

The Role of Simulation-Making in Crisis Unfolding

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ABSTRACT

Believing precedes seeing. In this sense, strengthening alertness – a system’s ability to see problems before they impose themselves – requires emphasizing on what makes believing: mindfulness. Grounded in Karl E. Weick’s theoretical approach, this paper repositions crisis simulation as a sociotechnical process fostering organizational mindfulness and supporting the emergence of an organized collective mind under conditions of uncertainty. We argue that simulation design(ing), through scenario construction, entails a recursive reassessment of organizational preparedness mirroring the full (simulated) crisis lifecycle – before, during, and after. Drawing on a three-year longitudinal ethnographic study of crisis simulation exercises, we analyze the intertwined processes of design, facilitation and feedback. Our findings show how simulations enact collective sensemaking and organizing through three interrelated reconfiguration dynamics: prospective, actualized and retrospective. By conceptualizing simulations as generative systems rather than mere training tools, the paper highlights their role in shaping organizational routines, coordination practices and reliability mechanisms in crisis contexts.

Keywords

simulation-making, crisis unfolding, organizing, sensemaking, mindfulness.

INTRODUCTION

In a perspective of *change* as constitutive of organizational life (Ann Glynn & Watkiss, 2020; Langley et al., 2013; Tsoukas et al., 2020; Tsoukas & Chia, 2002; Weick, 1979, 1995b, 1995a, 2006), routines are key mechanisms for maintaining continuity through ongoing change (Farjoun, 2010; Feldman, 2000; Feldman & Pentland, 2003; Howard-Grenville, 2005; Tsoukas & Chia, 2002; Weick & Quinn, 1999). They operate as forms of *enactment*, through which actors engage with the world and construct their *enacted* environment socially (Daft & Weick, 1984; Tsoukas & Chia, 2002). As such, since enactment involves the creation, through our actions and meanings, of the environment, which in turn constrains us (Weick, 1979), crises represent its ultimate form, constraining learning and interpretation capabilities of organisms – individuals, collectives, organizations – striving to sustain continuity while continually reconfiguring themselves (Weick, 1988, 1993, 2010).

As extreme and rare organizational phenomena, crises embody change in its most salient form and compel the reconfiguration of interpretative frameworks and organizational identity (Christianson et al., 2009; Morin, 1976; Tsoukas, 1998; Weick, 1988, 1993, 2007). Yet, in a context shaped by information technologies (DeSanctis & Poole, 1994; Orlikowski, 1992, 2000, 2007; Weick, 1990; Weick et al., 1999), contemporary crises increasingly reflect broader cognitive, technological and informational transformations (Comfort et al., 2020; Mumford & Gray, 2007; Simon et al., 1971; Taarup-Esbensen, 2023). This evolution calls for re-examining socio-technical coordination processes among crisis stakeholders (C2).

To account for the simultaneous reconfiguration of structures and agencies, such processes must integrate innovation, emergence and improvisation (Orlikowski, 1992, 2000). From this perspective, enactment, understood as a process of situated co-emergence (Espedal & Carlsen, 2024; Tsoukas & Chia, 2002; Weick et al., 2005), supports a practice-oriented understanding of the recursive interactions between actors and technologies (DeSanctis & Poole, 1994; Orlikowski, 2000). Information technologies are thus continuously reappropriated in practice. It is in this sense that routines and technologies continually *make* and *unmake* organizations through the re-accomplishment of shared practices that enable coordination among actors with diverse (and sometimes divergent) interpretations and objectives.

Within this perspective, we focus on collective minds (Weick & Roberts, 1993) and on the conditions that strengthens their capabilities in crisis situations. Collective mind refers to the intertwined dynamics of learning and interpretation that emerge through the entanglement of *organizing* and *sensemaking* (Ann Glynn & Watkiss, 2020; Diaz-Moriana et al., 2024; Hernes & Maitlis, 2010; Kornberger et al., 2025; Maitlis & Christianson, 2014; Tsoukas et al., 2020; Weick, 1979, 1995a, 2001, 2009, 2012; Weick et al., 2005). We understand organizing as embedded social learning processes, and sensemaking as embodied interpretative dynamics linked to identity construction. These processes are inseparable and together constitute what we call collective mind.

We examine the role of simulation in integrating organizing and sensemaking, particularly considering the interdependence between civil protection services and critical infrastructures. While these organizations operate under distinct logics and principles of subsidiarity, such diversity can hinder coordination in extreme situations (Treurniet & Wolbers, 2021). Crisis management thus shifts in scale and nature when disruptions affect critical infrastructures such as transport, telecommunications, energy or water systems (Boin & McConnell, 2007; Schulman et al., 2004), transforming emergencies into systemic crises involving multiple interdependent actors (Kapucu & Garayev, 2011).

This dynamic is especially visible in large-scale natural disasters, whose growing intensity and transboundary effects demand extensive coordination across territories (Ansell et al., 2010; Avery, 2020; Boin et al., 2014; Christianson & Barton, 2021; Comfort et al., 2020; Gargani, 2022; M. G. Hermann & Dayton, 2009; Kanaan & Mayer, 2023; Nakrošis & Bortkevičiūtė, 2022; Noordegraaf et al., 2017; Rouleau et al., 2021). These challenges are likely to intensify given IPCC projections of more frequent and severe climate-related phenomena (Calvin et al., 2023), making planning, communication and technology critical coordination levers (Kapucu, 2008).

