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Emergent Groups for Emergency Response – Theoretical Foundations and Information Design Implications

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ABSTRACT

Experience from recent crises strongly suggests that involvement of ordinary individuals or groups of people in emergency response is a critical contribution to large-scale disaster relief, especially at the beginning of the crisis. While not meant to displace response from trained authorities, they should not be regarded as a liability but as immediately available assets. Instead, the issue is to find ways to support these emergent groups in the middle of a large-scale disaster, when formal responders have yet to arrive at the scene and information is scarce, confusing, depressing, and not informative enough to support rescue work. In this paper, we investigate theoretical foundations that explain the motivational basis, group dynamics and information and communication needs of a helping community. Given the central role of information and communication technologies (ICT), we suggest how critical information should be gathered, presented and disseminated using a workflow-based template design to assist emergent groups to help others.

Keywords

Disaster, emergent groups, motivation, information processing, template, workflow.

INTRODUCTION

Disasters are situations or events that overwhelm local rescue capacity (CRED, 2008). While waiting for large-scale efforts to get organized and fully deployed, citizens and groups that do not belong to any formal authority structures or emergency response plans are often the first to deal with on-the-spot disaster relief and humanitarian assistance.

Known as emergent groups, these “happened-to-be-there” citizens appear at all stages of the disaster cycle, and take a variety of forms. In immediate response to Hurricane Katrina, groups emerged that participated in search and rescue (e.g., collaboration of civilian boat operators with the Coast Guard and other response agencies), provided shelters and first aid (e.g., privately run shelters before approval from the Red Cross), and communicated important information (e.g., knowledge dissemination through the KatrinaHelp Wiki, which was established by many independent individuals to share information on shelters, government resources, affected population) (Majchrzak, Jarvenpaa and Hollingshead, 2007). In immediate response to 9/11, an emergent group grew from a few volunteers to hundreds over the course of three weeks (Voorhees, 2008).

Researchers have examined the opportunity provided by the Internet for involvement of local and geographically removed citizens in disaster response. Examples include citizen-led online forums and other “backchannel” response activities that emerged following Hurricane Katrina, the Southern California wildfires (Palen, Hiltz, and Liu, 2007; Sutton, Palen, and Shklovski, 2008), and the Virginia Tech shooting (Vieweg, Palen, Liu, Hughes, and Sutton, 2008). As Palen et al. note, ICT reveals the role that citizens have always taken as first responders in emergency situations (Palen et al., 2007). Indeed, emergent behaviors observed on social networking sites and blogs may be catalysts of change for future disaster response (Sutton et al., 2008).

Scope and magnitude of disasters tend to be positively related to the phenomenon of *emergence* (Drabek and McEntire, 2003). Existing authorities may not be able to meet urgent rescue demands, due to rigidity of public institutions and inappropriateness of organizational structures and tasks (Drabek and McEntire, 2003). In most unexpected crises, volunteers often find themselves as the only available resources (Tierney, Lindell and Perry, 2001).

The centralized approach to response considers *ad-hoc* emergence as counterproductive. However, disaster sociology researchers have repeatedly argued that the model's incorrect assumptions about behavior in the emergency phase tend to

lead to misguided conclusions at the expense of needed flexibility, and that the command-and-control approach is too static particularly for large disasters (Drabek and McEntire, 2003). Due to inherent unpredictability of large-scale disasters, formal plans and communication links break in unexpected ways, and formal organizations are prone to paralysis from overwhelming lack of certainty and structure (Lanzara, 1983). The horizontal model of response (including local communication links and emergent groups) tends to work more effectively in extreme conditions.

Failure of central structures like those established by the US National Preparedness System has been observed consistently across large crises (Majchrzak et al., 2007). In a Hurricane Katrina case study, emergency responders noted that formal emergency preparedness structures, including interagency and inter-organizational coordination, failed within hours of landfall with the loss of infrastructure and equipment, and lasted up to two weeks (Fischer, Gregoire, Scala, Letukas, Mellon, Romine and Turner, 2006).

