized? It means a stereotyped and routine response to an operational situation". For navigating crews, standardization does not only refer to procedures. These crews also use a common language, which was published in NATO documentation and which they call code words. *Push when ready, Continue, Investigate or Abort* are the code words easily

understandable by the team members, which facilitate concise and rapid communication, while significantly reducing the risk of misinterpretation. Finally, the automation of behaviors is equally noticeable. Back from Afghanistan, a member of a fighter crew explains: "Automatisms are habits […]. We internalize typical action patterns that evoke positions and maneuvers and allow us to more effectively build an image of the airspace". Automatisms gain time, reduce verbal exchanges and facilitate work, irrespective of team composition. The development and acquisition of automatisms can be observed within groups of experts from other fields, such as the crews of civilian aircraft (for example, [HUT 95]) or nuclear plant control room teams (for examples, see [JOU 05]).

Thus, operating in extreme environment does not at all mean that the respective actors are perpetually faced with unexpected situations and surprise. A significant part of their activities is governed by routine action patterns, guides of conduct that are known in advance and most often become automated due to exercises and training. These routines are, however, not rigidly fixed, since their performative dimension can lead to their gradual evolution. They allow teams to effectively solve predictable problems, that is to say problems whose probability of occurrence has been anticipated and whose causes are known well before the problem emerges. Therefore, the degree of evolutivity, uncertainty and risk in a routine situation is relatively low.

1.2.2.2. *Unexpected situations*

The second situation constitutive for an extreme environment refers to the emergence and development of unexpected events or sequences of events. Consequences are most often controlled by the implementation of specific management processes, but may also have dramatic outcomes.

Revisiting the works of Cunha *et al*. [CUN 06], it is possible to distinguish two types of unexpected situation, depending on their nature and origin (Table 1.2). The first type refers to an unexpected situation that was anticipated, but whose causes remain unknown to the teams; the second type refers to an unexpected situation that was not anticipated, but whose causes are known.

Let us now elaborate on the two types of unexpected situations presented in Table 1.2.

Nature	Origin	Examples	Management processes
Anticipated The probability of occurrence of the event has been assessed and taken into account Training, rehearsals, exercises, etc., have allowed actors to assimilate the event-processing procedures	Unknown cause String of failures at all levels (individual, team, organization, regulatory authorities, etc.) Complexity	Air France Flight 447 Reason's Swiss Cheese model	Collective meaning reconstruction (collective discussions) Consensual decision Actions: return to processing procedures, task distribution
Not anticipated The probability of occurrence of the event has been neither assessed nor taken into account	Known cause Group destructuring Leadership weakness Sudden evolution of tactical and operational conditions	Mann Gulch fire Transall C-160 flight	

Table 1.2. *Two types of unexpected situation*

An unexpected situation can occur when the event, though anticipated, and taken into account by processing procedures assimilated by the team, is part of a complex and iterative process that makes it difficult to identify causes. Let us consider the example of the Air France 447 Rio–Paris accident in June 2009: the aircraft crashes into the Atlantic Ocean after being stalled for 3 min and 30 s. The three pilots in the cockpit are experienced, together having over 20,000 flight hours. They had trained on stalls (low altitude) in a simulator several times. Nevertheless, that night weather conditions were rather mediocre (however, not exceptional) and the problems multiplied during the flight [BUR 12]. In particular, the automatic pilot shutoff produced real surprise in the cockpit. Emotions and confusion intensified when they realized that airspeed indicators were inaccurate (the Pitot tubes were blocked by ice) and the after stall alarm went off twice. According to the BEA report, the AF-447 crew went was not able to identify the causes of airspeed drop and various alarms and messages. Moreover,

they added to the complexity of the situation through persistent attempts to pull up (maintain an ascending path), which stalled the aircraft. Thus, despite the high level of expertise of the pilots in the cockpit, their training on stalls and their mastering of procedures applicable for recovering from stall, the crew failed to understand the "why" of the situation. They failed to make sense of its causes.

In military aeronautics, Reason's Swiss cheese model [REA 90] is often referred to when analyzing incidents and accidents. This model shows that there are latent failures spanning all levels (individual, team, organization, etc.) and an accident occurs when all these failures are aligned. Reason stresses the complexity of causes of an unexpected situation. These causes emerge from a string of failures whose interpretation will serve the groups in making sense of the event. This first type of unexpected situation is, therefore, part of a process of high complexity which makes it difficult, if not impossible, to identify its causes and comprehend its magnitude.

