

Sense-making and Information Management in Emergency Response

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Crisis Informatics

Emergency response conditions are characterized by a high degree of turbulence and dynamic change, time constraints, cascading events, a multitude of actors and high stakes [1]. Emergency responders need to make decisions on the course of action they will pursue, and they also need to make judgments on what is happening around them and understand what is going on in order to decide and act appropriately. Our research shows that in such demanding conditions, effective response is very much dependent upon the responders' sense-making abilities.

Sense-making

Sense-making literally means making sense of things, making things sensible. Sense-making is usually initiated by a sudden loss of meaning caused by unforeseen changes in the environment which break the imaginary link between expectation and reality and force actors to reevaluate what they are doing and where they should go. When people's sense of what is happening is affected, and they do not know how to proceed, they experience what is called a cosmology episode: they are being thrown into an ongoing, unknowable, unpredictable streaming of experience in search of answers to the question, "What's the story?" [2]. When people who are struggling to make sense actually find an answer to that question and their sense-making efforts have actually produced sense as the final product, they have the fundamentals to make decisions about future steps. Sense-making is not just the end product of understanding itself, but is even more so the process of how people try to find out the story, the deliberate effort to understand events

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and how they give meaning to what is happening in order to reduce the equivocality and ambiguity that surrounds them.

Research on sense-making has identified a set of seven properties that characterize the sense-making process [3]. First, sense-making is grounded in *identity construction*, meaning that the interpretation one gives to what is happening depends on who the sense-maker is and who he or she represents. Second, *retrospection* plays an important role in sense-making, since people use hindsight to look back at experiences and use the lessons learned of their success or failure in the current context. The third characteristic of sense-making is *enactment*: people do not wait passively for things to happen, but act to influence the environment and observe what happens. Fourth, the *social* dimension is important for sense-makers, as they always try to find out what other people think and understand, and they take into account other people's reactions when they act. Fifth, sense-making is *ongoing*, a process that never stops, especially in such a dynamic environment as an emergency. Sixth, people *extract cues* from the environment and focus on them, as they cannot pay attention to everything that is happening around them. Finally, sense-making is driven by *plausibility* rather than accuracy, as plausible accounts of the situation are often good enough to act upon.

Information Processing in Emergency Response

Emergencies are characterized by various types of information problems that complicate responses. Information can be inaccurate, late, superficial, irrelevant, unreliable and conflicting. It is extremely difficult for responders to make sense of what is going on and to take appropriate action as information about the environment is subject to multiple interpretations. Struggling with interpretations, responders are searching for the right frame of reference for the situation they are confronted with. Frames of reference

are the interpretative frames that provide the context for creating and understanding information.

Emergency responders typically face situations in which there is a lack of a frame of reference or in which there are too many frames of reference to process [4]. Ambiguity results when responders do not have a framework for interpreting information. Ambiguity is a difficult challenge to overcome since it involves developing a frame of reference when none is available. Usually the first stages of an emergency are characterized by ambiguity. Over time, as more information is gathered, people negotiate their interpretations and share their understandings. Other events develop, such as the arrival and intervention of emergency response teams or the increasing involvement of political stakeholders and media, typically leading to multiple, conflicting interpretations of what is happening. This is a situation of *equivocality*, and the responders have to make sense of several competing or contradictory frameworks.

A balance is needed for creating new frames of references in situations of unclear meaning (ambiguity) on the one hand and reducing the frames to avoid confusion created by two or more meanings (equivocality) on the other hand. People actively try to make sense in an attempt to overcome situations of ambiguity and equivocality. Information and communication exchanges help people to make sense – to deal with interpretative frames that provide the context for creating, managing and understanding information in emergency response settings.

Information and Communication Exchange

In order to understand how people who work in emergencies make sense of what is going on, we interviewed many humanitarian actors working in the Democratic Republic of Congo (DRC). We specifically investigated the information and communication that actors exchange for sense-making. We could distinguish three different activities in which such exchanges are important for sense-making: noticing, interacting and enacting [5].

Noticing is the first important activity for sense-making. Environmental stimuli can be noticed through the actor's own efforts and observations, by attending meetings, keeping an ear on the radio, reading email, physically observing the emergency and browsing the Internet. But as it is impossible

for an individual person or organization to monitor everything that is happening, we observed that actors make use of a wide variety of sources to assist them in noticing what is going on around them. These sources act as cues through which actors notice stimuli. This noticing takes place through both formal, established channels, such as inter-organizational structures, and informal channels, such as personally based contacts. What was especially interesting to hear in the DRC is that actors actively keep an ear on the rumors – what they call the news of the streets.

Confirming the important role of the social context in sense-making, we observed that people actively *interact* to reduce ambiguity and equivocality. In the DRC we found evidence of several specific uses or goals of interaction. Foremost, people interact to update one's understanding of the situation, to stay informed and to triangulate the available information and negotiate what is going on. There are many information exchanges with colleagues, partner organizations and friends, both formally through meetings and such and informally through chats over coffee; other people are contacted to contribute and compare information. Interaction is also a means to inquire about specific things actors want to know. People are directly contacted when actors think that they might have more information than the inquirer or when they are regarded as more knowledgeable or experienced in a specific topic. Interaction also serves a purpose of verification of the source of information, its accuracy and its implications. Finally, we found that actors interact with friends and colleagues for advice and to reflect on the decisions they face. Our research indicated that emergency responders in most of these interacting activities revert to a limited number of tools, usually just the mobile phone, as they need fast, easy and direct contact when faced with an emergency situation.

