

# *Digitally enabled disaster response: the emergence of social media as boundary objects in a flooding disaster*

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**Abstract.** *In recent times, social media has been increasingly playing a critical role in response actions following natural catastrophes. From facilitating the recruitment of volunteers during an earthquake to supporting emotional recovery after a hurricane, social media has demonstrated its power in serving as an effective disaster response platform. Based on a case study of Thailand flooding in 2011 – one of the worst flooding disasters in more than 50 years that left the country severely impaired – this paper provides an in-depth understanding on the emergent roles of social media in disaster response. Employing the perspective of boundary object, we shed light on how different boundary spanning competences of social media emerged in practice to facilitate cross-boundary response actions during a disaster, with an aim to promote further research in this area. We conclude this paper with guidelines for response agencies and impacted communities to deploy social media for future disaster response.*

**Keywords:** disaster response, social media, boundary object, case study

## INTRODUCTION

A catastrophic earthquake struck Haiti in January 2010, damaging much of the country's limited infrastructure and leaving millions of people in distress and struggled to know the fate of their loved ones who might be trapped under the rubble (Harnesk, 2013). A deadly tornado struck Joplin in May 2011, disrupting phone lines and transportation, and tearing apart nearly 7000 homes (Paul & Stimers, 2012). Such extreme events are, unfortunately, not uncommon. According to a recent review by the International Monetary Fund, the occurrence of natural disasters has increased in frequency across the globe over the past few decades (Laframboise & Loko, 2012). More specifically, the United Nations estimates the direct cost of disasters in the 21st century to be \$2.5 trillion, which is at least 50% higher than its

previous estimates (GAR, 2013). The increase in these destructive events not only had detrimental impacts on economies but also significantly threatens the resilience of our societies (UN-APCICT, 2013).

The devastating impacts of disasters have stimulated attention among practitioners and scholars not only in assessing the efficacy of the existing disaster response measures but also in building more effective disaster response strategies for future crises. Among the different initiatives to improve disaster response, technology is seen as a panacea for overcoming several challenges that arise during disasters (Leidner *et al.*, 2009; Pan *et al.*, 2012; Nan & Lu, 2014). Scholars have started to explore the roles of disaster response technologies, including natural disaster management websites (Chou *et al.*, 2014), emergency response information systems (Chen *et al.*, 2008b) and crisis management information systems (Carver & Turoff, 2007; Leidner *et al.*, 2009; Pan *et al.*, 2012), in facilitating information transfer and resource coordination during disastrous events.

However, during disaster situations that are usually characterized by time urgency, stress and uncertainties (Majchrzak *et al.*, 2007; Pan *et al.*, 2012), traditional disaster response systems that feature centralized, command and control modes of coordination may not always be effective (Majchrzak *et al.*, 2007; Nan & Lu, 2014). 'The *ad hoc* nature, time pressure, often-missing preparation and destroyed information infrastructure associated with these [disaster] events require flexibility and adaptability' (Wakolbinger *et al.*, 2013, p. 69). Existing research and empirical evidence have shown that formal disaster response technologies may often be too slow and inadequate to fulfil the emerging and often unprecedented requirements during disasters (Crowe, 2012).

Fortunately, in recent years, social media has demonstrated its unique affordances that could surmount the limitations of designated disaster management systems and significantly improve disaster response. During the 2012 Hurricane Sandy, for example, the extensive use of social media resulted in a shift in disaster response paradigm (DHS, 2013). Social media platforms such as Facebook, Twitter, YouTube and Instagram were used in place of the traditional disaster response channels, as a tool for situational awareness and two-way communication. For example, on Instagram, impacted communities uploaded nearly 10000 hurricane-related photos every second with the hash tag #Sandy (Schifferes *et al.*, 2014). In total, approximately 800000 photos were uploaded, and most of these photos were geo-tagged with locations. These data served as a critical information source for disaster response agencies such as the American Red Cross to accurately strategize their relief efforts (DHS, 2013). Countless lives were saved by volunteers monitoring these social media updates (Haddow & Haddow, 2013).