An unexpected situation can also occur when the causes of the problem are known, but its occurrence has not been anticipated by the actors. It is, for example, the case, described by Weick [WEI 93], of a team of firefighters who, in 1949, were parachuted over an ordinary forest fire area in Mann Gulch (Montana) and lost 13 of its members. The team had in effect wrongly analyzed the fire expansion and was rapidly encircled. This case highlights a destructuring problem that leads to the emergence of an unexpected situation: the loss of leadership. In effect, the leader's position, which had until then been beyond questioning, is challenged when he orders his crew to throw away tools to facilitate escape. As Weick writes: "A fire crew that retreats from a fire should find its identity and morale strained. If the retreating people are then also told to discard the very things that are their reason for being there in the first place, then the moment quickly turns existential. If I am no longer a firefighter, then who am I? With the fire bearing down, the only possible answer becomes, An endangered person in a world where it is every man for himself" [WEI 93].

The order to leave the tools behind is indirectly a signal for crew "disintegration", and thus the leader loses legitimacy. The crew stops listening or following him, despite the fact that he has the solution for group survival. The fact that material environment and the constituent "objects"

(tools, bodies, body language, esthetics, etc.) allow a group to identify as a team of experts has already been shown in the specialist literature [BAR 13, CAR 13, HAW 15]. In this example, the unexpected incident – loss of leadership – was never judged as probable by the group leader, not even when his orders lead, by way of consequence, to the very destructuring of the group.

Let us continue with an illustration from the military, an extract from interviews conducted with members of Transall C-160 crews (tactical and cargo transport military aircraft) of the French Air Force. Many unexpected situations arise in the tactical transport field. During action, changes compared to what was anticipated and planned for frequently occur. In particular, tactical and/or operational conditions often evolve between briefing (conducted just before take-off) and fly-over of the landing area. For example, one pilot says that once above the place where he was supposed to take on troops, the crew noticed that the ground was on fire. It was purposely set on fire in order to force the plane to divert. Given this unexpected incident, the crew had a discussion aimed at reaching an agreement on "what to do". Once the decision was made, the captain validated it and each member of the team implemented it based on automated task allocation. In this example, the unexpected incident – landing area on fire – had not been considered by the crew during briefing. However, the crew very rapidly grasped the causes: a significant evolution of tactical conditions due to the enemy forces trying to generate a diversion.

Generally speaking, when confronted with unexpected situations, teams need to know how to make or give sense to changes that have occurred in the action environment. This collective sense-making goes through common discussion. Even if very short, it generates the atmosphere needed to reach an agreement on "what to do" and to subsequently implement the processing procedures and the adapted task allocation. Unexpected incidents thus require teams to rapidly make and implement decisions in order to be able to achieve their initial objectives. In an extreme environment, there is a strong probability that unexpected situations arise (high evolutivity and uncertainty). Risk level is directly correlated to the collective sense-making process, either through the anticipation of the cause of the unexpected situation, or through the anticipation of its occurrence.

1.2.2.3. *Crisis situations*

The third and last management situation constitutive of the extreme environment is crisis. It is in effect noticeable that routines and the actors' capacity to adapt may not be sufficient when the problems they are confronting are not anticipated and have unknown causes. Crisis differs from an unexpected situation to the extent that it is characterized by an exceptional and rare event. As noted by Roux-Dufort and Ramboatiana [ROU 08], this event occurs suddenly and develops rapidly, in parallel with a significant flow of information, both in terms of quantity (volume of available information) and quality (multiplicity of sources of information and heterogeneity of content).

A crisis is thus a "high turbulence process that affects an organization" [LAG 84]. Lagadec distinguishes three dimensions of this "high turbulence":

– wave-like unfurling: crisis submerges teams and renders regular management tools useless, even counterproductive [LAG 84]. It overwhelms the capacity of actors and structures [LAG 91];

– things are thrown out of order: routine action and operational patterns become helpless and even aggravating factors during crisis [LAG 84];

– the break: the key goals and missions of the team and/or of the organization are called into question and have to be reconsidered [LAG 84]. Crisis can, therefore, significantly destabilize the very foundations of the system, threatening to bring the teams' reference universe to disintegration [LAG 91].

For work groups, a crisis situation is similar to facing a black hole: the event is stunning and they can easily find themselves pulled in and overwhelmed. Literature notes the existence of a "cycle of incompetence". It is a sequence of behaviors that are part of an event(s) perception process that is out of phase with the reality of facts [ROU 08, ROU 09]. What is stressed here is the actors' difficulty or lack of capacity to grasp the event as it is effectively unfolding. This form of disconnect between perception and reality may aggravate the crisis situation, by triggering bad decision-making and adding to tensions [ROU 08].

In the defense environment, a crisis situation needs to be approached from two different perspectives:

– On the one hand, military crews, all armed forces taken together, can be instrumental to crisis management. For example, in 2004, the Staff of French Armed Forces established the operations planning and execution center (Center de Planification et de Conduite des Opérations, CPCO). Among its various missions, the CPCO is responsible for: (1) upstream crisis intervention, by devising warning indicators of potential crises; (2) during crisis intervention by proposing an adapted military component and/or by arming the interministry emergency committees; and finally (3) after the crisis intervention by deciding on how the Armed Forces can contribute to the exiting crisis [TEU 07].

