Training decision-makers: Existing strategies for natural and technological crisis management and specifications of an improved simulation-based tool

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ABSTRACT

Serious games and environmental computer-based simulations can be useful training tools for people who have to act in emergencies. Currently, stakeholders who deal with crises have to make decisions under stress, for example in order to mitigate consequences or avoid negative impacts on high-stake elements.

Many factors are critical in a training environment for ensuring that effective learning occurs, principally: experience improvement, engagement and immersion, and realism.

This paper aims to identify the limits of existing learning systems for emergency stakeholders within a crisis cell and then to propose a set of recommendations in order to specify a system to improve the effectiveness of peoples' actions in case of a major crisis.

The development of this approach requires the pooling of information concerning varied and multidisciplinary skills. The paper first focuses on the classical difficulties of crisis management, after which the notion of experience in decision-making is defined. The issue is studied from three points of view: the educational approach, the simulation system, and the training environment. The last section of this paper contributes to establishing a set of enhancements which can lead to the specification of simulation based learning systems for further development. More particularly, we specify the needed characteristics of our learning approach and teaching strategy. Finally, we propose a model with the main steps that have to be implemented in order to design a new learning system: a semi-virtual training environment for strategic crisis management.

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1. Introduction

Disasters impinging on the world over the last thirty years illustrate how most societies are increasingly faced with highly disruptive events (e.g. Fukushima in 2011).

According to Morin, the concept of emergency has spread to all areas but remains the sudden and intense appearance of a rupture event, which usually requires a human response (Morin et al., 2004). In most countries, the emergency response is not only structured depending on the type of event and its intensity but also codified via a specific organizational system: the crisis cell (Wybo and Madland Kowalski, 1998; Dautun, 2007).

In the field of major risks, a crisis is characterized by a loss of control and thus a high level of stress for the stakeholders involved due to a "spark event" (i.e. an unexpected trigger) causing a disruption of the balance of a system (for example an organization, an infrastructure, a territory, etc.) (Marguin, 2002).

Crisis management involves quick decision-making in critical conditions, with the obligation of issuing a public report to the media (Sniezek et al., 2001; Lagadec, 2007). Crises therefore lead decision-makers into an urgent decision-making situation, with the obligation to minimize the potential consequences for a wide range of high-stake elements (Tena-Chollet et al., 2013).

On the one hand, estimating the consequences of a decision taken in a risky situation is delicate due to the complexity of the available information and also because of the emergency context in which such strategic decisions must be taken. On the other hand, the decision-makers involved may become particularly vulnerable and hence unable to fulfill their missions with regard to events concerning the management of crises (Lachtar and Garbolino, 2012).

Recent works demonstrate that simulation games are effective tools in the teaching of management techniques and engineering

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and have been widely used in experiential learning (Mawdesley et al., 2011).

This subject is a research project studying the way to improve the conditions of cooperative learning of the actors involved in crises (stakeholders for example) within a closed group (a crisis cell). We believe the innovation of our approach is that we recognized the lack of suitable simulation-based training environments through a state-of-the-art study of existing educational strategies, and also that we identified key concepts and specifications that can guide the development of an innovative deployable learning system.

The development of this approach requires the state of the art study concerning varied and multidisciplinary skills. The paper first focuses on the classical difficulties of crisis management, after which the notion of experience in decision-making is defined. The issue is studied from three points of view: the educational approach, the simulation system, and the training environment. Finally, the last section of this paper contributes to establishing a set of enhancements which can lead to the specification of simulation based learning systems for further development.

2. Classical crisis management difficulties

Many authors have noticed that the human factor, rather than existing plans, the management of resources, or the uncertainty of the situation, is often a major source of vulnerability in the decision-making process (Turner, 1978; Denis, 1993; Parkin, 1996; Pearson et al., 1997; Loosemore, 1998; Smith and Dowell, 2000; Weisæth et al., 2002; Sayegh et al., 2004; Crocq et al., 2009; Heiderich, 2010). Conversely, decision-making, communication, mental model sharing, leadership and coordination are critical skills to be used by a crisis cell (Salas and Cannon-Bowers, 1997; Dautun, 2007).