Empirical evidence has shown us how social media 'assumed extensive and previously unconsidered roles' (UNISDR, 2012, p. xxvi) in facilitating effective disaster response. Social media is able to effectively overcome the obstacles of a traditional disaster response model – it allows accumulation and dissemination of knowledge, supports *ad hoc* network formulation and provides a common ground for the communities to collaborate during chaos (Yates & Paquette, 2011). Despite its importance, however, social media-enabled disaster response is still a relatively under-researched phenomenon. Identifying the motivations and uncovering the mechanisms through which technologies influence disaster response are essential to

inform future response actions (Leidner *et al.*, 2009; Fraustino *et al.*, 2012). We contend that if an emerging technology, such as social media, is to be mobilized for disaster response, how it functions and what makes it effective need to be studied in more detail. The present study is motivated by this knowledge void and set forth to address one research question: How does social media enable disaster response?

We draw on the theoretical perspective of boundary object (Star & Griesemer, 1989) and a case study of the 2011 Thailand flood – one of the worst flooding disasters in 50 years that left the country severely impaired – to address this research question. The theoretical concept of boundary object allows for the exploration of the dynamic nature of technology – it provides a perspective that captures how actors within a particular context understood and accepted the local usefulness of a particular technological artefact and subsequently enacted it to achieve a boundary spanning purpose (Levina & Vaast, 2005). In the context of disaster response, boundary object perspective allows us to examine how response agencies and impacted communities could enact social media to overcome barriers towards enabling more effective disaster response. In a summary, the objective of the study is twofold: (1) to contribute rich theoretical insights by conceptualizing the mechanism and implications of social media use in disaster response from a boundary object perspective and (2) to stimulate attention to this highly relevant, yet relatively underexplored area of research.

The organization of our paper is as follows. First, we discuss existing research on disaster response with a particular emphasis on the emerging roles of social media (a summary of our literature review process is shown in Appendix A). Next, we present a discussion on our theoretical lens – boundary object. Then, we provide details of our research methodology followed by a case description. After that, we present an in-depth discussion of the findings of our data analysis and explain how our findings could inform existing research. Finally, we conclude the paper with theoretical contributions, guidelines for practice, followed by the limitations and the suggestions for future research.

## SOCIAL MEDIA FOR DISASTER RESPONSE

### Digitally enabled disaster response

A disaster indicates an unpredictable, uncertain and urgent event that imposes severe threats to life, well-being or other significantly held values (Leidner *et al.*, 2009). It is also described as an 'unexpected, unpracticed and unprogrammable' (McKinney, 2009, p. 42) event, which often presents 'entirely new environmental, geographical, political, economical and sociological concerns' (Yates & Paquette, 2011, p. 7). Disaster management often comprises four stages: mitigation, preparedness, response and recovery (Chou *et al.*, 2014). Disaster response, in particular, takes place 'when a disaster is in progress and involves addressing immediate and short-term needs, including evacuation and rescue management' (Chou *et al.*, 2014, p. 1000).

Given that disaster is, by definition, a novel operational environment, disaster response actions are often challenging and difficult (Majchrzak *et al.*, 2007). Experiences built up prior to

the disaster could easily lose relevance when new, unprecedented requirements arise as the crisis unfolds (Majchrzak *et al.*, 2007). Unlike collaborative actions in predictable and routine contexts, such actions in the context of a disaster are often difficult, given the complex interdependence among group activities and the great time pressure to respond to the unexpected events (Ren *et al.*, 2008). In all, as summarized eloquently by McKinney (2009), disaster response is essentially a series of complex, urgent tasks, which involves 'figuring out what is happening, dealing with incomplete information, thinking through irrevocable decisions and making them before it's too late' (McKinney, 2009, p. 42).

Recognizing the severe impacts of disasters and the challenges of disaster response, scholars have begun to explore the potential of technologies in facilitating effective response actions. Until recently, the emphasis of our existing disaster response studies has been on the strategic use of designated, formal disaster management systems commonly adopted by response agencies to monitor and coordinate disaster response actions (see Appendix B for a list of studies reviewed). For example, existing research has explored the use of natural disaster management website (Chou *et al.*, 2014), emergency response information systems (Chen *et al.*, 2008b) and crisis management information systems (Carver & Turoff, 2007; Leidner *et al.*, 2009; Pan *et al.*, 2012) in disaster response. These studies focus on exploring the traditional, command-and-control disaster management model, mostly in the context of corporate environment (Turoff *et al.*, 2004). In other words, most scholars examined how decision makers or disaster response agencies make use of preplanned disaster response technologies to assist victims during disasters.