Despite the reservations some professional rescuers, experience from recent crises strongly suggests that involvement of emergent groups is a critical contribution to immediate large-scale disaster response. Local volunteers from the affected populations are the first potential helpers in close proximity to the most urgent needs. They have detailed knowledge of the area and possible needs, which enhances their ability to improvise and respond effectively.

This paper focuses on the support of emergent groups that operate when formal responders have not arrived at the scene.

THEORETICAL PERSPECTIVES ON EMERGENT GROUP SUPPORT

In order to determine how we can help individuals or emergent groups with ICT-based communication and information support, we must understand their nature, dynamics, and operations in the context of severe crises situations. In this section, we discuss a selected theoretical background from sociology, communication sciences, and organizational theory, which we believe contributes significantly to an increased understanding of more effective interaction with volunteers. We then derive a set of propositions for an information design aiming at effective support of emergent groups in large-scale immediate disaster response situations.

Individual-Level Considerations

Research has described five types of informal convergence behaviors immediately following disasters, which refer to dynamic dominant motivations and potential social roles: helpers, returnees, anxious, curious, and exploiters (Fritz and Mathewson, 1957). ‘Helpers’, often surviving community members who are present or nearby, initiate crucial disaster response activities as those described above (Lowe and Fothergill, 2003).

The Altruistic Community Model and Motivators to Help

Allen Barton’s altruistic community model proposes social mechanisms that produce helping behavior among victims of collective stress situations, based on individual-level variables, corresponding aggregate-level variables, as well as global variables that characterize impact, community structure, and role of media (Barton, 2005). The motivational basis for a helping community rests on the individual-level variables of sympathetic identification with victims, individual feelings of moral obligation, and perception of a ‘helping community’ norm. These motivators are influenced by other factors in the model. Interestingly, recent research suggests that man-made disaster agents (e.g., technological threats), as opposed to natural disasters, may impact emergence by eroding community consensus (Tierney et al., 2001). While not meant to be comprehensive, Figure 1 shows the most important relationships, which Barton identified (Barton, 2005).

While the altruistic community model may have the strongest potential related to disaster preparation, it is to some extent possible to encourage and support emergent groups with the consideration of positive and negative impact variables in the design of support mechanisms. Although the majority of factors that have an impact on motivators are beyond the control of disaster managers, response effectiveness may be increased with maximization of awareness of the nature and severity of the disaster and ongoing help efforts, and incorporation of a sense of moral obligation.

