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Crisis Response and IT Use: Literature Review and Suggestions for Future Research

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ABSTRACT

Crisis response highly depends on managers' use of information technologies (IT). Given the growing frequency of crisis, it is urgent to concretely investigate IT use in crisis response. Still, crisis characteristics have been tacitly overlooked in the literature on IT usage. As a result, both researchers and managers rely on a *routine* view of IT usage that does not match to the reality of crisis. Knowledge on IT usage in crisis response is missing and managers lack specific recommendations regarding IT use.

The objective of this paper is to respond to that gap by proposing a literature review of the variables that affect crisis response and are likely to differ from routine to crisis situation. From this review, we suggest some potential questions for future research on IT usage. Doing so, we promote more salient recommendations on IT use to managers and IT professionals.

KEYWORDS

Crisis response, IT usage, user, task, system.

INTRODUCTION

The impact of crisis on companies and social life can be tremendous, leading to financial loss and layoffs or even endangering social stability in the case of disasters (Allenby, Fink, 2005). As a result, more and more studies in different disciplines examine this phenomenon and its consequences for individuals and organizations.

Recently, reflection has developed on how users interact with technologies during crisis response. It is true that IT tools represent a crucial means for coordination in crisis response For instance, they enable connection for distant workers and facilitate immediate feedback to avoid fatal misunderstandings Although, IT provides a number of advantages to employees, researchers have also identified some limitations to the use of technologies during a crisis. The main target of their criticism concerns the gap between IT design and user needs in critical situations (Quarantelli, 1997, 2007). Literature also addresses the issue of misuse of IT that impairs crisis response (Dawes, Cresswell, Cahan, 2004). Several streams in IS research examine user needs, such as the Human-Computer Interaction (HCI) community that frequently investigates user requirements. HCI research has considerably developed since some decades (Zhang and Li, 2005) and aims at improving user interaction with IT by highlighting the key design criteria and user expectations.

However, there is scarce knowledge on the specificities of IT use in crisis response, particularly on the question of how managers interact with IT. Crisis response is a highly documented research topic in management research, but the connection with IS research has only been recently explored. This area of research is important because the emergence of salient technological design requires knowing more about how crisis responders concretely use IT.

As a consequence, the objective of this paper is to respond to this gap by investigating how IT usage and more precisely, user, tasks and systems characteristics differ in a crisis context. From this investigation, we rely on Blaikie (2007) guidelines to suggest some agenda for future research. Our work suggests that treatments of IT usage in routine situations may not fit to crisis response that impact both users, tasks and systems variables. We deduce from it the need to further explore the IT usage construct in crisis response. By doing so, we hope to contribute to research on IT usage and promote the development of recommendations for crisis managers.

This exploratory paper is organized as follows. First, we compare a routine environment with a crisis context and highlight their differences. Second, we introduce a set of technologies that are commonly used during a crisis response. Third, we

present the gap in IS research that has mainly focused on IT usage in a routine environment. From this review, we suggest in a fourth section some potential questions for future research on IT usage and finally discuss our work and findings.

CRISIS VERSUS ROUTINE ENVIRONMENT

Crisis significantly differs from routine in that organizations have to deal with social stakes and risks (Allenby, Fink, 2005). Manager' reactions and decisions therefore have to be made rapidly. Crisis has been defined as a situation of important emotional and time pressure that threats an organization fundamental objective and values (Hermann, 1963). Mainly, the organization survival is at stake in crisis situation. When crisis occurs in the context of a natural or a technological disaster, human lives are also endangered. Managers' decisions are likely to have a strong impact on other people lives. For example, during the Bhopal disaster during which 200,000 persons were injured, Union Carbide CEO decided to fly to India as soon as the explosion happened. Arriving without having prepared his trip, without visa document, he was blocked at the frontier, which allegedly slowed down the crisis response to the explosion. It is therefore safe to assume that managers' decision process is crucial in crisis response.