At the same time, critical infrastructures themselves can become sources of crisis. Comparable to high-reliability organizations (HROs), they rely on tight couplings and operate in uncertain and risky environments, which are likely to affect both their own organization and their environment (LaPorte, 1996; LaPorte & Consolini, 1991; Salovaara et al., 2019; Weick, 1989). The large-scale failure of emergency telecommunications in France on 2 June 2021 illustrates how such disruptions expose the State's dependence on private infrastructure operators to fulfil its protective mandate. Given their potential cascading effects, these infrastructures are now tightly regulated and increasingly embedded in national and European security strategies (Assemblée nationale, 2025; European Parliament, 2022; Loi de programmation militaire, 2013).

Simulation-based preparedness therefore plays a central role, enabling crisis cells to develop shared routines, operational reflexes and collective mindfulness (Paton & Jackson, 2002). This is crucial as crisis complexity strains cognitive capabilities and undermines collective coordination and control (Bergström et al., 2010). Accordingly, we raise the following research question: *‘How do crisis simulations, viewed as socio-technical processes, shape collective minds (organizing–sensemaking) within crisis cells across the entire before–during–after cycle?’* In other words, the question is no longer merely how collectives act in crisis situations, but how they are enabled to act. *‘How can we foster the conditions for collective thinking?’*

Framed this way, the problem changes in nature, as we examine the mechanisms – organizational, informational and cognitive – that enable collectives to cope with the inherent limitations of rationality under uncertainty: information overload, fragmentation of interpretations, time constraints and frameworks instability (Maitlis & Christianson, 2014; Tan et al., 2020; Weick, 1998, 2012). Thus, our article is structured in four parts:

First, we address the embodiment of mindfulness and define crisis as a revealing organizational phenomenon that exposes latent vulnerabilities and underscores the need for preparedness within crisis cells. Second, we move beyond the structure–agency divide by examining the enactment of socio-technical systems through routines as points of tension between continuity and change. Third, we present a methodology grounded in Weickian social psychology, combining sensemaking and organizing through a longitudinal ethnographic study. Finally, we present our findings, identifying three types of reconfigurations: prospective, actualized and retrospective.

EMBODYING MINDFULNESS TOWARDS BEHAVIOR-MANAGEMENT DUALITY

Karl E. Weick's (1998) appreciation of Barry Turner's (1978) work provides a useful starting point for addressing

mindfulness. Rather than offering a prescriptive framework, Weick's essay critically interrogates *ontological assumptions* and pre-established frames that can generate self-reinforcing dynamics – or *steering problems* such as those identified by Shrivastava et al. (1988) – ultimately leading organizations toward disaster. In this view, disasters emerge from *human preconditions*, not only because behaviors may be misguided, but also because attempts to correct them through management and administration may themselves generate confusion. *Man-made disasters* thus stem from *ontological confusions*, such as “perceptual rigidities, information ambiguities, disregard of rules, susceptibility to decoys, over-confidence, hubris and mis-placed concreteness” (Weick, 1998).

Accordingly, this essay is neither a method nor an approach, but a warning that mindfulness is the embodiment of “processes [...] that suppress tendencies toward inertia” (Weick et al., 1999). Such inertia is perfectly illustrated by natural disasters, which function as mechanisms exposing existing organizational weaknesses. The Fukushima incident exemplifies this logic: expert reports clearly attribute the disaster to the accumulation of latent organizational vulnerabilities (The Fukushima Daiichi Accident, 2015), corresponding to structurally embedded conditions or pathologies (Mitroff et al., 1989; Pauchant & Douville, 1993; Pauchant & Mitroff, 1988; Perrow, 1984; Roux-Dufort, 2009; Turner, 1976; Weick, 2010).

While this perspective emphasizes prevention, vigilance, warning systems, risk mitigation and organizational learning (Mitroff et al., 1988, 1989; Pauchant & Mitroff, 1988; Reason, 1990; Shrivastava et al., 1988), it is unavoidably constrained by organizational perceptions shaped by intentions, assumptions and beliefs. These *pre-configurations* – referred to as *worldviews* – reflect the principle that *believing precedes seeing* and structures what can be perceived (Weick, 2006). Predetermined paradigms thus delimit problem recognition, making the tension between structures and agency central. *Administrative practices*, in this sense, merely reflect organizational practices, forming behavior–management dynamics symptomatic of deeper ontological confusions (Weick, 1998).

This behavior–management duality rests on simplifying assumptions that obscure weak signals and early warnings, enabling surprise, the accumulation of anomalies, hypothesis refutation and the escalation of unintended consequences. At Fukushima, this took the form of insufficient preparedness, overconfidence, negligence, and a latent culture emphasizing authority and hierarchy, all of which undermined information sharing, decision-making under uncertainty, communication under pressure, and anticipation of cascading effects. In the context of natural hazards, each episode thus functions as a stress test that evaluates both established procedures (planning) and those responsible for enacting them (behavior).

