

Handling experience feedback on crisis management for decision support

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Résumé – En matière de gestion de crises, malgré les progrès réalisés dans ce domaine, un ensemble de questions demeurent posées par les managers de cellules de crises et les responsables du SAMU (Service d'Aide Médicale Urgente). Ses questions sont généralement autour de : la pertinence des décisions, la rapidité et l'efficacité des interventions sur le terrain, la communication, la coordination et la perte d'information. Nous cherchons à contribuer à ce domaine par des moyens et des méthodes permettant, d'une part ; de reconnaître les situations et d'autre part ; d'assurer des formations aux acteurs concernés. Nous présentons dans cet article nos premiers résultats liés à la définition de structures de retour d'expériences et les éléments d'un futur système d'aide à la décision.

Abstract – Crisis management is a special type of collaborative situation in which the actors are subject to an uninterrupted stress. To deal with the important consequences (human and economic losses) of these situations, we study how to represent emergency management situations based on experience feedback. We use several techniques: situations representations, knowledge engineering techniques and scenarios definition. Several dimensions are considered in this study: organization, communication and problem solving activities. We present in this paper our first results related to the representation of crisis management. Our first concern is to define the structures and interface in order to handle experience of crisis management. This creates the necessary foundation to help the actors to make decisions during the management of crisis and be more focus on gaps during the training and preparation exercises. This work is done with the collaboration of the Aube' Emergency Department.

1. Introduction

The medical services have a key role when the crisis endangers lives. The surprising events and the time pressure render the decisions more crucial [7] and intervention become more complex. A lot of progress has been made on this issue, such as improving emergency services in hospitals and the establishment of cell crises, definition of general and specific plans of intervention and ministerial circulars awareness to deal with most common threats [4]. But, the problems of the optimality of decisions speed and effectiveness of interventions are still present. Those problems have, in general, three issues; communication, coordination and loss of information. The first stage of this research is to examine, through a series of interviews, within Aube's Emergency Department interventions in crisis management, identify and determine how they deal with the situations and how they coordinate actions in order to make optimal decisions. We will also, in this context, report on training exercises.

Our work focuses, mainly, on understanding the domain of medical intervention, its limits and chain of interactions between human factors and systems elements; Those elements represent the keys for such a catastrophic management failure or success. Some crises also point to the problems that exist around our knowledge of the processes that represent modern organizational practices [15]. Crisis management is also a cooperative activity.

Organization, coordination and communication must be at least considered. So, we integrate the cooperative dimension in crisis situation representation. The notion of place and time [15] are also very determining as important indicators take place on decision making during crisis management. Experts identify different types of situations to represent and we work with them for acquiring experience and definition of common structures [8] [13] to represent this experience. They are looking forward to promote the reuse of this experience and acquiring a future one Thus, we can develop several techniques in order to handle problem solving and experience memorization. We promote the use of experience feedback to support learning and decision making. As first solutions, we offer to represent the experience feedback using on one hand experience-based and situation representation methods and on the other hand knowledge engineering methods, in order to define the specifications of a system as decision making environment. We also aim at studying scenario representation to promote learning from this type of situations.

We define in this paper several techniques as situations and experience based method and knowledge engineering. Then, we detail with our results using noted methods to make explicit the experience feedback structure and reuse within an example including deferent aspect tacked on consideration. We finish with showing how the final system will provide the help to decision maker.

2. Used techniques

We use several techniques in order to identify a representation structure of an accident. In fact, works on situations representations [2] give techniques to represent a situation as states and events. Case-based-reasoning (CBR) [6] [1] proposes to define the context as well as the solution of a problem. It also provides a process for case recognition and adaptation. Otherwise, Knowledge engineering [12] techniques help to extract and formalize expertise as strategies, plans, and concepts. These techniques serve as a base for an operational system to help the decision makers.

3. Representation of crisis

Crisis situation differs from an emergency by its destabilizing effects [7] "Emergency, plus destabilization," an emergency is an event for which intervention procedures are known, the specialized requirements are clearly identified, and the roles and responsibilities are clearly divided. Thus, in our study, we aim to define a structure in which the process of intervention is related to each situation. This structure represents as well as roles and responsibilities assignment.