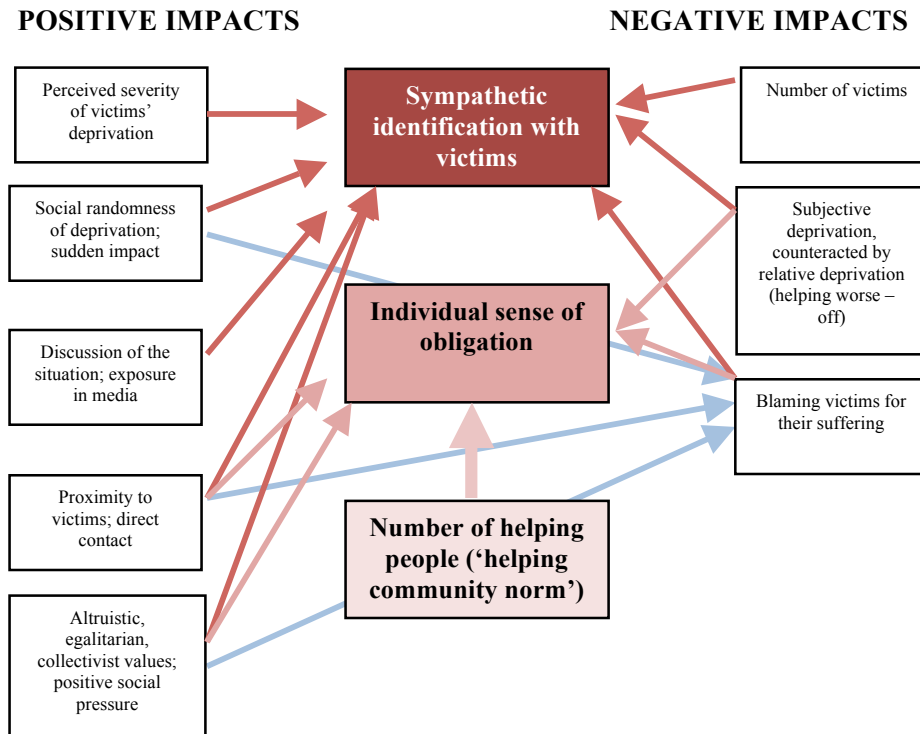


Figure 1. Major Impacts on the Motivational Basis of a Helping Community

Affective and Sense-Making Perspectives on Information Processing

The concept of “affective revolution”, which focuses on emotional aspects of information processing, is of central importance to the design of the information environment for disaster volunteers. Several research streams in Information Science, related fields, and HCI (Human-Computer Interaction) emphasize the importance of emotion in information system design (Nahl, 2007). Affective control theory focuses on the control mechanism of emotions on cognitive operations, and explains mental processes related to receiving and using information through interaction of three human biological systems with each other and with technology (Nahl and Bilal, 2007). Nahl’s unified theory of information behavior, while not tested in crisis situations, provides valuable guidelines for the design of interface and instructions for volunteers by considering the biological procedures of how users notice, think, and intend when interacting with technology.

Sense-making is another important concept to disaster research. By analyzing the use of social media related to the Virginia Tech shooting, Vieweg et al. (2008) observed the existence of altruistic online communities with characteristics of collective distributed problem solving and sense-making. Most studies, however, focus on sense-making related to decision making in formal disaster response (e.g., van de Ven and Neef, 2006; Grant, 2005). Sense-making is described as a social and collaborative process, in which the social context affects selection and interpretation of cues, and therefore actions (Landgren, 2005). Research suggests that crisis management and IS design for professional responders should support the sense-making process particularly in ongoing crises, as sense-making, more effectively than rational decision-making, addresses characteristics of crisis situations (e.g., discontinuity, dissonance, ambiguity, and ill-structured problems) (Muhren, van den Eede and van de Walle, 2008).

In the psychoanalytical field, researchers argue that the process of sense-making, an ongoing attempt to address uncertainty through establishing a familiar framework of understanding in the critical period, can help or hinder reaction and the likelihood of survival (Stein, 2004).

Information seeking and use were conceptualized as part of sense-making, again with a central affective component with consequences for motivation (Dervin, 1983). Studies utilize cognitive and affective help categories to examine the information seeking and use process (Nahl and Bilal, 2007). The variation of situational characteristics and perceived value of help sources constitute interesting guidelines for information requirements and effective design of information support in

crises. Those results should be seen as a guideline for integration of more affective, interactive and encouraging information support, not as an implication that cognitive help is not valuable. Users should immediately notice and understand important content. Design must mitigate potential adverse reactions to unfamiliar instructions in the absence of disaster response skills (e.g., overwhelmed and intimidated feelings), based on the assumption that affective and cognitive procedures are learned group practice-based skills and require adaptation to new situations (e.g., learning unfamiliar information systems) (Nahl and Bilal, 2007). Instructions must support affective information processing as much as cognitive aspects. According to affective load theory, successful information behavior in a situation of increased ‘affective load’ (an affective satisficing procedure combining uncertainty and time pressure) depends on counterbalancing procedures related to coping skills, consisting of self-efficacy and optimism (Nahl and Bilal, 2007).

Disaster-induced Stress

Emergent groups are likely to operate under significant stress and urgency, particularly in a search and rescue scenario. From a crisis perspective, sociological research has concluded that citizens generally react positively, rationally, and constructively under the stress of immediate response, contrary to ‘disaster myths’ that suggest panic reactions (Tierney et al., 2001). Recent empirical research finds that social interaction is crucial for affected citizens. Contribution helps to cope with the stress based on the severity of the situation and uncertainty of information (Sutton et al., 2008).