Nevertheless, the volatility and unpredictable nature of disaster events impose unique challenges and requirements on disaster response technologies (as summarized in Table 1). Effective disaster response actions demand technologies that have a high level

**Table 1.** Digitally enabled disaster response

Key issue during disasters		Requirement on disaster response technologies
Information	The need to be comprehensive in taking into account all hazards, stakeholders, and impacts relevant to the disaster (Crowe, 2012)	Collect complete and accurate data from multiple sources (Janssen <i>et al.</i> , 2010) (i.e. obtain quality information from experts and situational updates from impacted communities)
	The need to disseminate and receive notification and targeted alerts (Chiu <i>et al.</i> , 2010; UN-APCICT, 2013)	Disseminate up-to-date, relevant information with transparency (Crowe, 2012)
Communication	The need to rapidly identify and contact appropriate personnel (Wakolbinger <i>et al.</i> , 2013)	Adaptable to highly diverse communication needs (Janssen <i>et al.</i> , 2010)
	The need to efficiently support the coordination of tasks (Sniezek <i>et al.</i> , 2002)	Sustain collaboration among multiple parties (Pan <i>et al.</i> , 2012) and support improvised response (Janssen <i>et al.</i> , 2010)
	The need to monitor progress and allocate resources accordingly (Sniezek <i>et al.</i> , 2002)	
Connection	The need to establish relational linkages (Nan & Lu, 2014) and emotional support for recovery (Kaewkitipong <i>et al.</i> , 2015)	Enable real-time conversation among individuals to establish relational ties and to build association (Nan & Lu, 2014)

of agility and responsiveness (Park *et al.*, 2015) and that are flexible enough to facilitate emergent activities and enable improvisation (Majchrzak *et al.*, 2007). While we have seen how the designated disaster response technologies such as emergency management websites played a role in assisting disaster response actions, these rigid technologies that only allow for centralized disaster management might not be able to fulfil emerging requirements in a chaotic environment (Nan & Lu, 2014). Formal disaster response systems were 'built on the foundation of formally organized command, control and approval of all emergency actions, including public dissemination of information' (Crowe, 2012, p. 187). During disasters of a large scale and scope, this command and control model tends to break down as individuals react in unforeseeable ways (Majchrzak *et al.*, 2007). In other words, the traditional, formally organized disaster response model may be ineffective in fulfilling the emerging, often unprecedented, requirements during disasters (Crowe, 2012; Nan & Lu, 2014).

Plenty of empirical examples have shown that traditional disaster response model may fail to serve the complex requirements in a highly dynamic and uncertain disaster environment. During Hurricane Katrina, for example, 'government emergency response plans failed to meet the urgent needs of those affected' (Majchrzak *et al.*, 2007, p. 147). Despite extensive preparation, planning and training, the preplanned response model was too slow and inadequate to fulfil critical requirements during the disaster (Majchrzak *et al.*, 2007; Chen *et al.*, 2008a). Similarly, during the Haiti earthquake, we have seen how the traditional disaster response systems failed to fulfil the informational needs and engage Haitian communities during the emergency (Heinzelman & Waters, 2010). The traditional disaster response systems adopted by response agencies were designed for information sharing and collaboration between internal teams (Janssen *et al.*, 2010) and did not reflect the situation on the ground (Heinzelman & Waters, 2010). 'The inability of disaster response organizations to effectively utilize information coming from Haitian communities compromised the relief effort' (Heinzelman & Waters, 2010, p. 4). In all, these examples show that disaster response systems that were designed based on authorities' perceptions of risks, scales and usefulness of technologies may not be effective when confronting the reality in the event of a mass casualty (Majchrzak *et al.*, 2007). These costly experiences have illustrated a need for new technologies that can be enacted to fulfil critical requirements in a chaotic environment (Heinzelman & Waters, 2010) and fill the void that cannot be filled by designated disaster response technologies (Majchrzak *et al.*, 2007).