Crises may therefore be understood as sudden triggering events, disruptive occurrences (Lalonde & Roux-Dufort, 2013), cosmology episodes (Weick, 1993) or external shocks that interrupt routines and normal functioning and demand immediate response (Boin et al., 2005). They correspond to low-probability, high-impact situations that threaten organizational viability and social identity (Pauchant & Mitroff, 1990; Pearson & Clair, 1998; Weick, 1988). Often characterized by surprise, crises force stakeholders to make rapid and consequential decisions (C. F. Hermann, 1972; Rosenthal et al., 1989). In contexts of extreme uncertainty, individuals face intense stress that can destabilize their belief systems (Christianson et al., 2009; Maitlis & Sonenshein, 2010; Pearson & Clair, 1998; Weick, 1993).

Although an event-based perspective emphasizing agility, coordination and communication under pressure may seem intuitive (Comfort, 2007; Weick, 1988), it quickly reveals its limits. Crisis is deeply embodied and selective, affecting stakeholders unevenly. Hurricane Irma, for instance, exposed long-standing inequalities in preparedness across more than ten territories (Gargani, 2022), while the COVID-19 pandemic amplified such disparities on a global scale – across populations, organizations, states and continents (Avery, 2020; Comfort et al., 2020; Rouleau et al., 2021). In this sense, crisis is inherently revealing.

Across its temporal (Boin et al., 2005; Roux-Dufort, 2009) and spatial (Ansell et al., 2010; Boin et al., 2014; M. G. Hermann & Dayton, 2009; Noordegraaf et al., 2017) unfolding, crisis brings together interdependent stakeholders, their methodologies and sometimes conflicting objectives. From its before–during–after cycle to the constitution of a crisis cell (Lagadec, 1995), crisis induces norms, regulations, standards, rules and action plans, particularly in the case of critical infrastructures (Boin & McConnell, 2007). While such planning often follows a traditional top-down and typological logic (Mitroff & Anagnos, 2001), it may also constrain actors' capacity for organizing and sensemaking by prescribing overly specific expectations.

It is for these reasons that Weick (1998) formulates a critique of both organizational behavior and management. Increasing order may enhance task achievement, but it simultaneously amplifies the risk that errors will occur and diffuse widely – what Turner describes as “*anti-tasks*” (Weick, 1998). In constantly seeking to monitor, regulate and contain inappropriate behaviors, management may itself become the embodiment of these very deviations. This is where crisis collectives and simulation-based preparedness play a joint role: only through a subjective, interpretative, embodied and enacted approach can organizations prepare for what their systems can neither predict nor control under current conditions.

EXPLORING TECHNOLOGIES BEYOND THE TENSION BETWEEN STRUCTURES AND AGENCIES

The management–behavior tensions discussed above are particularly visible in HROs, where routines stabilizing collective action simultaneously function as essential resources for coordination and as potential sources of error when they become automatic or insufficiently questioned. Paradoxically, “HROs may be failure-free in spite of their order-seeking, not because of it” (Weick, 1998). This ambivalence leads Weick et al. (1999) to advocate greater integration of HROs into organizational theory, as they illuminate a set of distinctive processes that sustain effectiveness under demanding – and even extreme – conditions. In exemplary HROs, these processes constitute a cognitive infrastructure supporting both “adaptive learning and reliable performance” (Weick et al., 1999).

HROs are therefore theoretically valuable because they prioritize reliability, which implies heightened sensitivity to failure rather than success (Weick, 2011; Weick et al., 1999; Weick & Sutcliffe, 2001, 2007, 2015). Mindfulness, in this sense, is the capability to suppress natural tendencies toward organizational inertia. It is a prerequisite for organizational reliability, enabling the development of cognitive infrastructures that support the reconfiguration of both existing and emergent interpretative schemes or patterns (Weick et al., 1999). This explains why mindfulness involves “mastery of [such] pattern generation” (Weick, 1998), allowing organizations to balance adaptability – retrospective behavioral adjustment – and adaptation – prospective administrative adjustment.

Because of increasing technological interconnectivity and resource interdependence, most organizations are now evolving toward systems that are both tightly coupled and interactively complex (Weick et al., 1999). Organizational mindfulness thus increasingly concerns the internal relationship between behavior, management and computation mediated by technology. This raises ongoing questions about the degree of latency required in managerial practices to effectively constrain complex systems, placing the principle of requisite variety at the core of the debate. This principle concerns the ability of human structures to make sense of the complexity of the systems they are meant to regulate, monitor and control (Weick, 1987). In this regard, sociotechnical coordination processes play a decisive role both in crises and under “normal” conditions.

Whether through command-and-control systems (C2) (Claverie & Desclaux, 2016; Johansson et al., 2024; Landsberg et al., 2025; Zobel & Landsberg, 2025), incident command systems (ICS) (Bigley & Roberts, 2001; Moynihan, 2009b, 2009a), or common operational pictures (COP) (Treurniet & Wolbers, 2021), these systems pursue a shared logic: enabling even bureaucratic processes to remain flexible in complex and stressful environments (Bigley & Roberts, 2001). This can only be achieved if the very structure of the system adapts to that of the social actors, maintaining a continuous mutual adjustment (of thought) through its interface. Their objective is to combine command and control with performance and safety, jointly enacted by stakeholders and information technologies, even under extreme conditions (Arena et al., 2013).