However, typically, people’s cognitive abilities tend to reduce under stress (Bui and Sankaran, 2006). Information support for volunteers should therefore approach stress as an issue related to information processing.

Group-Level Considerations

Emergent Group Dynamics

Not only individual-level considerations, but also dynamics specific to emergent groups are critical for the design of information systems. Formal disaster response has not determined how to use emergent groups effectively, partly because it is difficult to predict what types of emergent groups with which skill sets will appear.

Emergent groups are distinctly different from disaster response groups with preexisting structures, as they are transitory organizations that form to address particular ad-hoc situations. They are ‘dynamic’ insofar as they shift in response to events, information and people, and that their goals can change (Saunders and Kreps, 1987). Sociological disaster researchers define emergent response groups as groups of individuals who use non-routine resources and activities to apply to non-routine domains and tasks, using non-routine organizational arrangements (Drabek and McEntire, 2003; Tierney et al., 2001). In a field study of emergent groups during the 1980 earthquake in Southern Italy, Lanzara (1983) proposed eight characteristics of emergent organizations, taking into account the wide variety of organizational structures and behaviors, including variable boundaries and memberships, distributed leadership, “heterarchical” configuration, spontaneous activities and context-driven rules, short-term organizational memory and ephemeral and exchangeable roles.

Few attempts have been made to extend organizational theory to explain the unique organizational behavior of emergent groups, whose characteristics require non-traditional approaches to expertise and knowledge coordination. Recent research has proposed an extension of Transactive Memory Systems theory (TMS), which traditionally seeks to explain how groups with known group membership, perceived cognitive interdependence, and shared goals learn, store, use, and coordinate knowledge (Majchrzak et al., 2007). As the cognitive structure of emergent groups centers on action instead of deep domain knowledge and task-relevant expertise of members, Majchrzak et al. (2007) propose that task assignment and specialization is based on the group’s collective knowledge of relationships, tools, and tasks, willingness to act on that knowledge through capability (resources) and motivation, and knowledge flexibility. In the absence of a shared meta-structure, knowledge coordination is based on observing action scenarios, joint on-the-spot sense-making, simple coordination mechanisms, and community-developed narratives and observable records. Credibility in expertise is replaced by the concept of swift trust through action, known from research on *ad-hoc* project teams, which is highly dynamic and based on group dynamics rather than situations (Majchrzak et al., 2007).

PRACTICAL IMPLICATIONS: TOWARD A WORKFLOW-BASED TEMPLATE DESIGN FOR SUPPORTING EMERGENT INDIVIDUALS AND GROUPS

The above theoretical discussion shows that effective support and management of emergent groups needs to address their fundamental information needs. At the individual level, it seems natural and sensible to reinforce the sympathetic identification with victims and the sense of obligation to help. Also, based on the affective perspective on information

processing, we posit that information to best help the individual helpers should take into consideration both situation-sensitive cognitive activity and affective intentionality.

At the collective level, information design should pay attention to innovative and flexible mechanisms that enable collaboration and coordination of non-professionals in extreme environments.

Proposition 1: Integrate Behavioral and Organizational Models to Optimize the Information and Communication Support Process

Individual and organizational characteristics discussed in the previous section should be utilized in order to increase the effectiveness of emergent group support in disaster management.

Individual level

Based on the altruistic nature of emergent groups, information should be provided to encourage and reinforce the motivation to help:

- People who are helping: Positive reinforcement of the ‘helping community norm’ has a strong potential to heighten the personal sense of obligation and create a snowball effect of motivated volunteers.
- People in need of help: Information should be specific to the community, with sensitivity to the potential of overwhelming helpers by sheer number of victims, depending on the scale of the disaster. Specification of victims should increase motivation with stronger sympathetic identification with the victims through awareness of proximity and the severity of deprivation.
- Situational awareness: Information regarding the crisis characteristics has the potential to touch upon all positive impact variables listed in Figure 1, thereby – if balanced to avoid overwhelming recipients – increasing the potential of reinforcing the motivational basis of volunteers. A question for continued research is how much information is enough for motivating and executing a task, but not overwhelming in a decentralized/distributed management approach (e.g., Sengupta and Abdel-Hamid, 1993).

