Should I Be Aware of the Information of Other Actors
Transversal Communication in Crisis Management

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Abstract: In crisis management, multi-organizations are involved to deal with the events; however these services encounter several problems that make the transversal communication and information sharing very hard, with an ineffective mutual awareness during crisis response. Whereas, among the factors for crisis management success, figures prominently mutual awareness and awareness information, this requires effective interaction of the relevant information between emergency actors. But in the reality this communication is ineffective and influences the decision making. Thus, to support emergency response, enhance "awareness information" and transversal communication between different emergency actors, our contribution in this paper is to understand the organizations involved in emergency response and analyse the communication between actors. Thus we study at first, the vertical and the transversal communication in inter/intra emergency organizations. Second, we highlight and analyse the root causes of communication problems that actors encounter in operating level. Third, we classify by category the major information needed in emergency response and finally, we present the dependency between awareness information and actions achievement.

1 INTRODUCTION

Whether it is a flood, explosion in a factory, poisoning, climatic event, fire, power failure, attack etc…These events can produce a process of dysfunctions and generate a crisis. To deal with these events, several actors (professionals, volunteers ...) from different organizations intervene in the area to manage the crisis. Among the factors for crisis management success, figures prominently mutual awareness. Be aware about other activities gives a context to own activity (Dourish and Bellotti, 1992) and it is crucial to achieve a specific task (Schmidt, 2002; Steinmacher, 2012) in which awareness is considered as an attribute of action (De Souza, 2011). Achieving awareness in crisis management requires effective inter/intra-communication and relevant information sharing between emergency actors (Ellis, 1991; Stanton, 2007) especially in transversal level. Not necessarily that everyone needs to be aware of the same information about others' activities, but what really matters is, the right people have the right information at the right time to achieve an action (Gorman et al. 2006 ; Salmon et al., 2010).

For that, to support information sharing and awareness information, we study in this paper, the activities of different emergency actors, we analyse the communication in intra/inter-organizational and we identify their roles, actions and information needed.

2 RELATED WORK

Usually emergency actors encounter technical problems related to the infrastructure and transmission that affects communication, especially in rural areas; Bowman describes a mobile communication system to overcome this problem (Bowman, 2006), Sharma proposed architecture of cell-share to provide a back-channel for network troubleshooting (Sharma, 2009) and Secretan designs framework of ad-hoc network to share disaster information (Secretan, 2011). Another problem in which team member does not share information is lack of trust. Chan has introduced two points to boost confidence between actors: ability of actor to send relevant information to others and willingness to share information (Chan, 2012). Other

problems related to the information are the quality, the format and the quantity of information (Bui, 2000 and Ho et al., 2001).

In addition to the previous problems, we show in this paper that emergency actors encounter other problems related to their organization and culture.

Several studies are conducted to support the first responders in crisis management. In order to improve awareness among firefighters, Prasanna proposed a prototype for information sharing that provides awareness about the most important roles in fire department (Prasanna, 2011). However, this analysis is restricted to one emergency service. Other studies were conducted on multi-agencies; Ludwig showed and proposed semi-structure system for the communication between actors on the site and the control centres (Ludwig, 2013). Bui proposed a system of GIN (Global Information Network) to improve communication between multi-agencies (Bui, 2000). However in these work we do not see clearly the communication, the interaction of information sharing and actions between different emergency actors transversally in the operating level. Our contribution is to complete the previous study and make careful analysis of vertical and transversal communication.

Thus, before supporting crisis response and enhance communication between stakeholders, we study at first the multi-organizations, we focus on the communication and information sharing between the most important emergency services vertically and transversely. Second, we show the root causes of communication problems that actors encounter in sharing information. Third, we classify the information needed in emergency response and finally, we present the dependency between the

relevant information that an actor needs to make decision and achieve an action.

3 EMERGENCY ACTORS IN CRISIS RESPONSE

In this paper we study the activities, information sharing of stakeholders and communication problems that actors face during crisis management. Mainly in our work, we are interested in the major rescuers during a response: firefighters, police and emergency medical service (EMS).