This means that in critical situations managers have to deal with new and unstructured tasks (Quarantelli, 1988). Part of the response may be planned, but every crisis is unique and requires specific problem solving and actions (Quarantelli, 1988; Waugh, Streib, 2006). Crisis response also requires innovative action, even if organizations are sometimes victims of rigidity-threats (Staw, Sendelands, Dutton, 1981). Surprise is also an inherent dimension of crisis. It implies higher complexity (Fink et al., 1971), prevents managers from detecting crisis (Shrivastava, 1988) and makes problem solving even more delicate (Mitroff, Pearson, Harrington, 1996). As a result, alternate coordination, dialogical reasoning and collective improvisation are likely to occur during crisis response (Weick, 1993; Crossan, Cunha, Vera, Cunha, 2005; Faraj, Xiao, 2006; Mendonça, 2007). Collaborative tasks are also of major importance during crises (Ren, Kiesler, Fussell, 2008). It compels individuals to interact more, most of the times with unknown counterparts (Quarantelli, 2005). But both emotion and confusion can endanger interactions effectiveness (Weick, 1993).

Finally, crisis response differs from routine because it is a unique experience for managers (Pauchant, Mitroff, 1992). Managers' reaction to crisis is difficult to anticipate because each individual has one's own tolerance to stress, but the literature has identified four main reactions to stress that include thriving, resilience and succumbing (Carver, 1998). On the one hand, managers' ability to treat information efficiently is affected by time pressure (Wright, 1974). Time pressure also prevents managers from a making a complete assessment from a situation (Ahituv, Igbaria, Sella, 1998). On the other hand, crisis response provokes hypervigilance (Billings, Milburn, Schaalman, 1980), a higher ability to do with what is available (Crossan, Cunha, Vera, Cunha, 2005) and improvisation (Weick, 1993), which consequently changes IT use from routine situation. In the next section we review the literature on the theme of IT use in crisis response.

IT AND CRISIS RESPONSE

In this paper, we argue that the context of crisis is likely to influence decision-making process and requirements, and therefore IT usage and user reactions to IT use. We also suggest that this distinctive context requires a new extension in IS research that will investigate IT usage in crisis situation. So far, there has been some reflection on IT and crisis response (Comfort, 1993; Quarantelli, 1997; Turoff, 2002). The main concern has been focused on the ability of IT to support decision-making in crisis response. Actually, IT is a necessary means for communication and coordination in a critical context (Comfort, 1993; Quarantelli, 1997, 2007). IT maintains connections between distant locations. In that sense, it enables crucial interactions that would not be possible otherwise (Calloway, Keen, 1996; Jaeger, Schneiderman, Fleischmann, Preece, Qu, Wu, 2007). By quick information transmission, IT logically supports quick information feedback that is crucial in crisis response (Dynes, Quarantelli, 1976).

In the recent years, research has proposed a large panel of new tools and technologies to support crisis response. Table 1 below proposes a quick classification of these technologies on the basis of their function in organizations that respond to crisis. There has been special documentation on Geographic Information Systems (GIS) and Decision Support Systems (DSS). Repositories of knowledge are also extendedly used for crisis response in that they enable to keep track of experts who should be contacted. Recently, ad hoc usage of Internet also enabled citizen to take part in the crisis response and collaborate by exchanging information, comments, photos, etc (Palen, Liu, Hiltz, 2007; Majchrzak, Jarvenpaa, Hollingshead, 2007; Liu, Palen, Sutton, Hughes, Vieweg, 2008).

Function	Information Technologies	Most recent authors
Location and tracking	Geographic Information Systems	Comfort, Sungu, Johnson, Dunn,

		2001; Dawes et al., 2004.
	Geo-Collaborative tools (Geo-CSCW)	Cai, MacEachreen, Brewer, McNeese, 2005.
Risk identification	Risk assessment tools	Berghmans, Van de Walle, Van den Eede, 2008
Coordination and feedback	Internet response grid	Palen, Liu, Hiltz, 2007, Jaeger et al., 2007; Majchrzak et al., 2007 ; Liu et al., 2008.
	Collaborative virtual workplaces	Russo et al., 2006; Collins et al., 2008.
Decision making	Decision support systems (DSS)	Comfort, 1993; Mendonça, 2007; French, Turoff, 2007; Carver, Turoff, 2007.
	Intelligent Agents/Systems	Yuan, Deltor, 2005
Repository of knowledge	Shared databases	Larson, Metzger, Cahn, 2006; Carver, Turoff, 2007.
	Content Management Systems & Knowledge Systems	Collins et al., 2008.

