Impact of the distribution and enrichment of information on the management and coordination of a human-made fast-burning crisis

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ABSTRACT

Post hoc evaluations made of crisis situations and exercises often point at communication as an important reason for the failure of the management and coordination of the crisis. Crisis managers have to deal with the problem that they (and all other actors in the field) don't have the right information to coordinate the efforts and solve the crisis situation. This paper examines the relation between the information available - more specifically the richness of the information and the distribution of the information - and the management and coordination of a typical man-made fast-burning crisis. The literature on decision making and situation awareness is reviewed and an experiment is conducted with 40 crisis managers in Belgium to assess the impact of the information. Initial results indicate a relationship between the ways a crisis team receives information and the achieved level of situation awareness, the difficulty of making decisions and the perceived complexity of the crisis.

Keywords

Crisis management, situation awareness, decision making, information system

INTRODUCTION

After a crisis or a crisis exercise the post hoc evaluation (whether consisting of a document, paper, or committee) often mentions "communication" as a main problem for the coordination and management of the crisis. "Communication" tends to be a catchall phrase for a lot of the coordination problems that crisis managers face. Solutions that aim directly at the communication problem (eg. better transmitters, new procedures on radio communication, …) however don't seem to solve the problem, which seems to suggest that the problem is not well defined. In this paper the suggestion is made to redefine the communication problem to an "information problem". In a crisis, all actors need the right amount of adequate information to create a good awareness of the situation and to make good decisions. Communication, or getting the information from the sender to the receiver, may be part of the information problem, though creating useful information out of the data at hand is another important issue. So redefining the problem also allows for a different approach to the problem.

Human-made fast-burning crisis

During the last 20 years, the region consisting of the three countries of Belgium, the Netherlands and Luxemburg (also known as the BENELUX area), did not experience big disasters or humanitarian catastrophes. Of the 15 most recent large-scale incidents in the BENELUX, 14 are human-made, i.e., having an element of human intent, negligence, or error; or involving a failure of a human-made system. Most of these incidents share the characteristic that they have a (very) fast onset but are also solved in a rather limited time. There is no long political or significant humanitarian aftermath. This type of crisis is referred to as a fast burning crisis (Boin & 't Hart, 2005). In such crises, emergency workers have to deal with a lot of uncertainty, time pressure and complexity. Uncertainty however, is the only factor of these three that can effectively being altered during this type of crisis. Time pressure and complexity are two defining elements of a crisis and certainly time pressure is intrinsic to a fast-burning crisis. These factors have a large impact on sensemaking (Weick, 2010), situation awareness (Endsley, 1995) and decision making (Klein, 1991 & Kahneman, 2003). Reducing uncertainty by obtaining qualitative information might be a way to improve sensemaking, situation awareness and decision

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making (Lipshitz; 2001).

Crisis management team

In this paper, we describe the experimental design we have used to test the effect of information on the performance a crisis management team. The experiment is conducted with a typical Belgian operational crisis management team. The coordinators are emergency managers who act on the field to coordinate all the emergency services. They are surrounded by three to five commanding officers from different emergency services. The focus of operational coordination lies on addressing and resolving the source of the crisis. In our experiment, we focus on the operational coordination since this is the level where the combination of complexity, time pressure and uncertainty is most present. However in most cases, the strategical level has to deal with similar problems of uncertainty, time pressure and complexity, so our results and findings may be applicable to this level too.

RESEARCH DESIGN

Our experiment is a table-top exercise based on realistic scenarios of two man-made fast-burning crises. This means that the scenario is very chaotic in the first phase and becomes more structured in the latter phases when the emergency crews take actions. The crisis management team consists of four crisis managers: a general coordinator and three commanding officers. The team receives operational information from the terrain via a computer simulation. They receive textual and audiovisual information about the incident and have to deal with the problems that emerge in the incident. All participants are commanding officers of a police, fire or medical service, who all have to take on a commanding and coordinating role during a crisis in real life. All of them have experience with or training in crisis management, but no one is a full time crisis manager. Next to the crisis management team, two external observers were present. The experiments were conducted in January 2013 at three Belgian fire & rescue training schools. This paper reports on the preliminary results derived from the first experiments conducted in the first half of January.

Figure 1. setting of the experiment with the general coordinator in the front of the pictures surrounded by three advisors

Two variables are being tested. One variable is "information richness", where one condition offers enriched information, and the other condition only provides for "raw" information. In the condition where information is enriched, a summary of the situation is being inserted into the exercise every five minutes. The summary contains no new or additional information, but consists of the information that the team has already received. This situation can be compared to a realistic scenery, where an information manager is in the command post and summarizes all the information that is being sent by the actors in the field. The other variable is distribution of information or "information centrality", where one condition offers centralized information, and the other condition for decentralized information. In the centralized condition, the team receives the information trough an information manager (part of the team) and in the decentralized condition the team receives the information trough all the members of the team except the coordinator.
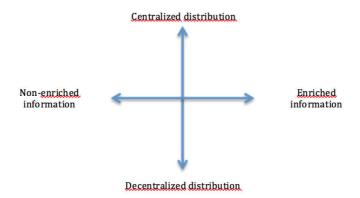
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Figure 2. Two variables that are tested

The effect of information richness and information centrality on situation awareness (SA) is measured by using the Situation Awareness Rating Technique (SART), which is a subjective measurement technique. SART consists of 14 dimensions, but can also be used with only three main dimensions: (1) demand of attention (D), (2) availability of attention (A) and (3) understanding of the situation provided (U). SA is calculated as SA = U-(D-A) (Endsley, 1995), or in other words the Situation Awareness (SA) is the understanding of the situation minus the amount of attention and mental capacity one has to use co create this understanding. Both the crisis management team and two external observators were asked to fill in this short questionnaire every ten minutes. The crisis management team scored their individual SA. The external observers on the other hand were asked to score collective SA, since SA is not only an individual process.