3.1 Data Gathering

We did a number of semi-structured interviews with emergency actors from different organizations: firefighters whose scales are different; we did two interviews with two commanders and two others, who are respectively column leader and group leader, an interview with police commander and three with specialists in emergency medical service (EMS) at the Aube department (France) In addition to four exercises debriefing with EMS.

We asked them to tell the most remarkable experiences to have general idea and through the interview, we asked pointed questions about communication, information sharing and how they communicate transversally with other organizations. After examining the different interviews and experiences, we translated data collection to models and we highlighted the information needed by each organization in each step, the dependency between actions and the need for information awareness to achieve their actions.
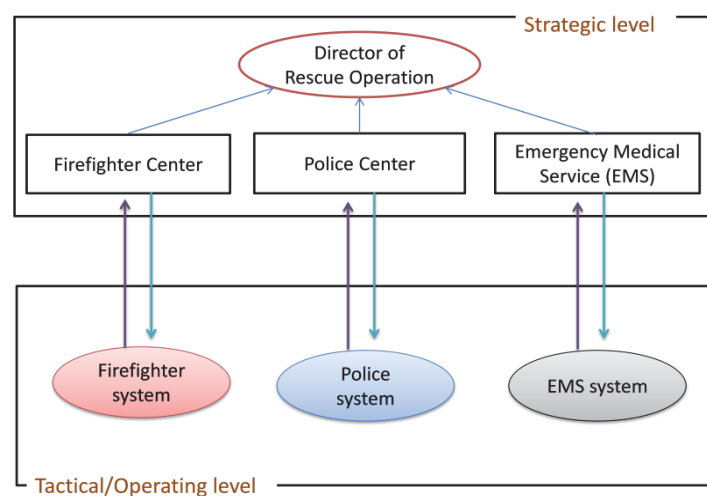

Figure 1: Organizational model in crisis management.

3.2 Organizational Model

Before analysing the information sharing and communication between actors vertically and transversally, we show first the organizational model to understand emergency system composition in crisis management. In Fig.1 we will present the model of inter-services operations, in which we define organizational levels in the management operation (Saoutal, 2014).

- Strategic level: The major decisions are taken in this level by the inter-ministerial governmental / territorial / politics and administrative crisis cell.
- Tactical level: In this level the responsible of each system, analyse the events and decides objectives for carrying out.

4 INFORMATION SHARING IN CRISIS MANAGEMENT

Each service has its own activity and its own objective, the difference of goals and actions between different actors can hind information sharing and then influence awareness. In this section, we show sequentially the vertical communication and information sharing for each service and then inter-communication between different services.

4.1 Vertical Communication

In this part, we present the communication and information sharing for each service and how team member exchange message.

4.1.1 Firefighter

In figure 1, we show the information progress from the beginning of event and what is the relevant information that Firefighter service need to achieve its objective (a). Also we show the interaction, message exchanging and information sharing between firefighters with different scale (b).