The choice of our approach as a case based analysis [3] is imposed by the informal nature of the crises field, in which the actors express their knowledge through a set of real-life situations. A crisis also has a dynamic character, thus we need an incremental process for the introduction of new knowledge (situation). We use the techniques of case-based reasoning (CBR) [6] and especially the description of situations to define a structure of representation of crisis, taking into account the context and problem solving. Similarly, the type of underlying reasoning in CBR systems can be based on an analogy of situations [1], very useful in the recognition of crisis situations.

In other parts of our work, we need to represent a feedback of these situations. This experience is generally owned by all the actors involved in this type of treatment as well as documents and reports prepared as a result of these treatments. Knowledge Engineering provides techniques to represent expertise in problem solving. These techniques allow highlighting key points as objectives and reasons for certain actions of the expert and the roles of data and objects used in these actions. We use these techniques to do interviews with experts and to represent rules and concepts used in crisis management experiences.

The cooperative aspect must be considered including coordination, communication and cooperative problem solving [10] in order to specify several actors with different objectives who are involved in crisis management. In this project, we studied the dimensions of coordination and communication conducted by a single type of actor: the Emergency Department. Cooperative decision making in a crisis where other types of actors are involved (the prefecture, firefighters, police,) is not studied in this work.

To summarize, the different aspects to be considered in the future system are:

- Representation of the context of the situation: environmental information on and available resources,
- Dynamic representation of the problem-solving considering the evolution of situation,
- Successes and failures pointed on each intervention as well as rules and concepts,
- Identification of the types of situations and criteria for recognition of these situations,
- Representation of the communication between the actors within spatial dimension (various locations)
- Coordination in actions as well as human and material logistics.

4. Crisis representation structure

4.1 Unwinding spaces of crisis

The space (place) is a mean dimension in crisis management, the representation of the organization of actors in relation to the space will help, in one hand, to clarify the type of existing communication and vision that each actor has on the situation. In the other hand it makes more clearly the manner in which we make sense of crisis events and issues around problems associated with managing the acute phase of a crisis, as well as dealing with its location, setting, victims destination and its aftermath. Three places have been identified [13]:

- The Crisis cell: is the place of the control and the orchestration of the intervention, its most important role is managing the material and human resources. The link with outside and the responsible of emergency department (the rear base) is done by the communication center.
- Crisis site: The area affected by the event, it includes actors such as the first medical team and advanced medical and other professionals.
- Emergencies: These services receive victims and their families and ensure their follow-up. The choice of the orientation of the victims is achieved by the rear base, depending on the distance of crisis site and or available places and required specialties for each victim.

4.2 Actor Tasks and communication links in chronological order

The time dimension is very important in crisis management as we clarified above not only in terms of life preserving as a final aim. But it has also a main importance on each episode during the intervention. It must be considered in manner that it can provide [13] to decision makers an empirical and control environment in which they can have an overview of what happens in terms of tasks and actions duration, what must be done or what should be done immediately etc.

The final system is based on a structure in which we can represent: in term of communication, the different communication links that the actor has with the others during the time and nature of exchange. In term of experiences representation, this structure helps to represent several tasks; to deal in each moment with associated problems as well as consequences if the task does not respect its attended duration and its recommendations. The (FIG. 1) shows the structure applied for the responsible of emergency department, it represents his work and communication links during the duration of an intervention.

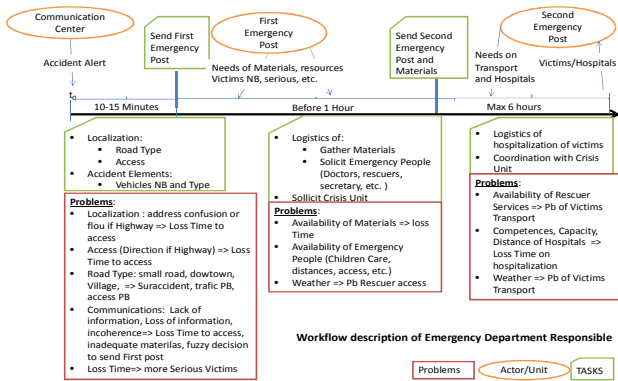


FIG. 1: Description of a work for an actor: the responsible of emergency department

The point t0 is the start point related to the reception of the trigger event, it offers the possibility to estimate the start time of each task as well as the appropriate moment for the various exchanges for better cooperation. This structure has been, already, tested on road accident situations, intervention on an infirmary establishment because of a fire alarm and on an accident in a school caused by a falling crane. This structure can be adopted to represent a number of situations and for each [8] specific one its success and failure keys depending on time.