– On the other hand, the Armed Forces can be themselves subject to crisis. This situation differs significantly from the former, to the extent that they have to interpret, analyze and manage a "highly turbulent" event that directly affects them. This has, for example, been the case for military forces at the Canadian Forces Valcartier, near Quebec. Studies conducted in 2001 revealed trichloroethylene contamination of the soil underneath the base. These carcinogenic substances had polluted the water wells of a neighboring town, being a serious threat for the population. The base's environment committee was quickly overwhelmed by the media storm which rendered it unresponsive. The image of the base and its military personnel was strongly undermined by this environmental and media crisis, which called into question their competences in terms of environmental and crisis management [BOI 05].

As this last illustration reveals, for the teams that manage and go through it, a crisis situation is a great challenge, particularly in terms of stress and frustration. Crisis often leads to breakdown [ROU 08]: of the decision-making process, of behavior in human relations and, finally, of regulations, due to inadequacy of routines and standard operating patterns.

Operating in an extreme environment can thus expose teams to crisis situations. Under these circumstances, they undergo radical changes (evolutivity), experience difficulties in anticipating events (uncertainty), particularly because their perceptions contribute to aggravating or improving the events, and finally they take significant risks (media-related, legal, symbolic, vital, etc.) whose impact may last. For this reason, crisis situations require the implementation of specific managerial processes.

Finally, an essential point is worth stressing: evolving in an extreme environment does not mean that organizations will necessarily and regularly be confronted with crisis. On the contrary, when they pay stronger attention and are vigilant with respect to procedures, error detection and proactive watch, they are identified as highly reliable and are not under a higher crisis threat than other structures evolving in more "classical" contexts [CAR 02, WEI 06].

This work will not focus on crisis management modes and tools, which have been described and analyzed by specialized authors.

1.3. Coordination in the extreme environment: shifting from one management situation to another

As characterized and illustrated above, the extreme environment consists of a set of management situations. These situations are constitutive of a continuum that goes from routine situations, providing recurrent and standardized patterns, to crisis situations in which actors face serious breakdown. Between these two positions of the continuum, teams need to be able to manage unexpected situations (Figure 1.2).
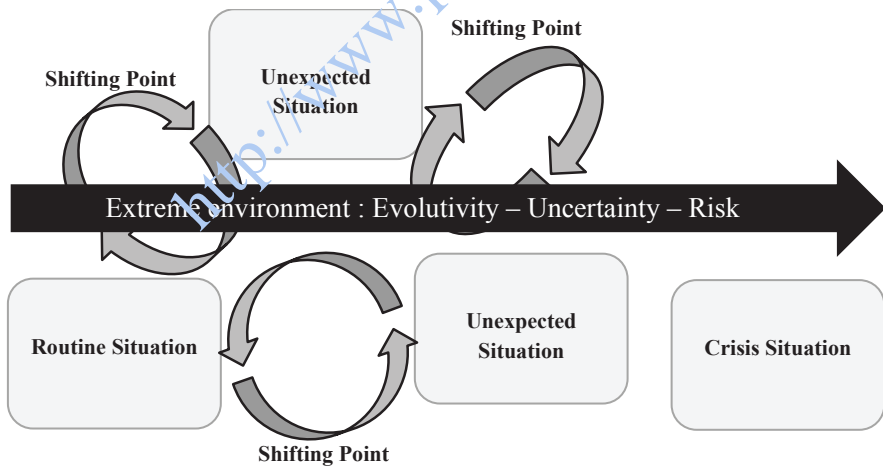

Figure 1.2. *Extreme environment: a continuum of management situations*

As shown in Figure 1.2, one of the major challenges that work groups evolving in the extreme environment are faced with is present at the level of the "shifting points" between routine and unexpected situations. As we have seen, there is a high probability of occurrence of such shifts in an extreme environment. Teams have to cope with sudden tensions and it is dependent on their capacity to manage the passage from one situation to the next that the mission or the project, and more generally, the organization's performance, relies. These tensions come into play in particular when shifting from standardized situations, governed by rigor and procedures, to an unexpected event, whose effective management requires flexibility, adaptation and often creativity.

Chapter 4 addresses the acquisition of collective competences that allow a team to manage the shift from one situation to next, as well as the tools that management can provide the teams with to facilitate the shift.

Chapter 2 delves into the concept of coordination. In particular, it stresses the limits of classical theories in their approach to team coordination in an extreme environment and proposes a more appropriate perspective: "practice-based" coordination.