4.1.2 Emergency Medical Service

For Emergency Medical Service (EMS), the first emergency post analyses the event, treats victims (a) and transmits the information / reports to the hospital to ask for needed emergency post and material (b) (Sediri et al, 2013). The EMS also transmits information to the DRO (figure 3).
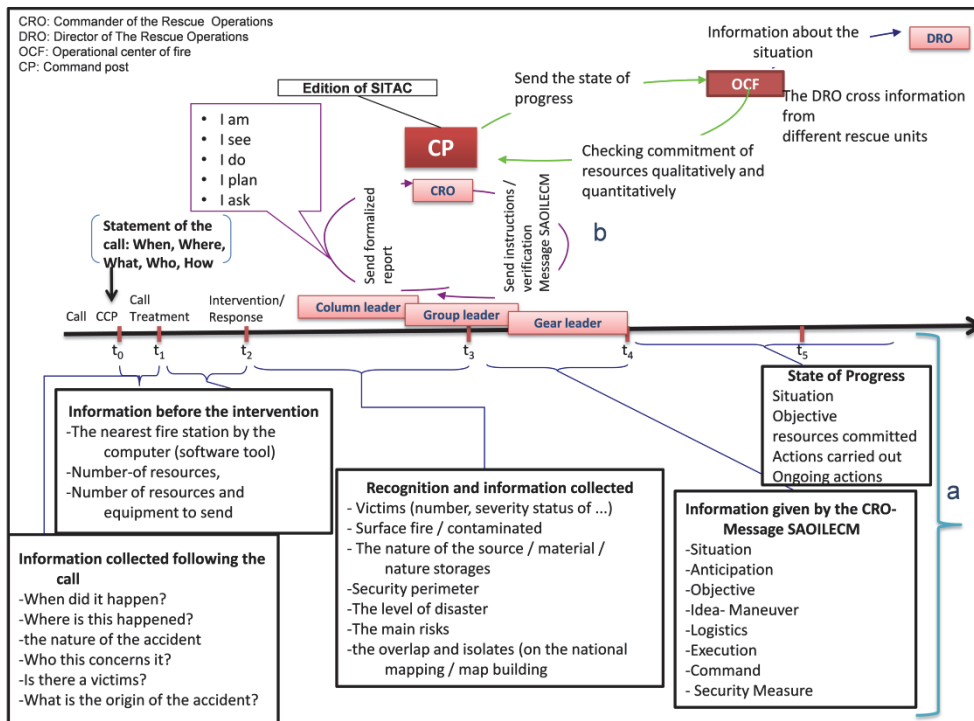

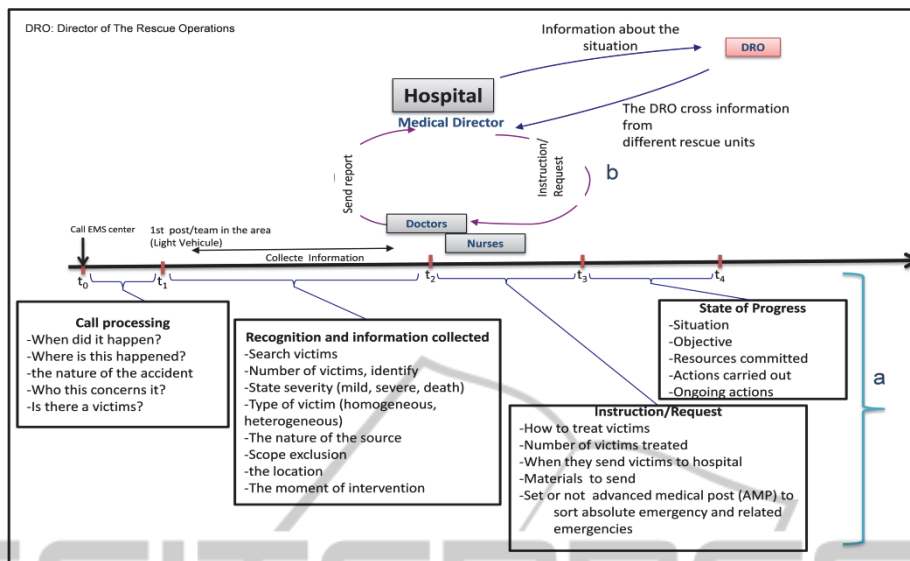Figure 2: Chronology of communication in crisis management for firefighters.