The challenge, however, is that in a world of growing complexity, interdependence and vulnerability, critical infrastructures must develop new ways of coping with crises (Boin & McConnell, 2007). This necessarily entails coordinating a wide range of organizations, implementing societal resilience strategies, and actively engaging and adapting the behaviors of citizens, key operators – particularly infrastructure operators – and local decision-makers (Boin & McConnell, 2007). We therefore focus on how collective thinking is organized during crises (Kornberger et al., 2025), integrating the role of information technologies within critical infrastructure contexts. The guiding question becomes: *“how can systems be designed to ensure critical infrastructure reliability while enabling continuous and reciprocal adaptation between social and technical structures?”*

This concern invites renewed reflection on system design, appropriate filters and organizational memory (Simon et al., 1971). These issues are central to crisis research, as they directly affect three critical mechanisms: imagination (*“how can future crises be envisioned?”*), information sharing (*“how can signal be distinguished from noise?”*), and preparedness (*“how can collective cognitive capacities be enhanced?”*) (Weick, 2005). Because crises also involve the dissemination – and therefore filtering – of unverified information, impressions and residual interpretations (Treurniet & Wolbers, 2021), memory becomes a central issue, particularly as technology externalizes memory and reshapes representations (Havelange et al., 2002). This concern is further amplified by the risks associated with large language models LLMs (Farquhar et al., 2024; Huang et al., 2025; Kosmyrna et al., 2025; Shumailov et al., 2024), especially given the historical role of writing in stabilizing human discourse (Goody & Lejosne, 2006).

Information technologies thus intensify tensions between structure and agency by profoundly reconfiguring cognitive infrastructures. Collective agency is continuously reshaped through sociotechnical systems that enable learning, interpretation, circulation and transformation of information (Leonardi, 2011; Orlikowski, 2007). Since “organizations are consumers, managers, and purveyors of information” (Feldman & March, 1981), and since organizing emerges through social interaction (Hernes & Maitlis, 2010; Weick, 1979, 1995a), we focus on structures and processes that integrate organizing and sensemaking. This highlights an interactional duality between structure and agency (DeSanctis & Poole, 1994; Orlikowski, 1992).

As the social and the material cannot be treated separately but are deeply entangled (Orlikowski & Scott, 2008), emphasis must be placed on both the embodiment of structures in design and their *embeddedness* through information technology artifacts. Because these artifacts are interpreted and enacted through routines in ways that may diverge from designers’ intentions (DeSanctis & Poole, 1994; Labatut et al., 2012), organizational routines function as *generative systems* (Feldman, 2000; Feldman & Pentland, 2003; Labatut et al., 2012). Artifacts – and the structures they instantiate – are therefore continuously reappropriated in practice, which is why “routines, like other social phenomena, embody a duality of structure and agency” (Feldman & Pentland, 2003).

DEVELOPING A METHODOLOGY BASED ON EMBEDDED-EMBODIED REVERBERATION

Through our longitudinal ethnographic study, we observed dynamics of collective thinking within crisis cells, facilitation teams, and their interactions. Over a three-year period, we examined the effectiveness of sociotechnical coordination processes in controlled, simulated environments. This immersion involved sustained presence and engagement with expert crisis management practitioners (consultants) within a specialized firm, across the full cycle of simulation design, facilitation and feedback, linking consultants (designers, facilitators, observers) and clients (commissioners and participant-players). From this prolonged immersion emerged an initial set of empirical insights grounded in an explicitly interpretative approach (Visconti, 2010). These insights are based on an extensive corpus of field notes, iteratively reworked to identify regularities, convergences and similarities (Webb & Weick, 1979).

