When Failure Cascades: Simulating Emergency Complexity in the EMCE Game Series

By Micael Sousa, Ph.D., Chief Game Designer, CAPTRS; Associated Researcher CITTA, University of Coimbra

Emergency management is, at its core, the management of interdependence. A power outage can disrupt entire territories, and hospitals can be critical nodes of the system. Flooded roads delay rescue operations. A damaged bridge cuts off entire communities. These are not isolated incidents but cascading effects and chains of incremental failures in which one disrupted system triggers dysfunction in the next. Training emergency managers to anticipate and respond to these chain reactions is one of the most persistent challenges in preparedness education and practitioner training. Traditional tabletop exercises often present events sequentially and linearly, failing to capture the simultaneous, non-linear nature of real disasters. Neither do they have interactive feedback loops based on player agency, where decisions matter and are visualized. A game provides solutions to these gaps, grounding experiential learning in the results of the players' actions.

The Emergency Management Cascading Effects (EMCE) game series, developed at the Center for Preparedness Threat Response Simulation (CAPTRS), an organization focused on redefining preparedness through serious games, takes a different approach from traditional tabletop exercises using an interdisciplinary team of experts. First, it is a serious game; second, its mechanics and narrative arc are designed to address targeted learning objectives and training exercises. At this moment, there are two games produced by CAPTRS that place cascading effects at the very center of their design that are ready to use, and more in development. These are (1) EMCE: City Blackout and (2) EMCE: Hurricane. Rather than describing complexity, these games simulate it. This article examines the mechanics of how each game's cascading effects are modeled, why this matters for the training of emergency management professionals, and what the EMCE series contributes to a growing field of serious games for emergency preparedness.

Rice University's Incident Management Team playing the EMCE: City Blackout game.

Attendees at the IAEM Annual conference playing the EMCE: Hurricane game.

The Anatomy of Cascading Effects in Emergencies

Cascading effects in emergencies are the processes by which disruptions in one system (physical, social, or institutional) spread to other interconnected systems, amplifying the overall impact of the initial event. A snowstorm is not simply a weather event; it is a trigger for road network failure, power grid collapse, heating system breakdown, hospital overload, and communication shutdown, all of which interact and amplify one another. As Pescaroli and Alexander (2016) have argued, it is precisely these cascading dynamics that overwhelm emergency systems, turning manageable incidents into crises.

Preparing for cascading effects requires more than knowledge of individual hazards. It demands what might be called systemic situational awareness, as the capacity to read a complex, evolving landscape and anticipate second- and third-order consequences of both the disaster and of one's own response decisions. This is difficult to teach in a classroom and nearly impossible to convey through static planning documents. It requires the kind of experience that serious games, at their best, can provide.

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EMCE: City Blackout — Cascading Effects as Game Architecture

EMCE: City Blackout simulates a severe snowstorm and subsequent widespread power blackout in an unprepared city. The game is built around a dual-layer spatial model: a Game Map made up of hexagons representing distinct urban zones (high-density, low-density, etc.), and a Cascade Board that tracks nine community-wide systemic failures unfolding across three timed rounds.

The Cascade Board is the heart of the game's cascading effects model. Each of the nine Cascade Boxes (CBs) represents a distinct failure domain, from road impact constraints and communications shutdown to water shortage, building heating system failures, looting and civil unrest, and, ultimately, reduced hospital services. These boxes are not independent; they are linked through explicit dependency rules. Success in the preparedness and planning phase of the game can unlock bonus tokens in later boxes; failure compounds as the crisis level rises. Players can literally read the cascade as it unfolds, translating the abstract systemic relationship into tangible visual elements to support decision-making, post-game analysis, and learning.

The game's power restoration mechanic introduces a second cascading logic, this time positive. Players who allocated their resources to restore power can decide where to go first. Power spreads from external grid nodes inward, from adjacency to adjacency, mirroring the real physics of grid restoration, which is not immediate due to safety and power stability considerations. Once a hex is powered, it's easier to respond to events at that location. This is a direct mechanical reward for systemic thinking. The message is clear: Spatial and systemic preparation pays forward.