Table 1. Information Technologies Used in Crisis Response

Research on IT and crisis response is generally normative and questions the technological fit to crisis response. Some studies criticize the lack of reliability of the technologies deployed for crisis response. IT infrastructures are sometimes not available during crisis response, which is likely to disturb coordination (Quarantelli, 1997; Jaeger et al., 2007). Other studies address technological flexibility to turbulent environment (Knoll, Jarvenpaa, 1994; Byrd, Turner, 2000). Criticism also targets IT design. IT interface is not always user-friendly, which is likely to slow down the crisis response (Landgreen, 2007). Graphical representation is crucial for crisis response (Mendonça, 2007) but is also criticized. The risk of information overload also obstructs the ability to take quick decision in crisis response (Dearstyne, 2007). Finally, additional research is required to improve support to creative decision-making that is required in crisis response (Mendonça, Wallace, 2002).

IT use is also problematic in crisis response because some IT functionalities obstruct users practices (Fisher, 1999, Dawes et al., 2004). For example, many-to-many communication can require that users permanently stay connected to each other's during crisis. Such a constraint implies a technical effort or slow down local action (Jaeger et al., 2007). Likewise, this functionality also creates dependence to technology that may be risky: lack of data or loss of access to information bewilders organizations during crisis (Hutchins, 1991).

The mentioned literature has investigated the influence of IT design or system features on crisis response. Nonetheless, none of these studies provide a systematic examination of how IT usage will differ in a crisis environment. Next section further details this gap.

LITERATURE GAP: FEW RESEARCH ON IT USAGE IN A CRISIS CONTEXT

IS use, also called IS usage, is a key construct for IS research and this variable has been included as the outcome variable in a number of research frameworks (e.g.Goodhue and Thompson, 1995, Delone and McLean, 2003, Sun and Zhang, 2006). For instance, Sun and Zhang (2006) developed a framework called the Model of Individual Interaction with IT (IIIT) that describes the influence of user reactions and traits on IS use. IS usage is modeled as the principal outcome of the interaction process. IS usage can be defined as "a user's employment of a system to perform a task" (Burton-Jones and Gallivan, 2007, p. 659)

However, IS usage is a key construct that needs further research, as pointed out by several researchers (Delone and McLean, 2003, Burton-Jones and Gallivan, 2007, Burton-Jones and Straub, 2006, Barki et al., 2007). Actually, these researchers indicate that the IS community needs to deepen its understanding of IS usage, but also to diversify the contexts of research

related to IS use. For instance, Burton-Jones and Gallivan (2007) promote a multi-level perspective on IT usage, while Barki et al. argue that IT usage is related to the types of activities performed by the users.

Furthermore, most of the IS literature has focused on analyzing IT use and user reactions to IT usage in a routine environment. Generally, there is a distinction between an utilitarian use of the system and an hedonic use. A utilitarian IS usage aims at functional or efficiency goals, while IT use in an hedonic context aims at entertainment or enjoyment of the users. Consequently, several IS studies have identified specific reactions (cognitive and affective) related to these specific environments. For instance, in a hedonic context of use, users are more likely to expect and experience enjoyment with the technology.

This paper draws on this idea, namely the fact that context of use influences the dimensions of IT usage. We suggest that IT usage and user interactions with a technology will be distinctive in a crisis environment. For instance, it is reasonable to posit that user cognitive and affective reactions will differ from those experienced in a routine context. Similarly, we argue that crisis and routine environments are going to induce different IT usage in terms of frequency of use, types of use, intensity of use, etc. Burton-Jones and Gallivan (2007) also explain that undermining the importance of context is one of the fallacies that can challenge the validity of a research. They identify contextual fallacy as a common threat in the examination of IT usage.