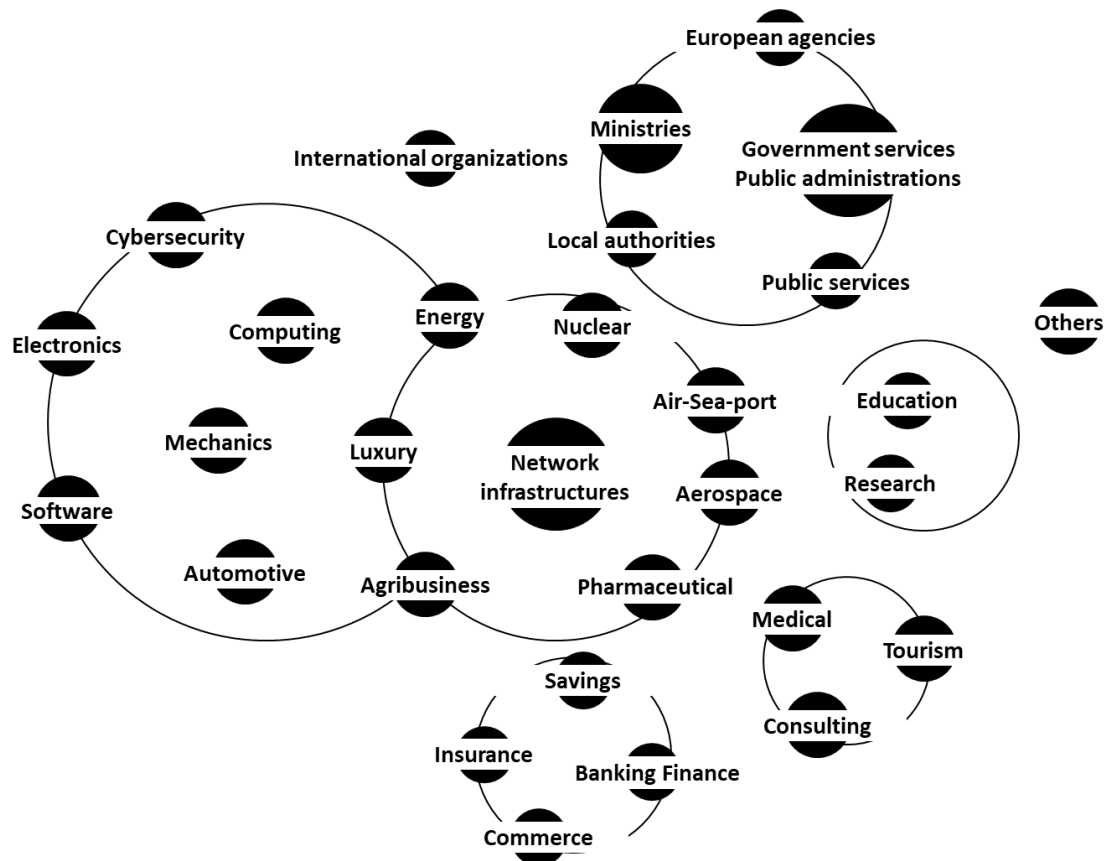


Figure 1: The diversity and interdependence across clients’ business sectors

In line with inductive approaches, this work progressed from first-order concepts to second-order themes and aggregated dimensions (Gioia et al., 2013). Our professional embeddedness provided a fertile field for experimentation and inquiry, while also posing a major challenge of theoretical convergence due to the strong heterogeneity of the contexts studied: diversity of clients¹ (see Figure 1), simulation exercises², thematic

¹ 35% public sector; 65% private sector, covering nearly 30 sectors, including a significant proportion of critical infrastructure.

² Nearly 500 exercises conducted by all consultants over the entire period.

scenarios³ and crisis cells⁴. This diversity was further amplified by variations in organizational maturity⁵, practices and structures; exercise formats and durations⁶; scenario complexity and intensity; participant numbers and roles⁷; and the tools mobilized. Beyond this heterogeneity, the empirical setting required strong interpretative reverberation, as any critical analysis of practices depends on grasping their meaning for all involved actors.

Table 1: Allocation of the researcher's time over the course of the longitudinal ethnographic study

Tpe of observation	Population studied	Number of hours (including feedback)	% of time spent	Number of simulations
Leave	–	884	14%	–
Exercises : Observation Crisis cells	Total	232	3,6%	28
	C- levels	120	1,9%	9
	Etudiants	60	0,9%	10
	Managers & C- levels	16	0,25%	4
	Managers & Operationals	36	0,6%	5
Exercises : Participant observation Facilitation team	Total	467	7%	71
	C- levels	92	1,4%	15
	Etudiants	28	0,4%	4
	Formation continue	56	0,9%	8
	Managers	175	2,7%	23
	Managers & C- levels	28	0,4%	6
	Multi-level	88	1,4%	15
Non exercises : Observations / Interviews Working groups	Total	2704,5	42%	–
	Consultants (obs/interviews)	2404,5	37%	–
	Consultants (working groups)	300	5%	–
Real crisis (cells) : Feedback Semi-structured interviews	Total	206	3,2%	–
	Managers & C- levels	172	2,7%	–
	Multi-level	34	–	–
Research & Development	–	1954,5	30%	–
Total	–	6448	100%	99

Accordingly, our analysis extends beyond consultants to include crisis cells themselves, whose dynamics are crucial for understanding the purposes of certain actions, interpretative processes, constraints, mutual expectations, interrelated challenges and contingencies. Ultimately, our study examines two populations – facilitators and players – observed in situation-specific contexts: crisis cells engaged in simulation exercises. This *situatedness* refers to learning-in-practice, which requires “situating the “person-in-the-world” and making sense of how persons become a member of what they call “socio-cultural communities”” (Contu & Willmott, 2003). Table 1 summarizes the longitudinal ethnography and highlights the researcher's observation work, structured around three sub-questions:

- *How do scenario design and client–consultant interactions upstream preconfigure interpretative frames and scenario plausibility?*
- *Which cues, artifacts and routines are mobilized by participants and facilitation collectives to reduce equivocality and construct a plausible narrative during the exercise?*
- *How does feedback (after-action review) transform situated learning into organizational memory (routinization, tools, procedures)?*

This positioning led us to adopt a theory-building approach grounded in qualitative research, which places *sensemaking* practices at the core of scientific inquiry (Quinlan, 2017). We draw on grounded theory to generate conceptualizations inductively from empirical data rather than from fixed theoretical frameworks (Timmermans

³ Climate, malicious acts/cyber threats, energy, infrastructure, communications/reputation, health/HR, etc.