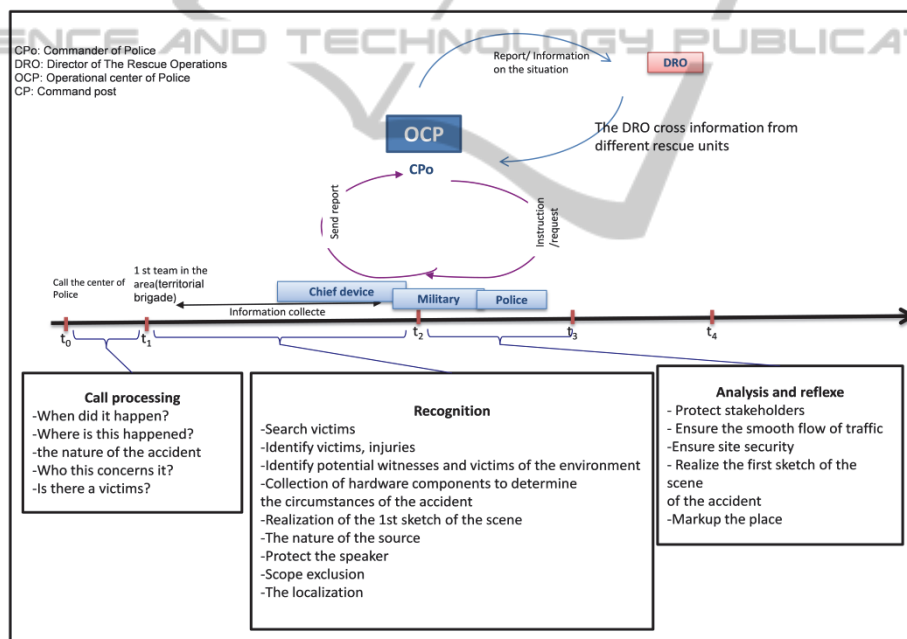Figure 3: Chronology of communication in crisis management for EMS.

Figure 4: Chronology of communication in crisis management for police.

4.1.3 Police

In parallel the first team of police collects its specific information: identify victims, identify witnesses, collect material element to determine the circumstances of accident, and determine the scope of exclusion. Then, all this information is send to the operational center of police.
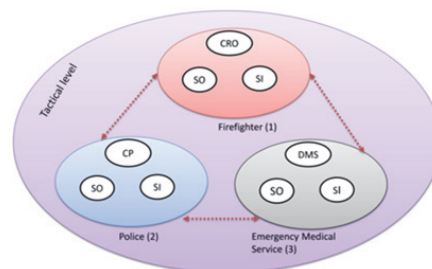

Figure 5: Operative system in crisis management.

4.2 Transversal Communication

In Fig.5, we present the model of inter-services at operating level in crisis management; it consists of three systems (1), (2) and (3) and each one includes leader system, sub-system operating and sub-information system:

- CRO: Commander of the Rescue Operations is a firefighter expert, the grade can vary depending on the procedure, and it may be in ascending order; from the team leader to the site leader. His role is to ensure the success of tactical operations close to the crisis site.
- DCG: Commander of police, his role is to ensure the site's security.
- DMS: Director of Medical Service is the responsible for all medical decisions and should always be in coordination with the CRO.
- SO: Subsystem Operating consists of teams and equipment.
- SI: Sub Information System, fire-fighters and police transmit their vocal codified messages by using a radio frequency band; the EMS uses the radio and sometimes GSM mobile phone to transmit photos and vocal information.

The plan and the procedure indicate that the commanders from different organizations (1) (2) and (3) (Figure 5) have to communicate and share relevant information transversally. However, in the reality, each service works vertically with its hierarchy with few information sharing and interaction between different team members in this level. However, each action to be performed may depend on the information possessed by other actors.

5 RESULTS ANALYSIS

5.1 Transversal Information Sharing Problems

The root causes of transversal information sharing problem are:

- **Time pressure**: When the actor must send information as soon as possible to the strategic level and waits the instruction from his hierarchy to act, it could result more deaths among the victims.

- **Self-esteem and competition**: We can note that different services are competitive in the crisis area.
- **Information direction**: In several times, information is misdirected and actors do not know to whom send or ask information.
- **Information type:** Actors do not know exactly which type of information is relevant for other actors to execute their actions.
- **Actors distribution**: We are not aware of who is in the area or not and who will have access to the specific area.
- **Different langage**: Understanding message depends on how we perceive the terminology used by the actor transmitter. Each unit has its terminology and uses its specific code, symbol of message to communicate and represent information, which is difficult to be understandable by other units.
- **Different culture**: Considering the multitude of organizations involved in a crisis and the differences of services' culture, each unit has its objective and priority.

The consequences of these problems are shown when each service sends a progress report to inform strategic level:
- **Impact on decision making**: The director of the rescue operations (DRO) finds different or even contradictory information, because each service works in its scope.
- **Losing time**: The DRO asks services to verify information in operational level, and when actors do not know to whom ask or send information.
- **Losing of information**: When an actor delivers information verbally to other actors verbally, it could be loosed.
- **Serious damage**: Several human and material damages are generated due to the lack of information sharing and awareness of the overall situation.