CONCEPTUALIZATIONS OF IS USE RETAINED FOR THE PAPER

The construct *IS use* can be studied from different perspectives. Some researchers have suggested that IS use should be assessed through measures such as frequency and length of use (Igbaria et al., 1996, Venkatesh et al., 2003, Van der Heijden, 2003, Hartwick and Barki, 1994). More recently Burton Jones and Straub (2006) highlighted that IS usage has been limited to a poor conceptualization, so the two researchers suggested a deep measure of IS usage. Burton-Jones and Straub (2006) present a richer view of IS usage that they conceptualized as the sum of three components: user, system, and task. Similarly, Barki et al. (2007) rely on this triptych (called in their research task-technology-individual) to reconceptualize IS usage. These three elements were also identified in other research as being the fundamentals of any interaction with IT. Indeed, Zhang and Li (2005) mapped the HCI research into four categories, which also represent the principal variables that play a role in any interaction (see Figure 1). These four categories are human, technology, task and context.
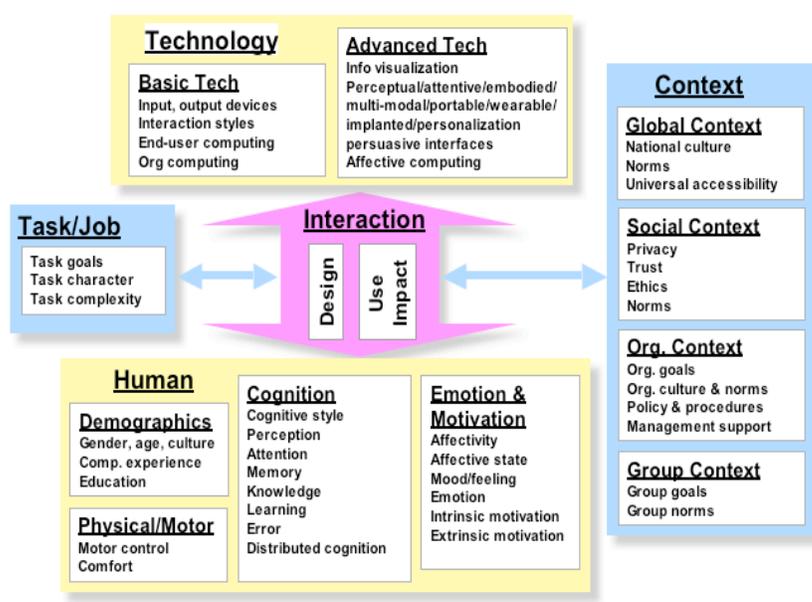

Figure 1. An Overview of Broad HCI Issues (Zhang, Li, 2005, p. 231)

AN AGENDA FOR RESEARCH ON IS USAGE IN A CRISIS CONTEXT

As far as possible we attempt to acknowledge these recent developments of knowledge on IT use in our work. More precisely, we relied on Zhang and Li's (2005) framework to determine the key variables of IT usage that could differ in a crisis situation in order to build Table 2 below. To that end, we considered each component of each category of variables that appears in the HCI framework and evaluated the differences between routine and crisis situations for each of them.

For instance, to determine which element of task differs in a routine and crisis context, we reviewed the literature on task goals, task character and task complexity, searching for the differences that could exist between crisis and routine situations. The main differences that we highlight refer to task coordination, task structure, and feedback.

In this paper, we did not retain all the variables that Zhang and Li mention in their paper (2005). We focus our attention on variables whose occurrences are documented in crisis literature as significantly different from routine situations. We have already detailed them in the *Crisis vs Routine Environment* section. We also have retained variables that appear core concepts in the IT use literature, such as computer self-efficacy.

This conceptualization of IS usage appears as the most suitable for this research since it allows us to examine both IT characteristics and user reactions. Other perspectives on IS usage exist, such as the engineering view or the perspective of user-centred design. However, the latter aims at knowing better user requirements and needs in order to improve software design (Kling 1977) and more generally information systems development (Hirschheim and Klein 1989). In contrast, this study focuses on cognitive and affective reactions.

We then relied on Blaikie's (2007) definition of research questions to formulate suggestions for research in this paper. More precisely, Blaikie identifies three main types of research questions:

- The *What?* Question assesses the nature of a specific phenomenon and calls for a description of the nature and dynamics of a particular phenomenon (1),

- The *why?* Question investigates the factor or reasons that account for the nature of the phenomenon under study (2),

- The *How*? Question concerns the practical outcomes of the phenomenon under study (3).

Applying Blaikie's guidelines to the construct of *IT use*, we suggest three main types of research questions. First, we question the nature of *IT use* in regard to some variable (1). For example, we suggest investigation on the *nature of IT use* under high emotional and time pressure. Second we question the *influence* of some key variables on IT use in crisis response (2). For example, we question the influence of the need for information feedback on IT use. Finally, we question the *implications* of IT usage on some crisis variables (3). Table 2 below recapitulates the differences between routine and crisis situations that have been discussed in the literature so far. For each IT usage key variable, we also suggest some research questions that could be investigated further in future research and precise the type of question it belongs to. Given all the differences between crisis and routine situations, we argue that crisis should be viewed as a distinct research context that deserves more investigation.