### The rise of social media in disaster response

*Social and networking media, and the rapidly evolving phenomenon of crowdsourcing, offer yet-unrealized opportunities for wider applications related to disaster risks and especially at times of disasters* (UNISDR, 2012, p. xxvi)

The increasing engagement with social media in the context of disaster response offers a potential panacea for this challenge. In recent years, we have witnessed the potential of social media in filling the void during a disaster response. For instance, during Hurricane

Sandy, 10 000 storm-related photos were uploaded on Instagram per second with the hash tag #Sandy (Giroux *et al.*, 2013). Users utilized the geo-tagging functions brilliantly to mark their locations and describe their situations in real time. These data served as important information sources for disaster response agencies to strategize their relief efforts (DHS, 2013). Also during the Haiti earthquake, victims took to social media to alert response agencies such as Red Cross of their needs. Countless lives were saved by volunteers monitoring social media updates (Haddow & Haddow, 2013). When tornadoes hit Joplin in 2011, social media was also widely adopted by the communities, not only to access updated news but also to offer mutual support and to coordinate the recovery process (Fraustino *et al.*, 2012).

In all, the recent emergence of social media in the disaster response arena is significant as it surmounts the limitations of designated disaster management systems and offers unprecedented opportunities to respond to disasters (James *et al.*, 2011). Social media enables fast-paced information exchange that is currently not possible under the formal disaster response systems, which focus on internal information sources and often call for reviews and approval before any information could be shared (Crowe, 2012). In other words, 'social media eliminated linear, manually intensive knowledge sharing processes typical of past response efforts and permitted localized "crowdsourcing"' (Yates & Paquette, 2011, p. 7). Such reachability and connectivity of social media allow it to serve not only as an information-sharing platform between local eyewitnesses but also as an information source for journalists or traditional linear media (Lachlan *et al.*, 2014). Furthermore, social media also facilitates effective collaboration during emergency, as it makes actions and actors visible, promoting sharing and communication (Majchrzak & More, 2011).

Nevertheless, the role of social media as an increasingly pervasive disaster response platform still remains largely underexplored. Only a handful of recent studies have focused on how social media has transformed the disaster response arena. For instance, Heverin and Zach (2012) studied the use of microblogging technology (e.g. Twitter) for collective sense-making during violent crises and suggested that microblogging technology provides a channel for connection and enables individuals to make sense of the chaos. Ahmed and Sinnappan (2013) examined the use of social media in facilitating communication during the Queensland floods in 2010. Oh *et al.* (2013) examined how Twitter was used in social crises, with a particular emphasis on information quality issues and rumour. More recently, Nan and Lu (2014) examined how online forums enabled self-organization among the communities during the 2012 Sichuan earthquake.

Taken together, in line with the conclusion drawn by scholars, our review of the existing literature suggested that research on social media-enabled disaster response is still at a nascent stage (Yates & Paquette, 2011). The present study aims to contribute to this gap in knowledge. More specifically, this paper explores the use of social media in disaster response from a boundary object perspective. Instead of looking at technology as a black box, the theoretical lens of boundary object sensitizes scholars in unveiling the process in which technology is enmeshed in the conditions of its use. In the following section, we present our review of boundary object literature to further discuss how this theoretical



perspective could be useful in explaining the phenomenon of social media-enabled disaster response.

## THEORETICAL BACKGROUND: BOUNDARY OBJECT

Boundary object is a notion developed in the field of science and technology studies by Star and Griesemer (1989). A boundary object is defined as a broad range of artefacts that 'are plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites' (Star & Griesemer, 1989, p. 393). Boundary objects can be understood as social objects that connect multiple social worlds (Bechky, 2003b) and facilitate collective action between them (Ritzer, 2004). A boundary object is adaptable, shareable across different problem-solving contexts (Carlile, 2002) and capable of 'inhabiting several intersecting social worlds and satisfying the information requirements of each of them' (Star & Griesemer, 1989, p. 393). Boundary objects have been widely applied in studies that aim to explore the process of translation and collective actions enabled by technologies (e.g. Bechky, 2003a; Carlile, 2004). Technological artefacts such as knowledge-sharing software, enterprise systems, virtual prototyping technologies and project management tools that are capable of facilitating interaction and collaboration between disparate groups of individuals are often suggested as boundary objects in IS studies (Carlile, 2002; Pawlowski & Robey, 2004). Appendix C summarizes a list of selected boundary object studies from the existing literature.