EMCE: Hurricane — Territorial Asymmetry and Probabilistic Cascades

EMCE: Hurricane addresses a different but equally important dimension of cascading complexity: territorial inequality. In the Hurricane game, four fictional jurisdictions (Salt, Amethyst, Coal, and Copper), each with realistic characteristics, manage their own territories using separate player screens, distinct resource pools, and asymmetric hex maps. The same storm affects each jurisdiction differently depending on its infrastructure, population density, and geographic exposure.

The cascading model here operates across two scales. At the macro level, a probabilistic storm path board models the realistic unpredictability of hurricane tracking. Players cannot know exactly where landfall will occur, forcing preparedness decisions under genuine spatial uncertainty. This mirrors the experience of real emergency managers who must allocate resources before knowing where the worst damage will fall.

Close-up of the EMCE: Hurricane game board.

At the micro level, damage cascades through four interdependent damage resilient capacity (wind, flooding, power/communications, and critical infrastructure) generating population impacts. High-density urban hexes on the map and riverside hexes accumulate compounding damage from multiple sources. As the crisis escalates, players are incentivized into inter-jurisdictional coordination, transforming what began as four parallel games into one shared crisis. The cascade, in this case, is social as well as physical, collapsing the boundaries between independent actors and demands collective response.

Both games approach learning the game mechanics in different ways. EMCE: Firetruck has a short, introductory tutorial game that introduces the core mechanics of EMCE: City Blackout. It reflects the SIMRED framework (Sousa & De Rosa, 2025), an acronym created which stands for Serious Game Integrated Methodology for Real-World Development. This framework is a tutorial design which is not merely pedagogical scaffolding but a learning experience. In EMCE: Firetruck, players experience a compressed version of the cascade model before confronting the full complexity of the City Blackout game, building the cognitive models they will need to play the full game and navigate systemic failure under time pressure. EMCE: Hurricane has an embedded tutorial that allows the players to learn the game mechanics as the game progresses and escalates.

Contributions to Emergency Management Training

The EMCE games have been tested with emergency management

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professionals, university students, city officials, public safety personnel, and policymakers across multiple contexts, including conferences, institutional training sessions, and university courses. These games make three specific contributions to training that stands out.

First, the games make cascading consequences visible and reversible. In real emergencies, the consequences of poor resource allocation may not be apparent for hours or days. In EMCE, a decision to neglect power restoration becomes visible within minutes as unresolved events re-trigger and crisis levels climb. The game's structured debrief, supported by the EMCE: Insight app (which records game data), allows facilitators to trace the exact chain from early decision to late consequence and to show immediate post-action reports. This closes the feedback loop that real emergencies rarely provide.

Second, the games cultivate systemic situational awareness across an expert–non-expert continuum. Emergency management is a team of teams, as Comfort et al. (2012) have observed, requiring coordination not only within but across organizations with different cultures and goals. The EMCE series makes this coordination a physical, spatial, and temporal challenge rather than an abstract principle. Players learn that managing a power outage is inseparable from managing a water shortage, and that both are shaped by decisions made in the previous game steps.

Third, the EMCE series models territorial and resource dynamics and inequalities that conventional training tools tend to smooth over. By encoding different urban densities, infrastructure levels, and geographic exposures directly into the hex maps, the games ensure that players encounter the spatial unevenness of real disasters. The same storm does not produce the same consequences everywhere. This is not merely a game design choice; it is a training objective that prepares emergency managers to reason about differential vulnerability rather than treating a disaster zone as a uniform problem space. 🔷

Conclusion

The EMCE game series demonstrates that cascading effects need not remain an abstract concept in emergency management training. By embedding cascade logic directly into game mechanics through interdependent Cascade Boards, probabilistic storm paths, power grid restoration, re-triggering events, and territorial asymmetry, EMCE: City Blackout and EMCE: Hurricane give players a structured, memorable, and engaging experience of systemic failure that transfers to real-world reasoning.

What distinguishes these games is not complexity for its own sake, but purposeful design in the service of specific learning objectives: to feel the weight of early decisions, to navigate resource scarcity under time pressure, to coordinate across organizational boundaries, and to read a crisis as a system rather than a sequence of isolated incidents. In doing so, the EMCE series makes a meaningful contribution to the growing field of serious games for emergency preparedness, and to the ongoing challenge of training professionals who must manage not just what fails, but everything that fails next.

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