Crisis Clever, a System for Supporting Crisis Managers

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ABSTRACT

Crisis management is a special type of collaborative approach in which the actors are subject to an uninterrupted stress. It is a quite significant issue because the consequences of crises can bring huge damages (human and economic loses). In order to learn from expertise and reduce consequences, we present in this paper our first results related to the definition of structure and interfaces in order to handle experience of crisis management. The project aims to define the CCS (Crisis Clever System) as a decision making environment based on the emergency experience feedback (Experience representation and use).

Keywords

Knowledge engineering and management, Experience and situations representations, Emergency crisis management, case-based reasoning

INTRODUCTION

Our work focuses, mainly, on understanding the domain of medical intervention, its limits and chains of interactions between human factors and systems elements; These ones are the keys for the success of such a catastrophe. Some crises also point to the problems that exist around our knowledge of the processes that represent modern organizational practices (Smith and Elliott, 2005). We take into account in our study the cooperative dimension of crisis situation as well as place and time dimensions (Smith and Elliott, 2005), these dimensions are very determining as important indicators taking place on decision making during crisis management. The first stage of this research is to examine, through a series of interviews, within Aube's Emergency Department (Troyes city, north-central of France) interventions in crisis management, identify and determine how they deal with situations and how they coordinate actions in order to make optimal decisions. We will also, in this context, report on training exercises.

Experts identify different types of situations to represent and we work with them for acquiring experience and defining common structures (Matta and al. and Sediri and al., 2012) 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 well as scenario representation to learn from this type of situations. To identify a representation of crisis structure and to define the specifications of the CCS, we use experience-based, methods for presenting situation and knowledge engineering methods. In fact, works on presenting situations (Brandherm and al., 2004) give techniques to represent a situation as states and events. Case-based-reasoning (CBR) (Kolodner, 1993; Aich and Loriette, 2007) 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 (Schreiber and al., 1994) techniques help to extract and formalize expertise as strategies, plans, and concepts. These techniques serve as a base for an operational CCS and for a crisis management analysis. Our approach aims mainly to identify the experience feedback and to represent it for defining a decision-making environment for crisis management, in relation to emergency activity.

REPRESENTATION OF CRISIS

The choice of our approach as a case based analysis (Chebel Moreloo, 2008) 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) (Kolodner, 1993) and especially the situations description to define a crisis representation structure, taking into account the context and the problem solving. Similarly, the type of underlying reasoning in CBR systems can be based on an analogy of situations (Aich and Loriette, 2007), very useful in the crisis situations' recognition.

In other parts of our work, we need to represent a feedback of these situations. This experience is generally owned by the actors of emergency sector, by the documents and the reports prepared or produced as a result of such intervention. Knowledge engineering provides techniques to represent expertise in problem solving. These techniques allow highlighting key points as objectives and reasons for certain expert actions, data roles 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 (Schmidt and al., 1996) 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 considered in the CCS are:

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

STRUCTURE FOR CRISIS REPRESENTATION

In contrary to other systems (Moehrle and al., 2012;Otim, 2006;Chakraborty and al., 2010;Oomes, 2004; Sell and al., 2009; Schoenharl and al., 2006; Johnson, 2000), the time and the space dimensions are used explicitly in managing actor, resources, victims , and tasks duration and in alerting the problems that may produce when we refer to a previous situation. In addition the structure of experience representation is not fixed; the system allows its adaptation depending on the crisis stage and available data.

Organizational dimension

The space is a main dimension in crisis management (Smith and Elliott, 2005), the representation of actors organization related to the space will help, on 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; it helps managing the acute phase of a crisis, as well as dealing with resources, victims' location, intervention setting and the damages in nearby areas. Three places have been identified (Sediri and al., 2012) as follows:

- Crisis unit: it's the place of the intervention control and orchestration, its most important role is managing material and human resources. The link between 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, the advanced medical team and other professionals.
- Emergencies: These services receive victims and their families and ensure their follow-up. The choice of victim's orientation is achieved by the rear base, depending on the distance of crisis site and or available places and specialties required for each victim.

Actor's tasks and communication links within timeline

The time dimension is very important in crisis management (Smith and Elliott, 2005) not only in terms of life preserving as a final aim, but also it has a main importance on each episode during the intervention. It must provide (Sediri and al.,2012) 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 and what must be done or what should be done immediately etc.

The CCS is based on a structure in which we can represent the different communication links and exchanges that the actor has with others during the time. In term of experiences representation, this structure helps to represent actor tasks and associated problems as well as consequences if the task does not respect its attended duration and its recommendations. The Figure 1 shows the structure applied for the Responsible of Emergency Department, it represents his work and his communication links during an intervention.