IT usage variable	Key variables that will differ in crisis	Details	Suggestions of research questions	Type of question: What? (1) Why? (2) How? (3)
User	Hypervigilance	This variable can either decrease (Wright, 1974) or increase (Billings et al., 1980). However, these aforementioned references do not identify how IT may relate to this phenomenon.	Therefore, we can wonder whether and how hypervigilance influences IT use in crisis response.	(1)
	Computer Self-Efficacy	It has been identified as an important user trait (Sun and Zhang, 2006) that influences performance within a system.	Do users have a higher computer self-efficacy when they have to deal with a crisis?	(1)
			What is the influence of computer self-efficacy on the management of the crisis?	(3)
	Emotional Pressure	Generally, emotional pressure is higher in crisis response (Hermann, 1963), but prior research has not investigated how IT help users to cope with the crisis. Therefore, future	What is the influence of IT use on emotional pressure?	(1)
			How to virtually deal with emotional pressure?	(3)
			How do emotions affect IT use in a critical context?	(3)

		research could investigate the following issues.		
	Nature of emotions	Emotions are diverse depending on personality and crisis experience (Carver, 1998) and they are likely to affect IT use significantly. But knowledge on the role of emotions in this context is missing.	How do technologies help reducing the arousal of negative emotions such as stress and anxiety during crisis response?	(3)
			How do users' affective reactions influence their interaction with the technology during crisis response?	(3)
	Time Pressure	Time pressure is higher during a crisis (Hermann, 1963). However, there are numerous innovations in ICT that could offer new ways to managers to better manage their time. Moreover there is the need to evaluate the effect of real time communication and immediate access to information on time pressure.	How do real-time communication and immediate access to information relief time pressure for IT users?	(1)
Task	Information feedback	Information feedback is crucial in crisis response (Dynes, Quarantelli, 1976), all the more when work is distributed. Still the risk of information overload is also higher (Dawes et al., 2004). This dilemma calls for further research on the informational needs in crisis response.	What is the effect of higher need for information feedback on IT use?	(1)
			How to evaluate the risk of information overload by in crisis response?	(3)
	Improvisation	Improvisation is particularly likely to occur in crisis situation (Crossan et al., 2005). But we know very little on its occurrence and its role.	Does IT support improvisation in crisis situations?	(1)
			How does collective improvisation affect IT use during crisis response?	(2)
	Coordination:	Coordination is likely to occur between unfamiliar organization and unknown counterparts, requiring dialogical reasoning and a trajectory pattern (Quarantelli, 2006; Faraj, Xiao, 2006), which has been little explored in respect to IT use.	How do crisis responders use IT when they need to coordinate to each other?	(1)
			Does IT facilitate or constrain dialogical reasoning among stakeholders in a critical context?	(3)
			Does IT support trajectory-pattern coordination for crisis response?	(3)
System	Technological fit	In terms of Design, interface and functionalities	Are technology fit requirements different or similar between crisis and routine situations?	(1)
			What are the adjustments that can be made to ensure a technological fit even during a crisis context?	(2)

	Flexibility	Flexibility of a system can take three different forms: flexibility in function, use and modification (Knoll, Jarvenpaa, 1994; Byrd, Turner, 2000). At first sight, flexibility allows users to respond in an innovative way to the crisis. Nonetheless, little attention has been paid to how technological flexibility facilitates crisis response.	How does technological flexibility affect crisis response?	(3)

Table 2. Crisis Characteristics and Research Questions

CONCLUSION

As illustrated in Table 2, crisis context clearly influences the characteristics of 1) users, 2) tasks and 3) systems. First, users tend to experience a higher pressure during a crisis leading to more rapid and reactive actions than in a routine context. Accordingly, user affective and cognitive reactions need to adapt to the crisis context. At the affective side, it is reasonable to posit that in a crisis context, negative emotions such as stress, anger or anxiety may even play a more important role than in a routine environment. A number of studies have supported the inclusion of computer anxiety in IS research models because this affective reactions is also a determinant of IT usage (Brosnan, 1999, Al-Khaldi and Al-Jabri, 1998). However, traditional IS research models, such as the IT Success Model (Delone and McLean, 2003), consider satisfaction but do not represent or include other types of user reactions. Future research should focus on the role of IS for engendering or reducing the emergence of negative emotions. Second, tasks radically differ between crisis and routine situation. Because the nature of the task is different it requires more frequent communication and therefore is likely to affect IT use. There is the need to look at conceptual ties between the IT use construct and task completion in crisis response. Finally, IT requirements are different in particular in terms of technological fit and flexibility.