5. Reasoning using previous situations

5.1 Situation definition

A crisis situation can incorporate several elements and characteristics related to others crisis, for example, a road accident can generate a sinister situation, specially a chemical accident when a tanker transporting a chemical substance is implicated. Then, representing situation as a road accident is not enough. Thus respecting this classic classification will require each time to add related elements that emerge. So, the result is a few number of cluttered situations seen that there are elements to ignore or add during each uses.

Our approach uses then another alternative, the idea is to create a new index for each indicator in order to define a new case which is a complete or part of a situation. This representation will allow the system to rebuild such situations using many combination possibilities. The search

within the cases is made using the perceived indicators as and when they are available. For each case we defined three parts; set of characteristics, set of tasks to do and the problems involved if the task is not completed.

To guide decision makers in crisis situations we can act at two levels. The first one concerns the perception of the context as an important element in reasoning process [16] by providing additional and useful data with less ambiguity about context using the quick and automatic research in GIS system and personal database. The second one concern guiding of the process of decision making [15] as a cognitive process, we aim to guide the reasoning process during each phase of the crisis using available cases on situation base.

5.2 Context perception

In term of context perception, the goal is to provide several data that will likely be used; this information will interact with their inferential processes during the reasoning. This kind of information can be easily lost or need time to be found. These information concern essentially localization of risk places, Human / materials resources, emergency, rescuers means and services information. So, we identified a number of risk places and their characteristics in the AUBE's State (Fig. 2).



FIG. 2: A map of risk and resources places

5.3 Guiding of decision making process

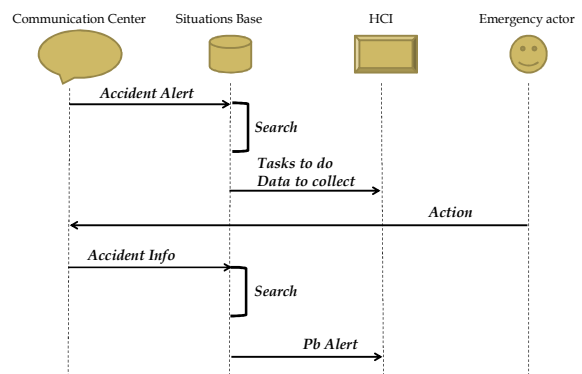


FIG 3: The interactions between system parts

The main object of this level is to deal with the neglect of important events .we aim to highlight (by alerts) important actions that can be forgotten. The technique

adopts an automatic recognition of the situation and following its evolution, this operation is occurred by interrogation of the situations base during the process of intervention.

The captured indicators as and when they are available are used, using CBR techniques, to search similar situations in order to avoid made mistakes and faced problems. We show in (FIG. 3) the main interactions between system parts.

6. Related work

Several systems and models are proposed in the literature around this thematic; they aim at representing the operational, organizational and communication level, these solutions offer generic treatments or rigorous techniques adapted to specific situations. The more used techniques and methods are based on workflow modeling, GIS, multi agent and rule-based systems [15] [9] [14] [11] [5]. The main contribution of our system is the use of actors experience feedback related to space and time dimensions, and the capacity of our system to adaptation and learning from future situations using techniques of tractability of the experience feedback, in order to be better aligned with decision making needs.

7. Conclusion and perspectives

We show in this paper, first results on analyzing crisis management. Our approach aims mainly at identifying the experience feedback and representing it. The aim of this study is to define a decision making environment for crisis management, related to emergency activity. Future work will also focus on the definition of experience traceability module for our system. Finally, we aim provide specification of the interface of the system to promote decision support for each role conceding the objectives of stakeholders in the main project.

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