⁴ Operational, managerial, strategic.

⁵ Ranging from beginner to expert level.

⁶ Of the 99 simulation exercises, 64% table-top, 36% explorative scenarios and 2 full-scale scenarios. Generally, 3 to 4 hours, up to several days for some very rare cases.

⁷ From a few individuals to several dozen participants spread across different teams, including directors, coordinators, communications managers, etc.

& Tavory, 2012). In doing so, we embrace a moderate constructionist stance that accounts for the plurality of socially and situationally constructed realities (Järvensivu & Törnroos, 2010). Abduction plays a central role, enabling the generation of novel insights from empirical observations – particularly case studies – while preserving analytical rigor and validity.

Rooted in a Weickian social psychology perspective, our approach articulates an embedded-embodied dualism that inseparably links sensemaking and organizing (Ann Glynn & Watkiss, 2020; Sandberg & Tsoukas, 2020; Tsoukas et al., 2020; Weick, 1995a, 2001, 2009; Weick et al., 2005). Within this framework, context shapes cognitive structuring: certain macro-contingencies may be explained by psychological characteristics, while micro-level conditioning may depend on sociological constraints – and *vice versa*. In this regard, enactment, like “*intra-action* signifies the mutual constitution of entangled agencies” (Barad, 2007, p.33). Action and meaning thus appear as states of *entangled state of agencies*, understood as conditions of *becoming*.

Before going further, three clarifications are essential.

First, our study focuses on scenario-based simulations (Berggren et al., 2025) rather than serious games. While closely related (Crookall, 2010) and frequently presented as effective tools for organizational and individual learning (Borodzicz & Van Haperen, 2002; Cros & Vraie, 2018; Sitzmann, 2011; 't Hart, 1997), simulation support systems remain underexplored and are therefore central to our analysis.

Second, although Kleiboer (1997) proposed a structured methodology for crisis simulation design, few significant advances have followed – particularly regarding associated support systems – highlighting both the relevance and urgency of renewed approaches, as confirmed by our observations of practitioners relying on heterogeneous tools to compensate for this gap⁸.

Third, we do not examine decision-support systems⁹ – although their appreciation of uncertainty is interesting (Zack, 2007) –, but systems dedicated to the production of interpretations – that is, to facilitating coordination processes among actors. The core issue lies less in identifying optimal decisions than in constructing, through organizing and sensemaking, a plausible narrative of unfolding events.

STRUCTURING EMPIRICAL FINDINGS ACCORDING TO THREE TYPES OF RECONFIGURATIONS

Our empirical findings underscore the structuring role of ontological assumptions in crisis simulations. These assumptions – comprising implicit presuppositions, internalized schemas and rules embedded in planning and internal policies – frame action upstream and generate sequences of roles and responsibilities that often remain unquestioned. When role allocation proves misaligned with the evolving scenario, this misfit is typically recognized only retrospectively during feedback sessions. Crisis cells thus tend to remain locked into initial (pre)configurations, often resulting from hierarchical decisions, role distributions mirroring formal organizational functions, or the uncritical application of procedures insufficiently adapted to the situation.

In simulations, as in real crises, these framing effects produce anchoring biases and forms of ontological confusion, whereby actors act on assumed interpretations without retracing their emergence or questioning enacted trajectories. Mindfulness emerges here as a central process countering organizational inertia. It materializes in the capacity to track decisions, interpretations and initiatives as they unfold, particularly when responsibilities are diffuse. Empirically, relevant remarks or quasi-instructions frequently dissipate in interaction without explicit follow-up, leading to unfinished initiatives and abandoned tasks – often recognized only *ex post* as having potentially critical consequences.

Simulation exercises therefore highlight accountability and traceability as core dimensions of coordination. Effective structuring requires following chains of action across stakeholders, prompting reformulations to ensure shared understanding, and formalizing commitments, notably through explicit and documented responsibility. The key issue lies less in the artifacts mobilized than in the organization of processes that sustain responsibility over time.

When such structuring is collectively shared, coordination becomes more fluid: interaction stabilizes, priorities clarify and anticipation improves. The most effective crisis cells display a proactive capacity for reconfiguration,

⁸ Communication (calls, emails, messaging apps), spreadsheets, mind maps, media and social media monitoring, mapping, graphics, diagrams, surveys, audio and video editing, etc.

⁹ It should be noted that decision-support systems are rarely integrated into simulation exercises. Their use requires the input of fictitious yet realistic data, which places a significant burden on the organizing teams. This is particularly complex for consultancy firms, which generally do not have access to historical data. Furthermore, such integration raises sensitive issues relating to transparency and access to potentially confidential information. Nevertheless, when they are used, their impact on realism, immersion and participant engagement is undeniable.

progressively adjusting their structure by creating sub-cells and decomposing objectives into operational tasks. This supports adaptive command-and-control processes that maintain flexibility under uncertainty and enables the emergence of new interpretative schemes through collective reflexivity.