The existing studies on boundary objects could be divided into two streams: (1) studies that focus on explaining the intrinsic properties of the object (i.e. *what* are the inherent properties of a boundary object?) and (2) studies that focus on explaining the emergence and actualization of 'potential boundary object' (i.e. *how* particular technological artefact functions as a boundary object in a specific context?). Our review of boundary object literature suggests that most of the existing studies adopted the first perspective. These studies apply the concept of boundary objects to artefacts that possess 'boundary-spanning features', such as modularity, abstraction, accommodation and standardization (Star & Griesemer, 1989; Wenger, 1998). Thus, these studies are often taxonomic and descriptive, focusing on the possible variety of boundary objects and the roles these objects may play in supporting particular tasks (Rosenkranz *et al.*, 2014). These studies presented important insights into the classification and characteristics of boundary objects. For example, scholars have suggested that for a technological artefact to effectively serve as a boundary object, the artefact should have a tangible identity, i.e., perceived to be able to solve specific problems in specific contexts (Henderson, 1991; Bechky, 2003a). A technological artefact that has the capacity for common representation (Mark *et al.*, 2007) and the capability to inhabit several social worlds (Briers & Chua, 2001) is often regarded as a boundary object. Taken together, this first stream of research tacitly assumes that the technological artefact that possesses certain features could serve as a viable boundary object.

The second stream of research emerged from the recognition that a boundary object is not necessarily stable or static (Carlile, 2002). Boundary objects are often ascribed with particular

functions (Nicolini *et al.*, 2012), 'subject to reflection and local tailoring' (Star, 2010, p. 603) and 'may evolve or change as they are modified to address internal or external contingencies' (Doolin & McLeod, 2012, p. 572). Boundary objects are plastic and adaptable, and they can be interpreted flexibly to take different roles in different contexts (Zeiss & Groenewegen, 2009). That is to say, they are capable of performing different roles in different settings or over time (Barrett & Oborn, 2010), and 'their characteristics are hard to sustain as problems and people change' (Carlile, 2002, p. 452).

Nevertheless, while some of these existing studies have commented on the dynamic nature of boundary objects, very little research has explored 'how boundary objects work' (Fox, 2011, p. 80). 'The majority of empirical research on boundary objects only describes their benefits, not *how and why* they function the way they do' (Carlile, 2004, p. 565). Only a few studies have broadly discussed the dynamic nature of boundary objects. Among them, Levina and Vaast (2005), and Star (2010) have presented influential works that have encouraged scholars to move beyond a static view of boundary objects. Star (2010) points out that the dynamics where boundary object is tailored to local use within communities of practices are often ignored in existing studies. Along the same line, Levina and Vaast (2005) suggested that while a technological artefact that was designed with 'boundary spanning properties' could potentially serve as a boundary object, such technological artefact can only function as a boundary object when it is meaningfully and usefully incorporated into the local practices. To further distinguish a technological artefact (i.e. a potential boundary object) and a 'functional' boundary object, Levina and Vaast (2005) introduced the concept of 'boundary object-in-use' (i.e. put simply, a boundary object that spans boundary in practice). The authors suggested that a designated boundary object could emerge into and function as a boundary object-in-use only when its local usefulness was enacted and its common identity was developed in practice. The authors thus encourage scholars to direct research attention towards the process in which a technological artefact emerged as a boundary object-in-use. As Levina summarized eloquently in another publication, 'whether an object was used at all and whether its use enabled or impeded effective collaboration could not be understood through the stable properties of the object itself, but only through the *use of the object in practice*' (Levina, 2005, p. 115).