Decision making was evaluated by observations from the external observers who were asked to focus on the decision making process within the team, as well as through an in depth interview with the general coordinator. The observations and in depth interviews are treated as qualitative data and are subject to further analysis.

FINDINGS

At the time of finishing this paper (January 15 2013), 8 out of 16 experiments have been conducted. The results we present here are therefore preliminary, but nevertheless seem to indicate relevant trends and possibly valuable lessons. Our qualitative analysis is not yet completed, but our early results hint at significant difficulties in the decision making process and the perceived complexity of a situation.
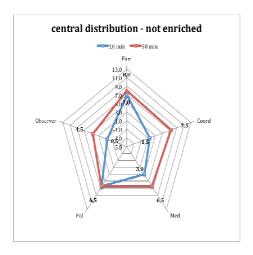
Situation awareness

Figure 3-6 show the spread of the calculated situation awareness for the four tested conditions. In these graphs, we visualize the calculated SA after 10 minutes (blue) and 50 minutes (red) for the four participants (coordinator, fire, medical, police) and the average collective SA as observed by the two external observers. Figure 4 represents the current situation of a typical command post: information comes in trough the three commanding officers (each from a different service) and is shared with the general coordinator.

Enriching the information (figure 7) seems to improve the SA during the exercise. Centralization of the information flow also improves the SA, but the improvement seems to generate slower compared to the enrichment (figur 6). The analysis of the different dimensions of the SA measurement show that attention availability (A) (i.e., the amount of attention left to coordinate, analyse, interpret, … the situation) seems to be the main reason for the improvement. Enriching the information gives the coordinator much more room for coordinating the situation, analysing the problems and evaluating the problems of the commanding officers. Centralizing the information only reaches this effect after 50 minutes and doesn't seem to give an important improvement in the first 30 minutes.

When the information flow is centralized and enriched, the SA diminishes. Based on preliminary qualitative analysis, this might be result of perceived information overload. The coordinator has to deal with several sources of information and with a lot of redundant information.

Related to the typical type of crisis that is tested and simulated here, it seems that enrichement of information is a good way to improve the coordination of a human-made fast-burning crisis. When information is enriched, the SA is not only higher compared with the current situation, but is also higher in the first phase of the incident which is the most chaotic. However enriching the information holds some risks like framing the information or over-simplification of the situation. Centralizing the information flow seems like another good alternative to

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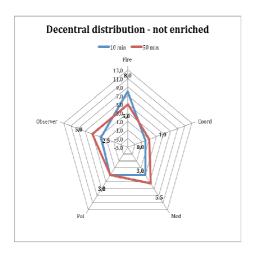*T. Comes, F. Fiedrich, S. Fortier, J. Geldermann and T. Müller, eds.*

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improve coordination, but the risk of giving too much information is very high. This was noticed in some of the teams that had to deal with centralized information.

Figure 3. spread of SA (calculated) for central distribution and not enriched information

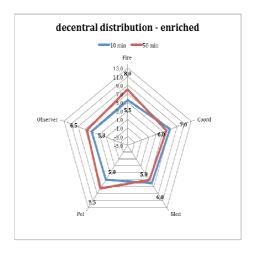**Figure 4. spread of SA (calculated) for central distribution and enriched information**

Figure 5. spread of SA (calculated) for decentral distribution and not enriched information

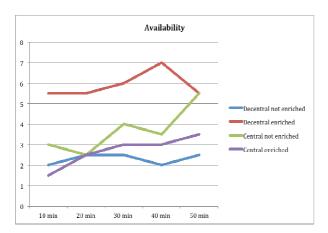**Figure 6. spread of SA (calculated) for decentral distribution and enriched information**

Figure 7. Availability of attention (dimension of calculated SA) of the coordinator over time and for the four settings tested

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Other results

Based on the preliminary analysis of qualitative data of in depth interviews and reports of external observers there are some other findings of interest. First there is a consistent report of changing perception of complexity. Every team has to deal with two different scenarios. The scenarios have a similar complexity. But based on the way the information is distributed and formatted, the perception of complexity changes. When the information flow is less optimal and requires more of the attention, the perceived complexity rises. The external reports also show a relation between the information flow and the way decision are made. Even though external observers were not asked to evaluate the technical correctness of decisions, most observers indicate a lowering level of technical correctness when the information flow is less optimal.

CONCLUSION

In this paper, we describe the experimental design we have used to test the effect of information on the performance of a crisis management team. At the time of finishing this paper (January 15 2013), 8 out of 20 experiments have been conducted. The results we present here are therefore preliminary, but nevertheless seem to indicate relevant trends and possibly valuable lessons. First it seems that improving the information flow has a positive effect on situation awareness, decision making and perceived complexity of the situation. Secondly it also seems that a good way to improve the coordination during a human-made fast-burning crisis is to enrich the information. Even a minor enrichment in the experimental setting has an effect on the situation awareness of the coordinator and all commanding officers and on the collective SA. For the final paper further analysis of the collective SA and group processes and of decision making processes will be conducted.

ACKNOWLEDGMENTS

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