5.2 Communication Protocol

The communication between different actors in crisis management has three categories:
- Information request: When an actor asks for information needed to execute an action, to follow the progress of events and to send instruction to achieve.

- Information description: the system operating gives the situation progress and sends description to the system leader to receive

Table 1: Information related to each service in crisis management.

| Information category	Firefighter	Police	EMS
Request	-When did it happen? -Where is it happened? -the nature of the accident? -Who are concern person? -Is there victims?-What is the origin of the accident?		
	-How to treat victims -Who could have access to the toxic area -Action objectives -Action ongoing -Action instruction	-When they can have access? -Who can have access to crisis area? -Ask for a number of military and vehicles if needed	-What they have to do? -Number of victims (access denied in the area)? -Severity status? -Number of victims treated -When they send victims to hospital -Materials to send -Set or not advanced medical post (AMP) to sort absolute emergency and related emergencies
Description	-Message SOAILECM. -I am: Identification of actor -I see: Describe what he sees -I do: Describe what he is doing -I plan: Describe what he plan to do -I ask: Describe what he needs	-The circumstances of the accident -Site security	- Number of victims -Severity status of each victim -Type of victim (homogeneous, heterogeneous) -The moment of intervention
Instruction	-Situation -Anticipation -Objective -Idea- Maneuver -Logistics -Execution -Command - Security Measure	- Mark-up the area -Logistics –Manoeuvre	-Install of an advanced medical post (AMP) -Send victims to correspond service. -How to treat this victims
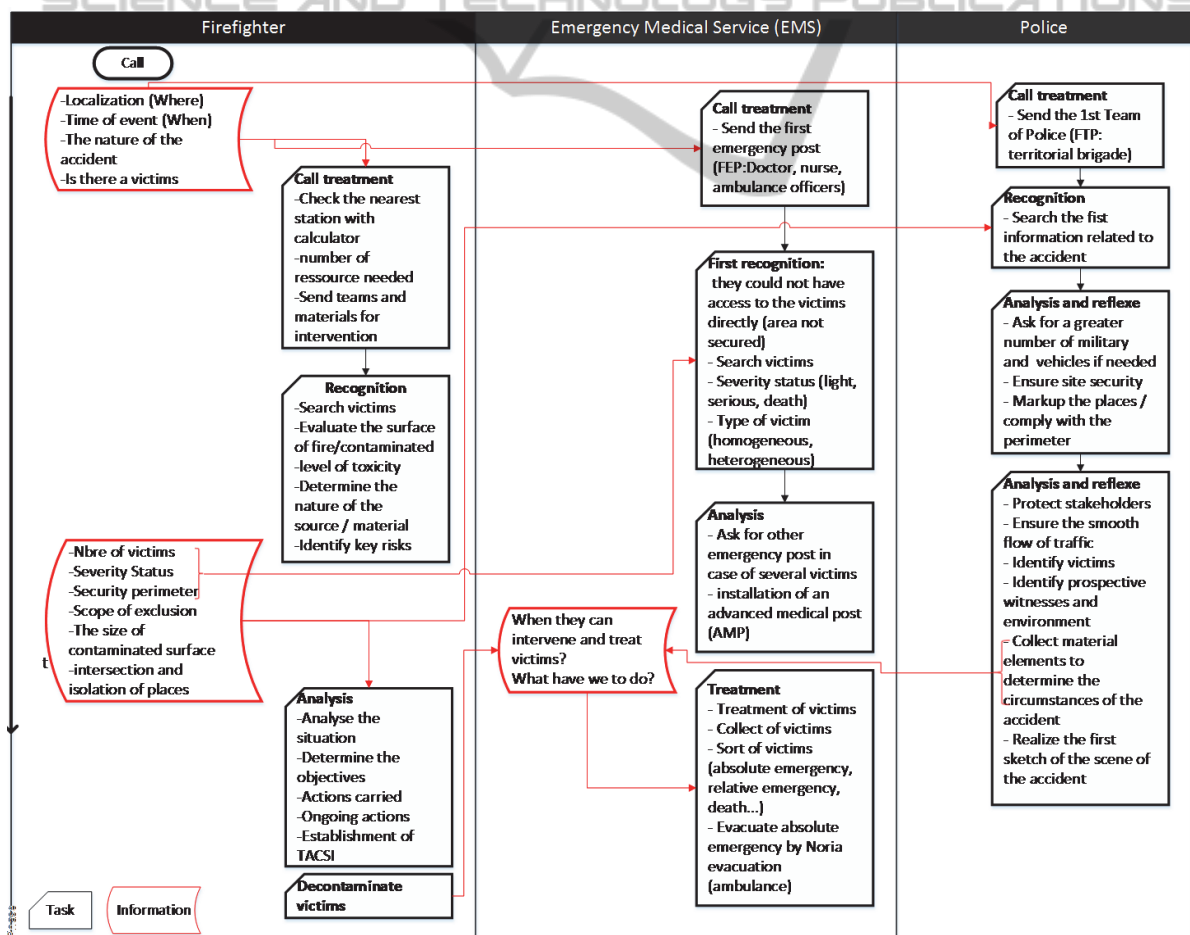
Figure 6: Information-Action dependency.