A rapid survey of past major accidents shows that management difficulties in emergency situations, problems of shared mental representations of an unknown problem, and behavior failures within a closed group, are the main sources of social vulnerability in decision-making groups (Tena-Chollet, 2012).

As a result, habits and knowledge which help to monitor the situation, to anticipate possible consequences, to choose concerted actions, and to communicate together and cooperate need to be taken into account. We thus propose to study all these skills, necessary for emergency management, through the decision-makers' experience.

3. Paradox of experience in emergency management

Theoretically, the processes of decision-making can be creative, analytical, procedural or naturalistic (Bryant et al., 2003). In practice, a crisis involves critical stakes, significant effects and limited reaction times, and the decision-making process is thus mainly naturalistic (Shanteau, 1987; Means et al., 1993; Klein, 1997). This raises the following paradox: although a crisis is exceptional, decisions during its management depend on previous experienced situations.

In order to achieve a common goal, each member of a crisis cell must perform tasks involving teamwork (Smith and Dowell, 2000; Schaafstal et al., 2001). The study of characteristic profiles enables developers, evaluators and decision-makers to be distinguished. These three profiles mobilize the following non-specific technical skills: anticipation, communication, teamwork, stress management, decision-making, and leadership (Rasmussen, 1983; Weisæth et al., 2002; Endsley, 2003; Crichton, 2009).

The uncertainty, complexity and fragmentation of the available information have a direct impact on the activation of the six skills mentioned above. Not only can decisions not be taken in full knowledge, but also require the cooperation of emergency management actors who are not always accustomed working together (Smith and Dowell, 2000). These difficulties can lead to a lack of:

- Internal and external communications of the crisis cell (Lagadec, 1995).
- Shared mental models between actors (Cannon-Bowers et al., 1993).

It has been found that individualism can sometimes outweigh cooperation, and that the actions of members of the same social group (a crisis cell for example) can be degraded by the following human behaviors: alterability, subjectivity, ignorance, credulity, disaffection or asociality. However, these undesirable behaviors tend to disappear whenever a situation threatens to affect psychosocial factors. Human behaviors are for instance positively impacted by stress, and the following qualities can be observed: instinct, learning, intelligence and adaptability (Bates et al., 1991; Buser, 2002).

Several authors postulate that decision-making in a crisis requires previous learning, and training exercises are therefore a classic way to help crisis management stakeholders to implement strategies with hindsight (Lagadec, 2001; Dautun, 2007). It is therefore necessary to study the different types of training provided in the crisis management field. The aim of this state-of-the-art is to check whether the required stakeholder skills are integrated in the existing training sessions, and in particular whether the simulated crises are realistic.

4. Research issues regarding the training of decision-makers

Training in crisis management aims to facilitate the transposition of learned skills from theory to practice (i.e. in real situations). During group sessions, learners can share their experiences, knowledge and points of view in order to experience new ways of thinking (Galvão et al., 2000).

4.1. Training research

The training session requires the following steps: planning, preparation, exercise, and reflexive analysis (Morin et al., 2004).

Usually, a training session can be based on exchanging roles, managing events, or acting under degraded conditions. This last type is also called "critical thinking training" (CTT) (Blickensderfer et al., 1998; Cohen et al., 1998; Fowlkes et al., 1998). We can notice that the event-based approach to training (EBAT) uses naturalistic decision making (Fowlkes et al., 1998) and is thus directly in the scope of our research question. It is also interesting to note that the CTT approach covers some key concepts of crisis management, for example to cope with large amounts of information. Fig. 1 summarizes the main pros and cons of each training approach. We can see that the first one (based on the exchange of roles) is not adapted to our research (do not train on skills usually assumed by stakeholders).

Different types of exercises can be implemented: tabletop, real-life, or functional. Real-life exercises usually focus on specific tasks and mobilize many actors (stakeholders, emergency services, residents…). They are then difficult to organize and are often one shot exercises. Tabletop exercises help to test the capability of an organization to respond to a simulated event in terms of planning, preparation, and coordination, in a stress-free environment: equipment is not used, resources are not deployed, and time pressures are not introduced. Generally, tabletop exercises are focusing on specific parts of a crisis only. Functional exercises confer the