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# Situated crowdsourcing during disasters: Managing the tasks of spontaneous volunteers through public displays

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ABSTRACT

Although emergency services have already recognized the importance of citizen-initiated activities during disasters, still questions with regard to the coordination of spontaneous volunteers and their activities arise. Within our article, we will present a technological approach based on public displays which aims to foster situated crowdsourcing between affected citizens, spontaneous volunteers as well as official emergency services. We will address the research question: How can the situated tasks performed by spontaneous volunteers be supported by the use of public displays during disasters? First we will present the current state of the art with regard to the coordination practices of spontaneous volunteers and emergency services within disaster situations as well as related problems, potentials and specifics of situated crowdsourcing and public displays. To gain insight into actual coordination practices, we conducted an empirical study with 18 different stakeholders involved in disaster management. Based on the literature review and our empirical study, we have derived a technical concept that supports the task and activity management of spontaneous volunteers as well as the coordination both of the demands of affected people and the offers from spontaneous volunteers. We have implemented our concept as the public display application 'City-Share', which provides a robust communication infrastructure and encompasses situated crowdsourcing mechanisms for managing offers and demands of activities on-the-ground. Based on its evaluation with several users, we will discuss our findings with regard to the assignment of tasks on-the-ground and situated crowdsourcing during emergencies. We outline that City-Share can improve a community's disaster resilience, especially when focusing on the kind of collaborative resilience emerging between official stakeholders and spontaneous volunteers or affected citizens at a local level.



## 1. Introduction

People all over the world are affected regularly by emergencies and disasters. Briefly, examples include typhoon Haiyan in November 2013 that killed approximately 10,000 people, the European floods in June 2013 that created overall losses of € 12 billion or hurricane Sandy that turned New York into a disaster area one year earlier in October 2012. All emergencies have in common that they constitute a "hazard impact causing adverse physical, social, psychological, economic or political effects that challenges the ability to rapidly and effectively respond" (Institute for Crisis Disaster and Risk Management, 2009). Depending on their impact, emergencies can develop into disasters, unpredictable in nature, and which can affect individuals, groups, communities, or whole societies. Recent disasters, such as the ones mentioned above, have confirmed that, in addition to formal crisis management provided by the professional emergency services (i.e. firefighters and aid agencies), citizen-based crisis management – characterized by situated altruism (Dynes, 1994) – is prevalent. Individual citizens organize to form emergent and temporary groups to deal with improvised relief and rescue activities (Stallings and Quarantelli, 1985; Wachtendorf and Kendra, 2006).

Although citizen-initiated self-help activities and voluntary relief tasks have always existed whenever disasters have occurred (Tierney et al., 2006), the sheer pervasiveness of modern technology has extended not only the types of communication possible but also the coordination activities and tasks available to all individuals prior to, during and following a disaster. Via mobile devices and social media, affected citizens and spontaneous volunteers can organize to perform physical activities that require the volunteers to be in a specific location, like filling sandbags or clearing up locations (Ludwig , et al., 2015). They can now quickly ask for support or assign tasks (on the go) for dealing with

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response and recovery activities when facing emergencies or disasters (Gao and Barbier, 2011). The uncertain character of a disaster, however, challenges the rapid provision of information for all stakeholders involved (Turoff et al., 2009). Especially at the onset of a disaster, both affected citizens and spontaneous volunteers demand both rapid help and concrete information from emergency services. It is only to be expected that in the early stages, information provided by local emergency services and organizations may only be rudimentary due to the fact that they are often being overwhelmed (Schweer et al., 2014). Emergency services have already recognized the importance of citizen-initiated activities during disasters (Kleinebrahn, 2014; Ludwig et al., 2015). However, questions still arise: How can the coordination of those situated tasks of spontaneous volunteers be supported? How can the demands of affected citizens and offers from spontaneous volunteers be managed on-the-ground? How can citizen-performed on-site activities be managed and aligned with official procedures? Not least, tackling these questions is important to prevent the disruption of both official interventions and existing volunteer work. Answering these questions requires empirically-based research on how cooperation between the various stakeholders takes place (Bhamra et al., 2011).