The overall design should build on the theories of affective information processing and sense-making to maximize information reception and reduce the potential of miscommunication. Particularly in high-stress situations and in the presence of inexperienced volunteers, the design must be simple, intuitive, concise and unequivocal, enabling volunteers to immediately notice and understand critical content without getting overwhelmed by unfamiliar instruction or interface formats, as well as providing a simple tool to document and communicate experiences and needs.

As possible, components of reassurance and interaction should be integrated into information support, based on sense-making studies and affective information processing research. The need of the person in more challenging situations appears to drive the use and increased perceived helpfulness of ‘more affective sources.’ As another practical step to address this, as well as to alleviate crisis-induced stress, any suggested rescue action would be assisted by a remote professional or expert via telecommunication means. In addition, whenever technologically feasible, a match-up volunteer network should be set up to create a sense of community among the rescuers.

Group level

An analysis of collective characteristics of the emergent groups in action was utilized to understand and inform information support that can leverage and mitigate their strengths and weaknesses in disaster management. Flexible boundaries, “heterarchical” organizational structure and lack of organizational memory in immediate response groups support our template design with detailed guidelines on how to execute a particular rescue task (i.e., “what” task to be performed, “where” to help, “why” to execute a specific task, “who” to communicate to), based on customized information compiled from past or current data. Lack of memory paradoxically adds to the appeal of emergent groups (e.g., routines may be ineffective, outdated, misleading for the current situation), but knowledge translated into best practices for future reference can prove useful.

Based on the dynamic nature of the probable action-based swift trust structure within and among emergent groups, low trust levels and potential conflicts should be expected. Information provided should consider the potentially helpful effect of a core member and trust augmenting measures (e.g., redundancy, goals and monitoring through performance measures, stronger reliance on external support) as suggested by the concept (Majchrzak et al., 2007), as long as flexibility is preserved.

Proposition 2: Design Workflow-Based Template as Means to Guide Emergent Groups

Information is the central structural support for all activities in extreme conditions with high uncertainties (Someren, van Netten, Evers, Cramer, de Hoog and Bruinsma, 2005). Members of emergent groups report that they often did not know the specifics of what to do and how to do it (Lanzara, 1983). An instinctive outcome of the discussion on emergent group characteristics is template-driven processing, i.e., design of a mechanism to support the creation and use of templates for representing, extracting, organizing, and acting on relevant information (Bui and Tan, 2007). Templates are tools to categorize and adapt actions on a scenario basis, which makes it easier to compare multiple cases and infer generalizations. Templates provide a flexible, structured medium to locate relevant information in an easier and timely manner, with simple, clear and intuitive presentations of instructions that support proactive information processing, are easily transferrable among group members, and allow for documentation (Bui and Tan, 2007). They are modular and scalable, and can be used for multiple protocol activation (Lee, 1997).

Instructions should focus on task completion rather than maximum efficiency, and enable quick ad-hoc decision-making. While information should help the group to identify existing expertise and opportunity, it should ultimately focus on providing knowledge and guidelines on activities, which are at the center of the emergent group cognitive structure. Assuming lack of expertise and high stress, instructions must not only be simple, but outside expertise should be made accessible when possible. Because of the potential for unstable ICT, information support should help groups to quickly develop and communicate a simple coordination mechanism that does not rely on individual expertise, but on a documented narrative of actions to enable assessment on what further help is needed, and to counteract the lack of organizational memory and intelligence.