Consequently, prior treatments of IT usage in traditional IS models may not fit to crisis response that generally impacts the three dimensions of IT usage. Although this research indicates that traditional IS research model were developed and applied in routine context, we also build some common knowledge with existing research models. For instance, Goodhue and Thompson (1995) explained that IT use and performance were a function of how tasks were designed. These two researchers pointed out with the Task-Technology-Fit model that these three elements were related. This paper supports this idea by arguing that a crisis context modifies the nature of tasks and so IT usage or user performance with the system.

This research presents some limitations. First, the list of variables considered in Table 2 is not exhaustive. We also approach technologies from a general perspective, where as IT gathers a complex set of tools and technologies. In our future work, we intend to distinguish issues in function of types of technologies such as communication technologies, decision technologies and so on. Our investigation is still exploratory and we think that it is valuable to take into consideration a large panel of technologies at this stage.

Then our analysis is questionable in that we rely on literature on routine situations to deduce interesting dimensions that should be taken into account in IT use literature. To that extent, we both rely and try to get some distance with the routine perspective of IT use. In that sense, our approach is not fully innovative.

Finally, we acknowledge the panel of research questions that we propose may be too large. We intend here to raise unsuspected directions for research and our approach is purely exploratory. By doing so, we undoubtedly keep analysis at a superficial level. Discussion is required on research questions' salience or legitimacy. On the basis provided by discussion, we suggest selection and deep investigation of the most relevant questions as a further research objective.

In spite of its limits, we hope our work contributes to the development of research on IT use in crisis response, thereby responding to managers' needs for more developed recommendations.

REFERENCES

1. Ahituv, N., M. Igbaria, et al. (1998). The Effects of Time Pressure and Completeness of Information on Decision Making, *Journal of management information systems,* 15, 2, 153-172.
2. Allenby, B. (2005). Toward Inherently Secure and Resilient Societies, *Science,* 309, 1034-1038

3. Al-Khaldi, M. A. and Al-Jabri, I. M. (1998) The Relationship of Attitudes to Computer Utilization: New Evidence from a Developing Nation, *Computers in Human Behavior,* 14, 23-42.

4. Berghmans, P. H., B. A. Van de Walle, et al. (2008). "A Systems Perspective on Security Risk Identification Methodology and Illustrations from City Council ", 5th International ISCRAM Conference, Washington, DC, USA.

5. Billings, R. S., T. W. Milburn, et al. (1980). A model of crisis perception: A theoretical and empirical analysis, *Administrative Science Quarterly,* 25, 2, 300.

6. Barki, H., Titah, R. and Boffo, C. (2007) Information System Use–Related Activity: An Expanded Behavioral Conceptualization of Individual-Level Information System Use, *Information Systems Research,* 18, 173–192.

7. Blaikie, N. (2007). Approaches to social enquiry, Polity.

8. Brosnan, M. J. (1999) Modeling Technophobia: A Case for Word Processing, *Computers in Human Behavior,* 15, 105-121.

9. Burton-Jones, A. and Gallivan, M. J. (2007) Toward a Deeper Understanding of System Usage in Organizations: A Multilevel Perspective, *MIS Quarterly,* 31, 657-679.

10. Burton-Jones, A. and Straub, D. W. (2006) Reconceptualizing System Usage: An Approach and Empirical Test, *Information Systems Research,* 17, 228–246.

11. Byrd, T. A. and D. E. Turner (2000). Measuring the Flexibility of Information Technology Infrastructure: Exploratory Analysis of a Construct, *Journal of management information systems*, 17, 1, 167-208.

12. Cai, G., A. M. MacEachren, et al. (2005). Map-Mediated GeoCollaborative Crisis Management, ISI 2005.

13. Calloway, L. J., Keen, P. G. W. (1996). Organizing for crisis response, *Journal of Information Technology*, 11, 1, 13-26.

14. Carver, C. S. (1998). Resilience and Thriving: Issues, Models, and Linkages, *The Journal of social issues* 54, 2, 245.

15. Carver, L., Turoff, M. (2007) Human-computer Interaction: The Human and Computer as a Team in Emergency Management Information Systems, *Communications of the ACM*, 50, 3, 33-38.