In this article, we will present a technological approach based on public displays which aims to foster situated crowdsourcing between affected citizens and spontaneous volunteers as well as official emergency services. We will address the research question: *How could the situated tasks performed by spontaneous volunteers be supported by the use of public displays during disasters?* We will present the current state of the art with regard to the tasks and coordination practices of spontaneous volunteers and emergency services within disaster situations as well as related problems, potentials and specifics of public displays (Section 2). To gain insight into actual communication and coordination practices, we conducted an empirical study with 18 different stakeholders involved in disaster management, including spontaneous volunteers, public administrators as well as the emergency services (Section 3). Based on the literature review and our extensive empirical study, we have derived a technical concept that supports the task and activity management of spontaneous volunteers as well as the coordination both of the demands of affected people and the offers from volunteers (Section 4). We have implemented our concept as the public display application 'City-Share', which aims to support affected citizens, spontaneous volunteers as well as public authorities and emergency services by providing a communication infrastructure that encompasses situated crowdsourcing mechanisms for managing offers and demands of activities during disasters (Section 5). Results of its evaluation with several stakeholders will be presented in Section 6. Finally, we will discuss our findings and draw relevant conclusions on and design guidelines for assigning tasks on-the-ground and situated crowdsourcing during emergencies (Section 7).

## 2. Related work

Establishing and supporting cooperation between all stakeholders in this context, such as emergency service workers as well as affected volunteers and other citizens has become a vibrant concern in the research fields of Computers-Supported Cooperative Work and Human Computer Interaction. It is particularly interesting for us as it stands at a juncture of several different research interests, including how spontaneous volunteers and their activities are structured, how information is used by the crowd, how their tasks are coordinated, how communication as well as cooperation between official emergency services and volunteers is managed, and what kind of interface can mediate and support effective and efficient disaster response.

### 2.1. Emergent citizen groups and spontaneous volunteers

In case of a disaster, usually three different groups of people are implicated. These groups encompass (1) the professional public authorities with security responsibilities, emergency services and private aid organizations with a "we care" attitude and acknowledged responsibility for most of the tasks during the response and recovery work, (2) the volunteer-based emergency services and aid organizations that are quite similar to and often perceived as fully and paid 'professionals', and (3) the citizens engaged in various ways during disasters, often with less involvement in prevention or response strategies, at least historically. More recently, the boundaries have blurred such that the sharp distinction between these three different groups is less evident.

Past disasters clearly show that the people affected by a crises also show a high amount of involvement (Palen et al., 2010; Quarantelli, 1991). Even if systematic involvement of citizens as active actors is not planned for official prevention strategies (Schweer et al., 2014), people in practice often take over "First Responder" activities (Stallings and Quarantelli, 1985). During long lasting and large-scale disasters even people that are uninvolved and not affected by the disaster itself can and do mobilize. Stallings and Quarantelli (1985) describe early and often spontaneous forms of citizen-based crisis management, with new structures as well as new tasks, which are characterized as "emergent groups (e.g. unaffiliated volunteers) undertaking activities that were previously foreign to them and developing a social structure that lacks formalization, tradition and endurance" (Stallings and Quarantelli, 1985).

Emergent citizen groups are helping in disaster situations through their autonomous searching and solving practices. They do that without significant hierarchical structures, allocating tasks between themselves in a self-organized manner (Stallings and Quarantelli, 1985). Citizen groups emerge in many disaster situations and in the past they were sometimes seen as the result of a failed preparation on the part of the professional actors. Today, however, they are more often seen as an alternative reaction by affected people towards a situation that evolves in such a way that the preparations of professionals are not adequate (Stallings and Quarantelli, 1985). The first and arguably most important requirement for emergent citizen groups is the exchange of information and concomitant networking. The second is knowledge about key positions and how to access them in the disaster environment. The third is specialized knowledge about the situation (Stallings and Quarantelli, 1985). Persons from outside often lack the information and contacts needed (Pfeil, 2000). Tourists and new members of the community as well as volunteers who do not arrive until after the occurrence of the disaster may have very little knowledge about relevant locations and therefore need information from other citizens or from crisis management teams (Pfeil, 2000).

It also seems that where disaster situations are commonplace, both long-term improvement in preparations as well as the formation of a so-called "disaster subculture" (Voorhees, 2008) can be discerned. For instance, in areas where floods occur on a regular basis, knowledge is often collected that can be applied and used by all in subsequent disasters (Voorhees, 2008). Nevertheless, not all engaged persons are integrated into those subcultures (perhaps because they are newly arrived, for instance) and therefore lack access to the knowledge available in the disaster subculture. One example of these groups arising spontaneously is the volunteers who grouped together impromptu following the attacks on the World Trade Center in 2001. This group, who became known as "Clarkson Village" or "Clarkson", was formed independently by volunteers on-site and its goal was to autonomously accept, sort and distribute donated resources (Voorhees, 2008). In the context

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