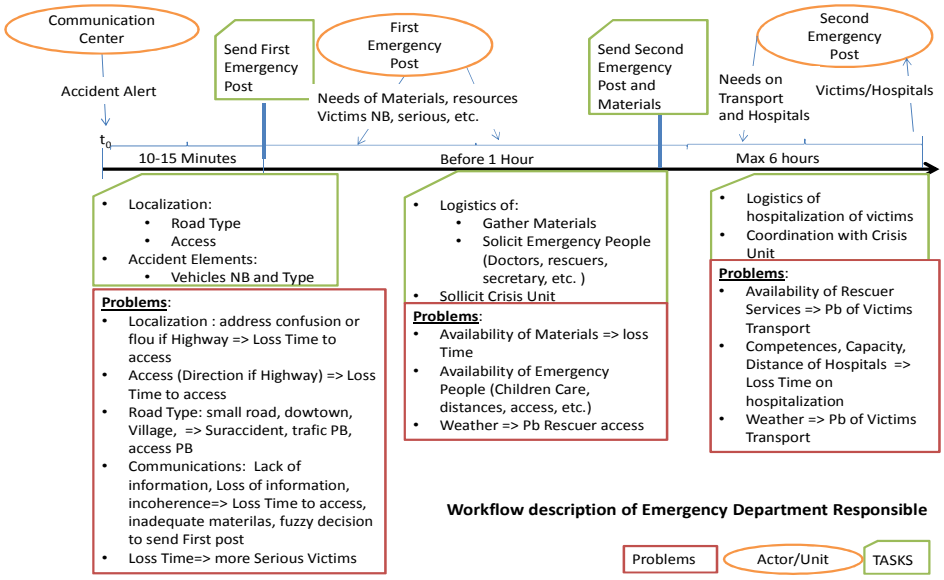

Figure 1. Description of an actor work: the Responsible of Emergency Department

The moment of trigger event (accident alert) helps to estimate the beginning and the end of each task. It helps also to alert the various exchanges between actors and problems that can occur. This structure has been, already, tested on road accident situations, intervention on an infirmary establishment due to 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 (Matta and al., 2012) to specify for each one its success and failure keys depending on time.

FIRST CCS SPECIFICATIONS

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, like 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 numbers of cluttered seen situations when there are elements to ignore or to 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 CCS to rebuild such situations using many combination possibilities. The search within the cases is made using the perceived available indicators. 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. The situation base is organized by actor. Each situation points for each actor on the important moments of the crisis in the form of time intervals. For each case we defined three parts; set of characteristics (data), set of tasks (actions) to do and the problems involved if the task is not

completed.

To guide decision makers in crisis situations we can act on two levels. In the first one we are interesting on the perception and presentation context as an important element in reasoning process (Van der henst, 2002) by providing additional and useful data with less ambiguity about context using the quick and automatic research in GIS system and personal database. In the second one the goal is to guide the decision-making process (Smith and Elliott, 2005) as a cognitive process, we aim to follow and to help the reasoning process during each crisis phase , this operation is provided by CCS by using available cases on his situation base.

Perception of the context

A non-integral perception of the environment may lead to limited inferences. In fact, the context has a major influence during reasoning and decision making process. This process is strongly influenced by the information received through sensorial registers, as well as the memory capacity. In consequence, any useful information will interact with inferential processes during (Van der henst, 2002) premises processing.

The goal is to provide several used data; this information will interact with their inferential processes during the reasoning. This kind of information is easily lost or needs time to be found. This information is, essentially, related to 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.

Guiding of the process of decision making

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 follows its evolution; this operation is occurred by interrogation of the situations base during the intervention process. The situation base is interrogated using captured indicators from crisis context; we adopt CBR techniques to search similar situations in order to avoid errors and problems.

The following UML diagram (Figure 2) illustrates a scenario to explain the operating system for the emergency actor. -The goal of this diagram is to describe how the actions occur between actors (emergency actor and communication center), human-machine interface (HCI) and the situation base. The vertical dimension of the diagram represents time.

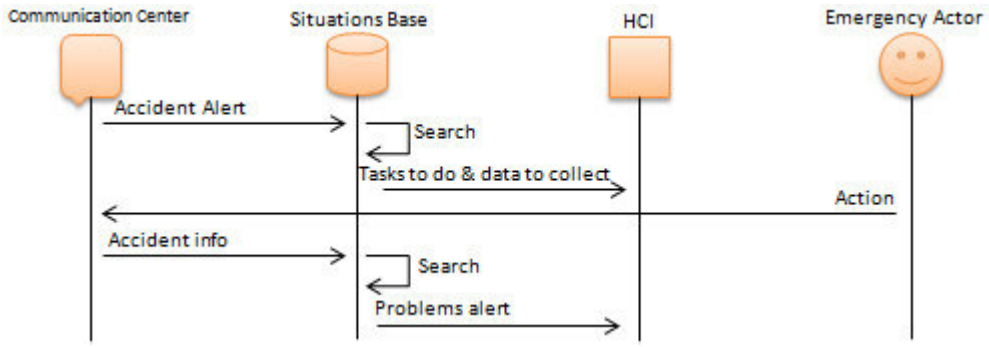

Figure 2. Interactions between system parts

Some related work

Several systems and models are proposed in the literature around this thematic; they aim to represent the operational, organizational and communication level, these solutions offer generic treatments or rigorous techniques adapted to specific situations. The most used techniques and methods are based on workflow modeling, GIS, multi agent and rule-based systems (Smith and Elliott, 2005; Oomes, 2004; Sell and al., 2009; Schoenharl and al., 2006; Johnson, 2000).The main contribution of our CCS is the use of actors experience feedback related to space and time dimensions, and the capacity of our system to adapt and learn from future situations using traceability techniques of the experience feedback, to respond better to decision maker needs.

Other works using case-based reasoning and knowledge ontology were recently presented, but they have big restrictions and they use many concepts definition which are not shared between cases and not adapted to the dynamic specificity of crisis situation (Moehrle and al., 2012; Otim, 2006; Chakraborty and al., 2010).

CONCLUSION AND PERSPECTIVES

We show in this paper, first results on analyzing crisis management. Our approach aims mainly to identify the experience feedback and to represent it. The goal 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 CCS. Finally, we will provide specification of the system interface to promote decision support for each role conceding the objectives of stakeholders in the main project.

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