instructions. The leader of each system send report to the strategic level about the progress, actions carried, material and resources needed etc…

▪ Information instructions: after receiving information description or request, the commander of rescue or system leader gives instructions and order to execute and carry out in the area.

The table 1 present the general information related and needed by each service classified by category.

5.3 Information-Action Dependency

On analysing the activities of different actors through the interviews and exercises, we conclude the interdependency between actions and information awareness. In other words, an activity to be performed may depend on information possessed by others. For example, EMS could not collect and treat victims if the firefighters haven't determined yet the scope of exclusion, secure the area and decontaminate victims. Also the police could not search the first information related to the accident before that. Actors need an informational interaction to execute an action. For instance, the firefighter needs information about "victim treatment" to treat the victim (e.g. area does not allow access to the doctor: Toxic area), but the doctor could not deliver the right information if he does not possess the information about "victim severity" and his state. Thus, it is important to share this information for both the sender and the receiver.

6 CONCLUSIONS

On analysing the operations and experiences of different emergency actors in crisis management, we found problems about communication and information sharing specially in transversal organizations. Different services with different cultures and priorities are invited to collaborate and deal together with crisis; however, many problems can hint the communication, information sharing and impact their cooperation as consequence. In this paper, we analyse the communication in each service and between different services. We emphasize the problems that influence transversal communication between different rescuers and how these problems can impact information awareness and then, achievement of actions.

In our future work, we will propose a

cooperative system and common workspace between different organizations to enhance the interaction of relevant information by emergency actors and in order to increase mutual awareness in crisis area to perform actions easily and at the right time.

ACKNOWLEDGEMENTS

REFERENCES

Bowman, M., Graham, J.H. and Gantt, J., 2006 A Robust and Affordable Mobile Communications System for Emergency Management and Crisis Response. In Fourth Annual Conference on Telecommunications & Information Technology.

Bui T. A 2000 Framework for Designing a Global Information Network for Multinational Humanitarian Assistance / Disaster Relief. 2000

Chan, K., Jin-Hee Cho, and Adali, S., 2012. Composite Trust Model for an Information Sharing Scenario. 2012 9th International Conference on Ubiquitous Intelligence and Computing and 9th International Conference on Autonomic and Trusted Computing, September. Ieee, 439–46. doi:10.1109/UIC-ATC.2012.11. http://ieeexplore.ieee.org/lpdocs/epic03/wrapper.htm?arnumber=6332033.

De Souza, C. R. B., and Redmiles, David F.. 2011. The Awareness Network, To Whom Should I Display My Actions? And, Whose Actions Should I Monitor? IEEE Transactions on Software Engineering 37 (3): 325–40. doi:10.1109/TSE.2011.19. http://ieeexplore.ieee.org/lpdocs/epic03/wrapper.htm?arnumber=5710950.