These dynamics are particularly visible when decision-makers create distance from operational pressure, opening space for shared sensemaking and constructive critique. Even less mature cells benefit from this progressive reappropriation of the environment, especially in later phases of exercises. In this process, information technologies appear not as determinants of action, but as extensions of social interaction. Observed limitations typically reflect misalignments – organizational, individual or collective – attributed to tools but rooted primarily in usage and engagement dynamics.

Simulation exercises thus function as devices of mindfulness, revealing organizational routines as generative systems through three interconnected reconfiguration dynamics (see Table 2).

Prospective reconfiguration operates from organizations toward individuals, mobilizing traces of the past – plans and previous crises – to structure scenario design and deployment. It contributes to shaping organizational identity and preparedness by interpreting yesterday’s learning to imagine tomorrow’s phenomena.

Actualized reconfiguration unfolds during exercises through interactions between crisis cells and facilitation teams. Under uncertainty, these collectives co-produce shared representations and solutions, supported by sociotechnical processes that continuously regulate alignment. Through this interaction, actors enact a shared environment.

Retrospective reconfiguration moves from collectives back to the organization. Through feedback processes, situated learning is captured, interpreted and aggregated into organizational memory, revealing strengths and vulnerabilities and enabling durable adjustments between behavior and management.

Table 2: The enactment of simulation, viewed as a process of situated co-emergence within the social environment

Temporality	Type de reconfiguration	Organizing perspective: co-constitutive interaction	Sensemaking perspective: purpose of selective vocabulary	Generative Systems Perspective: reappropriation through practice
Before	Prospective reconfiguration	Clients-Consultants	Construction and engagement	Interpretation
During	Actualized reconfiguration	Players-Facilitators Cells-Teams	Enactment and co-interpretation	Facilitation
After	Retrospective reconfiguration	Collectives-Organizations	Learning and reconfiguration	Learning

Taken together, simulation exercises provide a structured environment for developing shared competencies, reflexes and understandings that cannot be improvised under stress, particularly in C2 settings. Simulation design is therefore understood not only as a situated co-emergent process during the exercise, but as a broader process involving clients and consultants before and after simulations. Through this extended interaction, simulations contribute to the enactment of a shared (enacted) environment that subsequently shapes and constrains organizational practice (see Figure 2).

We describe this dynamic as situated emergence because organizational learning and interpretation unfold across multiple spatio-temporal scales. Within a single organization, distinct units may mobilize simulations independently to address specific issues, generating differentiated yet interrelated processes. Organizational change thus proceeds fragmentarily through evolving configurations of individuals, collectives and their respective agencies. It is through the interaction of these transformations that organizations continuously reconfigure themselves at the intersection of organizing and sensemaking – highlighting the need for simulation support systems capable of ensuring traceability across scales.

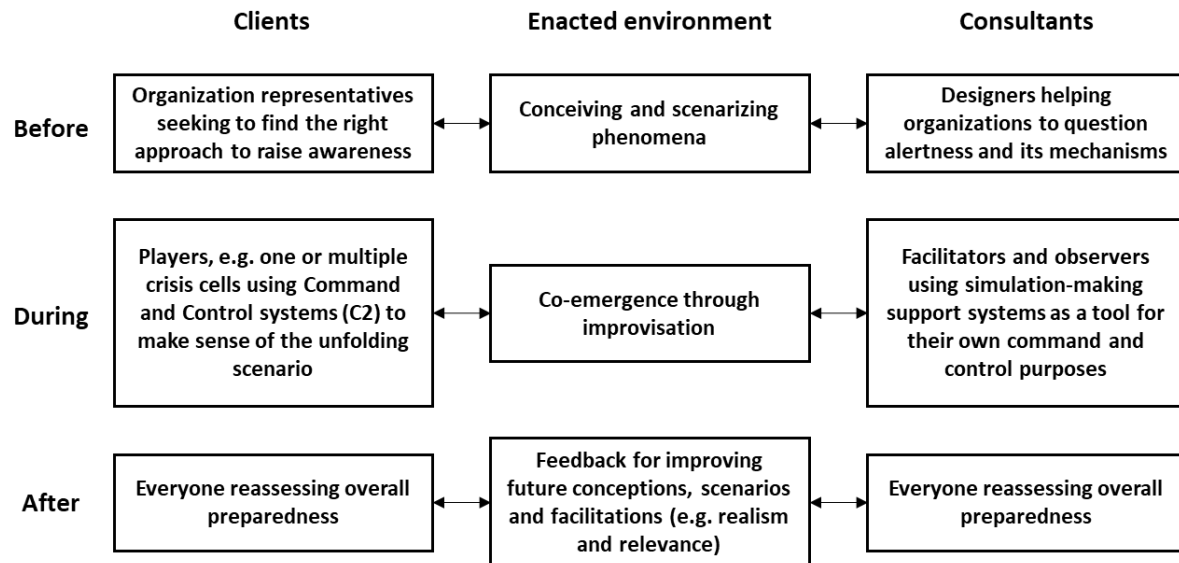


Figure 2: An overview of simulation-making support systems as social mechanisms for reassessing alertness

CONCLUSION: TWO SUPPORT SYSTEMS MIRRORING ONE ANOTHER

We define simulation-making as a participatory exercise and a process of social construction aimed at enacting a contextually rich sequence of events, situations and episodes – one or several phenomena – triggered and modulated by human-machine interventions. These stimuli are intended to generate interactions among actors that simultaneously constitute a learning environment, enabling individuals to develop adaptive capabilities (action, interpretation, signal transmission), and a strategic space through which organizations assess, refine and strengthen their crisis preparedness, coordination practices and reliability mechanisms.