16. Collins, L. M., J. E. Powell, et al. (2008). Emergency Information Synthesis and Awareness Using E-SOS. *5th International ISCRAM Conference, Washington, DS, USA.*

17. Comfort, L. K. (1993). Integrating Information Technology into International Crisis Management and Policy, *Journal of contingencies and crisis management*, 1, 1, 15-26.

18. Comfort, L. K., Sungu, Y., Johnson, D., Dunn, M. (2001) Complex Systems in Crisis: Anticipation and Resilience in Dynamic Environments, *Journal of Contingencies & Crisis Management*, 9, 3, 144-158.

19. Crossan, M., M. P. E. Cunha, et al. (2005). Time and organizational improvisation, *Academy of Management Review*, 30, 1, 129-145.

20. Dantas, A., Seville, E. (2006) Organizational Issues in Implementing an Information Sharing Framework: Lessons from the Matata Flooding Events in New Zealand, *Journal of Contingencies and Crisis Management*, 14, 1, 38-52.

21. Dawes, S. S., A. M. Cresswell, et al. (2004). Learning from crisis - Lessons in human and information infrastructure from the World Trade Center response, *Social Science Computer Review* 22(1): 52-66.

22. Dearstyne, B. (2007). The FDNY on 9/11: Information and decision making in crisis. *Government Information Quarterly*, 24, 1, 29-46.

23. Delone, W. H. and McLean, E. R. (2003) The DeLone and McLean Model of Information Systems Success: A Ten-year Update, *Journal of Management Information Systems*, 19, 9-30.

24. Faraj, S. and Y. Xiao (2006). Coordination in Fast-Response Organizations, *Management science,* 52, 8, 1155-1169.

25. Fink, S. L., Beak, J., Taddeo, K. (1971). Organizational Crisis and Change, *The Journal of applied behavioral science*, 7, 1, 15-37.

26. French, S. and M. Turoff (2007). Decision support systems. *Communications of the ACM*, 50, 3, 39-40.

27. Goodhue, D. L. and Thompson, R. L. (1995) Task-Technology Fit and Individual Performance, *MIS Quarterly,* 19**,** 213-236.

28. Hartwick, J. H. and Barki, H. (1994) Explaining the Role of User Participation in Information System Use, *Management Science,* 40, 440-465.

29. Hermann, C. F. (1963). Some Consequences of Crisis Which Limit the Viability of Organizations, *Administrative Science Quarterly*, 8, 1, 61-82.

30. Hirschheim, R., and Klein, H.K. (1989). Four Paradigms of Information Systems Development, *Communications of the ACM,* 32, 10, 1199-1216.

31. Hutchins, E. (1991). Organizing work by adaptation, Organization Science, 2, 1, 14-39.

32. Igbaria, M., Parasuraman, S. and Baroudi, J. J. (1996) A Motivational Model of Microcomputer Usage, *Journal of Management Information Systems*, 13, 127-144.

33. Jaeger, P. T., B. Shneiderman, et al. (2007). Community response grids: E-government, social networks, and effective emergency management, *Telecommunications Policy* 31, 10-11, 592-604.

34. Kling, R (1977). The Organizational Context of User-Centered Software Designs, *MIS Quarterly*, 1, 1, 41-52.

35. Knoll, K. and S. L. Jarvenpaa (1994). Information technology alignment or "fit" in highly turbulent environments: the concept of flexibility. *Proceedings of the 1994 computer personnel research conference on Reinventing IS : managing information technology in changing organizations: managing information technology in changing organizations*. Alexandria, Virginia, United States, ACM**,** 1-14.

36. Landgren, J. (2007). Investigating the Tension between Information Technology Use and Emergency Response Work. *European Conference of Information Systems.*

37. Larson, R. C., Metzger, M. D., Cahn, M. F. (2006) Responding to Emergencies: Lessons Learned and the Need for Analysis, *Interfaces*, 36, 6, 486-501.

38. Liu, S. B., L. Palen, et al. (2008). In search of the Bigger Picture: The Emergent Role of on-Line Photo Sharing in Times of Disaster . Proceedings of the 5th International ISCRAM Conference, Washington, DC, USA.

39. Majchrzak, A., Jarvenpaa, S. L, Hollingshead., A. (2007) Coordinating Expertise Among Emergent Groups Responding to Disasters, *Organization Science*, 18, 1,147-161.