Each task within a given disaster response operation can be represented as a set of descriptive templates. Figure 2 shows a generic template with a standardized set of placeholders as representation of the details of the activity.

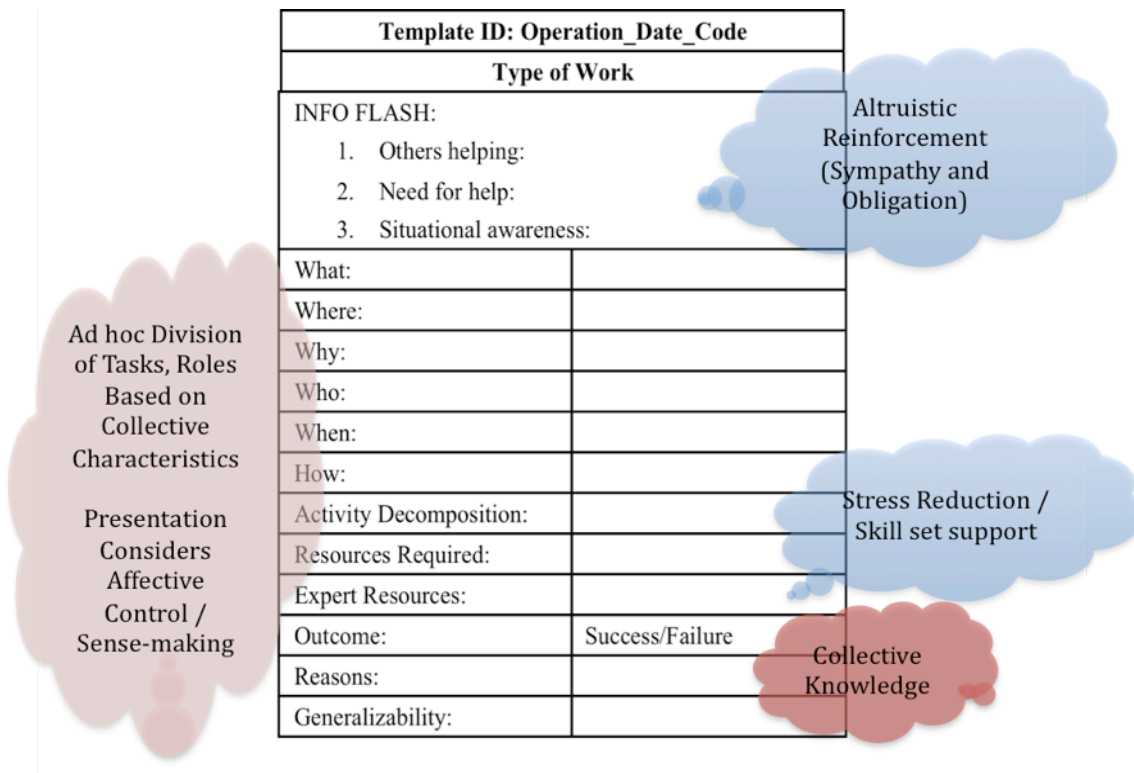


Figure 2. Generic Template for Emergent Group Support

Analysis and design of a template is based on detailed case-based and action-driven descriptions of concrete instances of crisis situations and relief operations. Templates may be categorized (e.g., Group Assignment, Task Execution, and Communication) for a more precise representation of activities. Normative templates are derived from descriptive templates specified as successful or failed, by generalizing the values of the descriptive slots, such as “Where”, “When”, and “Who”, to the appropriate level (Bui and Tan, 2007).

The template process is embedded as part of the information/action flow in various phases of disaster management. Preparation is widely recognized as critical (Bui and Sankaran, 2001), as urgency combined with consequences of one's actions result in heavy stress, often causing simple errors and non-optimal behaviors (Billings, Milburn and Schaalman, 1980). Template preparation includes definitions of all routine protocols, selection and customization according to descriptive (what happened) and normative (what should have happened) examples, and establishment of temporal sequences, context-sensitivity based on disaster taxonomies, and performance measures. During disasters, templates are used to optimize execution – or at least, reduce execution flaws, adjusting and adapting to the competencies of existing emergent groups. After disasters, templates' effectiveness should be debriefed, so that templates can be completed and analyzed with particular attention to lessons from successes and failures (Bui and Tan, 2007).