Only in recent years, few scholars have echoed this relational view of boundary object and provided insights into the emergence of boundary objects in practice. For instance, Boland *et al.* (2007) suggested that for a technology artefact such as 3D representations to serve as a boundary object, integration into practice is required. Doolin and McLeod (2012) also discussed how a prototype, as a designated boundary object in IS development, can be recognized and delineated as a boundary object-in-use from a sociomateriality perspective. Lainer-Vos (2013) then conceptualized the making of boundary objects by tracing the network within which boundary objects are nestled. The author suggested that 'one must follow the delicate *process* through which boundary objects are gradually equipped with the properties that allow them to mediate between groups' (Lainer-Vos, 2013, p. 518).

In all, the existing studies on boundary object have been relatively silent on how a boundary object emerged in practice. Addressing this void requires a shift in perspective – from looking at the static aspects of boundary objects, to examining the dynamic process in which the boundary spanning competence emerged. Situating boundary objects in this way helps to provide



theoretical insights centred not on the designated roles of the object alone but on the process in which *unique, often unprecedented* boundary spanning competence unfolds in different contexts (Lindgren *et al.*, 2008). Against such backdrop, our research sought to adopt a relational perspective of boundary object to explicate the *emergence process* whereby a boundary object is shaped and reshaped to fulfil different roles in practice (Levina & Vaast, 2005; Gal *et al.*, 2008). Our case study of social media-enabled disaster response, as presented in this paper, shows that the enactment of social media in practice will shape new, unintended functionalities for social media to provide important humanitarian assistance during disasters. Our findings presented in the later sections aim to extend the singular or static focus of existing boundary object literature by shedding new light on the emergence and enactment of boundary objects-in-use.

## RESEARCH METHODOLOGY

This study adopts the qualitative case research methodology. A case study methodology is particularly suited to exploring new topical areas when an in-depth understanding of the phenomenon is needed (Eisenhardt, 1989). It provides an opportunity for deep insights and rich descriptions to be developed. Developing rich descriptions is essential as it allows researchers to distil nuances and complexities from the phenomenon under study (Weick, 2007). As previously discussed, our phenomenon in question (i.e. social media-enabled disaster response) is a complex, multifaceted phenomenon that is currently understudied. A case study approach allows us to dive deeply into such novel phenomenon to capture significant details and insights, which can lead to theory development and meaningful practical implications (Eisenhardt, 1989; James *et al.*, 2011).

The 2011 Thailand flooding disaster was selected as our case study in light of our research objectives, guided by a few case selection criteria. First, theoretical sampling was used to select theoretically useful cases in which the process of interest (i.e. social media-enabled disaster response) is 'transparently observable' (Eisenhardt, 1989, p. 537). Second, we focus on selecting revelatory, interesting case study that has the potential to generate insights on novel, unexploited areas (Siggelkow, 2007; Pan & Tan, 2011; Avison & Malaurent, 2014). The 2011 Thailand flooding is an impactful and destructive disaster event that represents an observable shift in the disaster response arena, i.e., it demonstrates how social media has assumed important yet previously unconsidered role in facilitating an effective disaster response. This research setting thus allowed for a unique opportunity to explore and better understand the role of social media in disaster response.

## Data collection

In July 2011, a severe flooding disaster triggered by tropical storm Nock Ten hit Thailand. It affected more than three million people in 74 provinces for over 5 months. Our data collection started as soon as the flood subsided around early 2012. In this first phase of data collection, we focused on collecting documents and social media updates related to the disaster event.

Archival data were collected to 'obtain a rich set of data surrounding the specific research issue, as well as capturing the contextual complexity' (Benbasat *et al.*, 1987, p. 374). With the help of our research collaborators in Thailand, we screened and analyzed several influential social media communities, including a few of the most popular Facebook groups, a number of active pages and individuals on Twitter, and a number of videos on YouTube (a completed list is available with the authors).