From this perspective, simulation plays a dual role. First, it contributes to disseminating experience-based approaches that reinforce both alertness and mindfulness through systematic feedback processes. Second, it serves as a privileged setting for the design and testing of command-and-control (C2) systems. These two systems are deeply interrelated: one seeks to reconstruct phenomena from fragmented information, while the other decomposes phenomena into informational elements that must subsequently be reassembled. Their relationship is thus one of co-constitution, operating through a mirroring dynamic in which the outputs of one become the inputs of the other, embedding both within situated processes of co-emergence (see Figure 3). The issue, therefore, is not limited to system design(ing) as such, but extends to their capability for continuous adaptation to the contexts in which they are enacted.

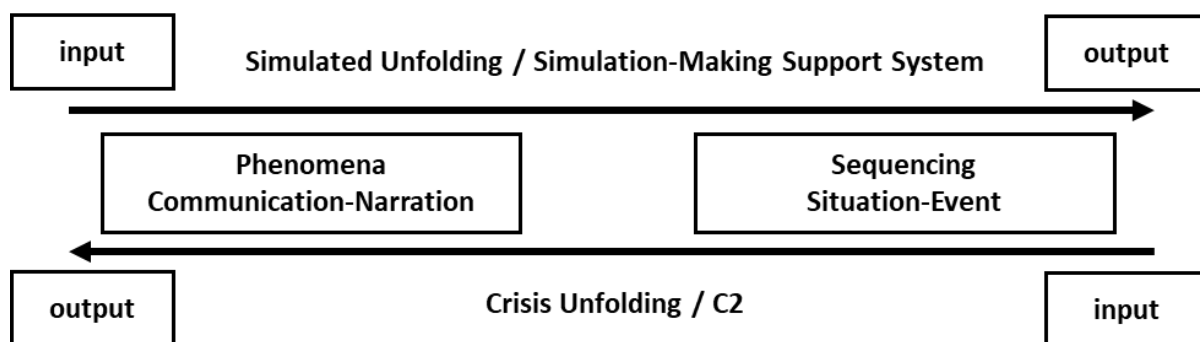


Figure 3: Simulated and non-simulated unfolding: two support systems mirroring one another

Our study sought to clarify the role of information technologies in the intra-actions and interpretative processes that structure crisis collectives, not only within simulations themselves but across the full simulation cycle – before, during and after. As constitutive elements of contemporary cognitive infrastructures, these technologies profoundly reconfigure the linkages between organizing and sensemaking. In this regard, simulation exercises appear as privileged spaces for exploring and experimenting with routinization processes that can both stabilize and transform organizations. Future research would benefit from approaching these mechanisms not merely as pedagogical tools, but as sites where organizational dynamics emerge, are tested and transformed.

Regardless of whether simulation systems are conceived as integrated systems, loosely interoperable sets of tools, or evolving sociotechnical assemblages spanning multiple artifacts, their design invariably raises the question of situated emergence: how will these systems actually be used in practice? From this standpoint, scenario design(ing) occupies a central role, insofar as it reifies imagined realities and enables participants to stage – i.e. to enact – possible future states and trajectories of a given social system (Kleiboer, 1997). Scenario design thus constitutes a powerful means of questioning conventional beliefs and encouraging more comprehensive and creative engagements with organizational futures.

Beyond the consolidation of learning for designers, facilitators and observers (Borodzicz & Van Haperen, 2002), simulation design entails a recursive reassessment of organizational preparedness that mirrors the classic crisis lifecycle: before, during and after. This approach actively engages stakeholders throughout the exercise and unfolds through three interconnected reconfiguration dynamics.

Prospective (or pre-)configuration takes place upstream of the simulation, as organizations and stakeholders collectively interrogate selected phenomena and their potential organizational implications, fostering early awareness of latent vulnerabilities. Actualized (or pro-)configuration unfolds during the exercise as a process of situated co-emergence, in which crisis cells and facilitation collectives collectively bring the scenario to life through guided improvisation. Finally, retrospective (or post-)configuration occurs after the exercise, as feedback processes are mobilized to assess individuals, crisis cells and the organization as a whole, particularly with regard to role preparedness, domain expertise, the adequacy of tools and artifacts, and the robustness of systems and procedures – in short, command and control.

Taken together, these findings highlight simulation design as a sociotechnical process through which organizations enact, interrogate and reconfigure their own conditions of reliability. By providing structured yet flexible environments for collective learning and reflection, simulations contribute to the continuous reconfiguration of organizing and sensemaking processes across time and scale, thereby supporting organizational resilience in the face of uncertainty.

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