Proposition 3: Monitor and Update

Effective support of emergent groups requires constant or periodic monitoring in order to evaluate progress of the volunteer operations (e.g., search and rescue), ensure timely delivery of critical information and resources, and maintain a sustained level of motivation and morale in line with the discussed behavioral models.

Urgency and error-prone stress suggest benefits from system automation with constant human monitoring and the ability to override. From the implementation perspective, agents and workflow have been proven useful in automating tasks and information flows while supporting judgment-intensive tasks of human decision makers (Bui and Tan, 2007). Workflow Management Systems can help implement large, heterogeneous distributed execution environments (Stohr and Zhao, 2001), and serve as natural repositories of organizational memory, particularly with reference to work processes and logic (Zhao, Kumar and Stohr, 2000). Workflow management provides tools for simulations, monitoring progress and providing quick feedback on previous decisions (Housel, El Sawy and Donovan, 1986).

For emergent groups, templates could be embedded in a workflow management system based on an ad-hoc or collaborative workflow model as an option to replace a centralized command-and-control structure of task distribution. This workflow type generally focuses on teams working together towards common goals, while teams can vary from small, project-oriented, to widely dispersed people with common interests. Process definitions are not rigid and can be amended frequently, and throughput is not an important consideration (Stohr and Zhao, 2001). For emergent group support, it should be used primarily as a set of guidelines and resources that allow execution flexibility.

Proposition 4: Plan to Enable Quick Restoration of ICT

The template approach assumes that the dissemination of information to emergent groups is possible through ICT. However, communication is often interrupted in early impact stages of a disaster. Hurricane Katrina critically impaired electricity, commercial landline and cellular services, local emergency management infrastructure and control centers. In the aftermath of Hurricane Katrina, cellular service was restored in two weeks or less, while parts of New Orleans did not have landline coverage one month after the event (Banipal, 2006).

Rapid deployment of communication systems for emergency responders and disaster managers is a primary technological challenge in such situations (Banipal, 2006). While existing satellite-based emergency communications systems enabled relative independence from damage to commercial networks, systems have to be designed for flexible, open, rapid communications. Mobile ad-hoc networks, wireless Mesh, and dual-mode technology offer increased flexibility, interoperability, and decreased dependence on central coordination (Manoj, 2007). Mobile telephony, as an advanced form of mobile computing, seems to be the most ubiquitous means for reaching out to emergent groups.

SUMMARY

Bui and Tan (2007) proposed a template-based workflow system as a means to provide information and assign individual tasks to emergent rescue teams in disaster response. In an effort to expand this framework in the context of social computing, the purpose of this paper is to address information needs of individual volunteers and emergent groups who are part of immediate rescue activities by integrating behavioral and organizational models to optimize the information and communication support process. We draw our analysis from a number of theoretical perspectives: altruism, affective control

and sense-making, and cognition under stress. We also look at the collective dynamics that may impact various levels of collaboration, trust and the ability to respond to a crisis as a group. Our analysis has led to a number of improved design propositions for Bui and Tan's template-based system.

Last but not least, if our propositions are implemented, we must manage change and integrate emergent groups into a broader framework as formal disaster response organizations take over in a potentially more efficient manner. Disaster research suggests that the most successful cases of disaster response coordinate emergent and professional resources, instead of eliminating volunteers upon arrival of formal response agencies (Barton, 2005). Recent research suggests that emergency managers with training regarding emergent groups should assess groups to objectively judge their value over time and effectively manage functions as groups' roles evolve from a critical asset in the immediate aftermath (Voorhees, 2008). Our aim is to design a workflow-based template approach that allows for delivering vital information to emergent groups in a manner that ensures effective allocation of assistance and relief activities.

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