Dourish, P., and Bellotti, V., 1992. Awareness and Coordination in Shared Workspaces. Proceedings of the 1992 ACM Conference on Computer-Supported Cooperative Work - CSCW '92. New York, New York, USA: ACM Press, 107–14. doi:10.1145/143457.143468. http://portal.acm.org/citation.cfm?doid=143457.143468.

Gorman, J. C., Cooke, N. J. & Winner, J. L. 2006: Measuring team situation awareness in decentralized command and control environment. Ergonomics, 49(12-13), 1312-25 (2006). DOI:10.1080/00140130600612788

Ellis, C.A. Gribbs S.J. and Rein G.L., 1991 Groupware - some issues and experiences, Communications of the ACM 34(1) . 38-58.

Ho, J. and Tang R. 2001. Towards an optimal resolution to information overload: an infomediary approach. In Proceedings of the 2001 International ACM SIGGROUP Conference on Supporting Group Work (GROUP '01), Clarence (Skip) Ellis and Ilze Zigurs

(Eds.). ACM, New York, NY, USA, 91-96. (2001) DOI=10.1145/500286.500302 http://doi.acm.org/10.1145/500286.500302

Ludwig, T., Reuter, C. and Pipek. V. 2013. What You See Is What I Need : Mobile Reporting Practices in Emergencies, no. September: 21–25.

Prasanna, R., Yang, L. & King, M. (2011). Evaluation of a Software Prototype for Supporting Fire Emergency Response. Proceedings of the 8th International ISCRAM Conference – Lisbon, Portugal.

Salmon, Paul M., Neville, A. Stanton, Walker, Guy H. Jenkins, Daniel P. and Rafferty, L.. 2010. Is It Really Better to Share? Distributed Situation Awareness and Its Implications for Collaborative System Design. Theoretical Issues in Ergonomics Science 11 (1-2): 58–83. doi:10.1080/14639220903009953. http://www.tandfonline.com/doi/abs/10.1080/14639220903009953

Saoutal A., Cahier J.-P., Matta N. (2014). Modeling the communication between emergency actors in crisis management. Collaboration Technologies and Systems (CTS), International Conference (to be published).

Secretan, J. 2011. Collaborative Filtering of Spatial-Temporal Information for Crisis Informatics. 2011 IEEE International Multi-Disciplinary Conference on Cognitive Methods in Situation Awareness and Decision Support (CogSIMA), February. Ieee, 292–95. doi:10.1109/COGSIMA.2011.5753461. http://ieeexplore.ieee.org/lpdocs/epic03/wrapper.htm?arnumber=5753461.

Schmidt, K. 2002. The Problem with 'Awareness': Introductory Remarks on 'Awareness in CSCW'. Computer Supported Cooperative Work, vol. 11, no. 3, pp. 285–298.

Sediri, M, Matta, N., Dai, J., Loriette, S. and Hugerot, A. 2013. Experience Feedback Guides for Crisis Management Using GIS. 2013 International Conference on Collaboration Technologies and Systems (CTS), May. Ieee, 294–99. doi:10.1109/CTS.2013.6567244. http://ieeexplore.ieee.org/lpdocs/epic03/wrapper.htm?arnumber=6567244.

Sharma, A., Belding, Elizabeth M. and Perkins, Charles E. 2009. "Cell-Share: Opportunistic Use of Cellular Uplink to Augment Rural WiFi Mesh Networks." 2009 IEEE 70th Vehicular Technology Conference Fall, September. Ieee, 1–5. doi:10.1109/VETECF.2009.5379029. http://ieeexplore.ieee.org/lpdocs/epic03/wrapper.htm?arnumber=5379029.

Stanton, N., A.,Stewart,R., Harris, D., Houghton, R. J., Baber, C., McMaster, R., Salmon, P. et al. 2007. Distributed Situation Awareness in Dynamic Systems: Theoretical Development and Application of an Ergonomics Methodology. Ergonomics 49 (12-13): 1288–1311. doi:10.1080/00140130600612762. http://www.ncbi.nlm.nih.gov/pubmed/17008257.