The third communication activity – *enacting* – is when people communicate to enable action. Action is of crucial importance in emergency response. The lack of appropriate action worsens an emergency and makes it more difficult to get it under control. Communication can generate new information, take away misconceptions and help formulate frames of reference. Enacting usually happens under time pressure in emergencies when people need to rapidly assess the situations. When rumors indicate that

there is a threat, one actor told us that he would first send a text message to his staff members and engage in verbal communication at a later point in time. Engaging in this communication could provide him with feedback, enabling better understanding of his enacted environment. An obvious important caution to be made here is that dependency on a single tool may create a deadlock situation in emergency environments as for example when the network breaks down and people cannot use their mobile phones.

Sense-making Support Systems

Actors need appropriate support to make sense of what is going on and to deal with problems of ambiguity and equivocality. Information systems can make it easier for actors to create and adapt frames of reference in emergency situations [6]. When specifically looking at ambiguity, information systems can prevent information overload and filter out information by focusing on specific cues. On the other hand, information systems can also provide access to appropriate contextual information. This access will assist emergency responders in creating a good picture of what is going on, a suitable frame of reference for their operations. In order to construct frames of reference, information systems also can enable storage of historical information and the incorporation of lessons learned. We have seen earlier that retrospection is an important property of sense-making, and the importance of experience in emergency response is widely acknowledged. As emergency response organizations typically face high staff turnover, information systems can play a role in maintaining the organizational knowledge.

Sense-making is at least as challenging when there are multiple and possibly conflicting frames of reference in the emergency. Emergencies are unique and dynamic events, and planning for emergencies is therefore difficult, with expectations of other actors – perhaps guided by previous experiences, agreements or common sense – not always met. As events unfold over time and understanding of events constantly needs to be updated, flexible systems are needed to support changing frames of reference. Also, every emergency is different in cause, circumstances and actors involved. This constant change means that the associated management of the emergency and the supporting systems must be adapted to that situation.

Information systems should facilitate interaction and collaboration by supporting timely and valid information exchange and facilitate the organization of all information available [7], enabling actors to construct the best possible frame of reference. But most importantly for creating and comparing frames of reference, people need to be able to freely exchange information in their social contexts. Our research indicated for example that humanitarian organizations were able to adequately operate in the region provided they had an extensive network of contacts. Colleagues and organizationally established structures are evidently important in this regard, but even more striking was the importance of informal contacts. Through all their contacts with embassies, NGOs, UN organizations, media, army and the local population, actors build up networks of work-related contacts. Maintaining these contacts is also important and happens through attending meetings, staying in touch with the embassy, going out to mix socially among the other international staff working in the country and employing local people as staff members. Setting up and maintaining a trust-based network of contacts appeared to be a vital component for successful sense-making. Especially when faced with an acute crisis situation, actors would fall back on their informal contacts in order to obtain more information. This contacts-driven infrastructure for sense-making could be supported by social networking tools. Maintaining their network through a web-based Internet platform such as Facebook, complemented by real-time information and communication exchange tools, emergency responders would be able to optimally use their network to exchange information in times of acute emergencies [5].

Sense-making for Coordinated Action

So far we have only discussed sense-making by a single actor. Emergency response, however, requires intense coordination of actions among all actors involved. All actors involved in the response need to share the same frame of reference, a common operational picture of the emergency and the response that is being developed. For the particular challenge of coordinated action leading to common sense-making, our ongoing research points at some important challenges to avoid suboptimal decisions being made.

Response organizations cannot make the right decisions if their

understanding of the situation is not based on the information that is available. At first glance, one would believe that unconstrained information exchange would solve this problem. However, research [8] has shown that suboptimal decision-making will also happen if the available information is misinterpreted or misrepresented. Even when actors jointly have all the necessary information to make a decision and there is an infrastructure in place for the actors to share all information, suboptimal decisions are still often made. These decision situations are addressed in academic research through so-called *hidden profile* experiments.

A hidden profile exists when team members individually have possession of only a part of the information required to reach an optimal decision or solve a problem, and therefore the group collectively needs to pool and process this information to solve the problem or discover the optimal decision. In hidden profile experiments, individuals have common information which is known to every group member, as well as unique information only known to single individuals. With the common information supporting a suboptimal

decision, the group needs to pool the unique information to find the true, optimal decision – the hidden profile. Experimental findings as well as our own research suggest that actors are focused on the common information much to the neglect of particular information owned by one or more individuals in the team and therefore disregard the construction of other, possibly more complete, frames of reference.

In conclusion, adequate sense-making requires an open mind to all possible scenarios, good management of information and free exchange of information to support the construction of these frames. In the absence of these conditions, the actors' failure to make sense will most likely result in a suboptimal response to an emergency.

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