40. Mendonça, D. and W. A. Wallace (2002). Development of a Decision Logic to Support Group Improvisation: An Application to Emergency Response. *The 35th Hawaii International Conference on System Sciences.*

41. Mendonca, D. (2007). Decision support for improvisation in response to extreme events: Learning from the response to the 2001 World Trade Center attack, *Decision Support Systems*, 43,3, 952-967.

42. Mitroff, I. I., C. M. Pearson, et al. (1996). The Essential Guide to Managing Corporate Crisis: A Step-by-step Handbook for Surviving Major Catastrophes, Oxford University Press.

43. Palen, L., Hiltz, S. R., Liu, S. B. (2007) Online Forums Supporting Grassroot Participation in Emergency Prepared and Response, *Communications of the ACM*, 50, 3, 54-58.

44. Pauchant, T. C. and I. Mitroff (1992). Transforming the crisis-prone organization: preventing individual, organizational, and environmental tragedies, Jossey-Bass.

45. Quarantelli, E. L. (1988). Disaster Crisis Management: A summary of research findings, *Journal of Management Studies*, 25, 4, 373-385.

46. Quarantelli, E. L. (1997). Ten Criteria for Evaluating the Management of Community Disasters. *Disasters*, 21, 1, 39-56.

47. Quarantelli, E. L. (2006). "Catastrophes are Different from Disasters: Some Implications for Crisis Planning and Managing Drawn from Katrina." Understanding Katrina, Perspectives from the Social Sciences. from http://understandingkatrina.ssrc.org/Quarantelli/.

48. Quarantelli, E. L. (2007). Problematic Aspects of the Computer Based Information/Communication Revolution with Respect to Disaster Planning and Crisis Managing. Preliminary Work #358, University of Delaware Disaster Research Center.

49. Ren, Y., S. Kiesler, et al. (2008). "Multiple Group Coordination in Complex and Dynamic Task Environments: Interruptions, Coping Mechanisms, and Technology Recommendations." *Journal of management information systems*, 25, 1, 26.

50. Russo, E., A. Raposo, et al. (2006). Configuring a Collaborative Virtual Workspace for Disaster Management on Oil&Gas Offshore Structures. *Joint International Conference on Computing and Decision Making in Civil and Building Engineering, Montréal, Canada.*

51. Shrivastava, P. (1988). Industrial crisis management: Learning from organizational Failures. *The Journal of management studies*, 25, 4, 283-284.

52. Staw, B. M., L. E. Sandelands, Dutton, J. E. (1981). "Threat-rigidity effects in organizational behavior: A multilevel analysis." *Administrative Science Quarterly*, 26, 4, 501-524.

53. Sun, H. and Zhang, P. (2006) In Human-Computer Interaction and Management Information Systems - Foundations (1)(Eds, Zhang, P. and Galletta, D.) M.E. Sharpe, Inc., Armonk, NY.

54. Turoff, M. (2002). Past and future emergency response information systems. *Communications of the ACM,* 45, 4, 29-32.

55. Van der Heijden, H. (2003) Factors Influencing the Usage of Websites: The Case of a Generic Portal in The Netherlands, *Information & Management*, 40, 541.

56. Venkatesh, V., Morris, M., Davis, G. and Davis, F. (2003) User Acceptance of Information Technology: Toward a Unified View, *MIS Quarterly*, 27, 425-478.

57. Waugh, W. L. and G. Streib (2006). "Collaboration and Leadership for Effective Emergency Management." *Public Administration Review*, 66, 131-140.

58. Weick, K. E. (2001). Making Sense of the Organization, Blackwell Publisher.

59. Weick, K. E. (1993). "The Collapse of Sensemaking in Organizations - the Mann Gulch Disaster." *Administrative Science Quarterly,* 38, 4, 628-652.

60. Wright, P. (1974). "The harassed decision maker: Time pressures, distractions, and the use of evidence." *Journal of Applied Psychology* , 59, 5, 555-561.

61. Yuan, Y., Detlor, B. (2005) Intelligent Mobile Crisis Response Systems, *Communications of The ACM*, 48, 2, 95-98.

62. Zhang, P. and Li, N. (2005) The Intellectual Development of Human-Computer Interaction Research: A Critical Assessment of the MIS Literature (1990-2002), Journal of the Association for Information Systems, 6, 227-292.