On-site data collection started in February 2013. We first started our interviews with few targeted informants in Bangkok. A purposeful sampling strategy with key informants is essential to provide an overview of the phenomenon under study (Pan & Tan, 2011). Next, we recruited more participants using a snowball sampling method, i.e., we requested our key informants to recommend suitable candidates to be interviewed (Myers & Newman, 2007). In total, we conducted 56 interviews and focus group discussions in Bangkok. Our interviews ranged from 40min to 2h (an average of 90min). All interviews were recorded and transcribed. Informants whose roles ranged across different levels were selected to provide a cross-sectional view of the groups involved in the disaster response process. Appendix D shows the list of interviewees involved. The interviews and focus group discussions were all open-ended, exploratory in nature and occasionally guided by some rudimentary questions (see Appendix E for the excerpts of interview guidelines). Throughout the conversations, the mirroring technique, introduced by Myers and Newman (2007), was used to invite the interviewees to share their 'stories' or experiences during the flood, in their own language. The participants were invited to recall the actions taken, decisions they made and critical events they experienced during the disaster. As most of the interviewees were more comfortable with expressing themselves in the Thai language, two native Thai speakers (who are also the coauthors of this study) helped with the translation and transcription. Table 2 summarizes our data sources.

## Data analysis

Our research is exploratory in nature, and thus, the data analysis process was inductive and iterative. We relied on the Klein and Myers (1999) principle of interpretive research to guide our analysis. To capitalize on the flexibility of the case research methodology, data analysis was performed concurrently with data collection. We initiated the data analysis process by summarizing and reviewing our observations and interviews throughout the data collection. The initial analysis of data involved identifying key roles of social media for disaster response. We paid close attention to the use of social media in resolving obstacles and enabling collaboration in disaster response, while remaining open to emerging ideas. We went through multiple readings of data interview transcripts, archival documents and updates on Facebook, YouTube and Twitter, and referred to the literature as themes emerged. Consistent with guidelines on conducting interpretive case studies, we neither seek to impose hypotheses on our data nor aim to verify a theoretical framework (Walsham, 2006). While we have identified aspects that are pertinent to the phenomenon under study (i.e. the use of social media in resolving challenges and enabling collaboration in disaster response), 'a considerable degree of openness to the field data, and a willingness to modify initial assumptions and theories' (Walsham, 1995, p. 76) will be retained to ensure that we are not constrained in identifying new issues and insights.

**Table 2.** Data sources and use in analysis

Data source		Types of data	Use in the analysis
Interviews	Semistructured and focus group interviews	Rich primary data gathered from onsite interviews with 56 interviewees (Appendix D shows the list of interviewees)	To develop an understanding of the meanings behind the process (Walsham, 1995)
Archival data	Social media postings	Archival data were collected from Facebook, Twitter, and YouTube (i.e. the main social media used by communities in Thailand).	To capture the contextual complexity (Benbasat <i>et al.</i> , 1987) and to support and triangulate interpretations emerged from interviews
	Relevant documents	Books, articles, government websites, news reports, journals, and conference papers	

All data collected amounted to a total of 648 pages of verbatim transcript.

The flexibility of social media in serving multiple purposes in disaster response has emerged as the highlight of our initial analysis. Turning to relevant literature on digitally enabled (and more specifically, social media-enabled) collaboration, we realized that most of the existing discussions do not consider the dynamic nature of collaborative technologies in facilitating changing needs in an emergent context. Extant studies predominantly focus on the ‘designated’ properties of technological artefacts to discuss whether these properties could (or could not) serve specific collaboration needs. Missing from these accounts was an understanding of how certain competences of technology were actualized in practice to fulfil new, emerging requirements. From our data, we observe that the use of social media in disaster response was unique in a way that it is capable of serving different purposes in a disaster response context as its identity changes. This is when our attention on the concept of boundary object emerged.

Upon choosing our theoretical lens, we thus return to the data. Adopting a boundary object lens sensitizes us in examining the fluidity of technology. This focus redirected our attention from designated functionalities of social media to the dynamic nature of such flexible technology. Our theoretical lens helped us to invert the conventional view of technology where the functionality was purely informed by the material properties. This allowed us to focus our analysis more deeply on how social media was enacted by the communities to serve different boundary spanning roles. Throughout our data analysis process, we also adopted a narrative strategy to construct a detailed storyline by mapping events and actions of the actors (Langley, 1999). Narrations reveal the sequence of events and help to delineate phases of process model from triggering mechanisms (Langley, 1999).

In short, the data analysis process involved an ongoing dialogue with the existing literature, the data collected and the emerging interpretations while continuously building an explanation for the phenomenon and gradually shaping the theoretical conceptualization. The process continued until we reached the state of theoretical saturation, that is, where it was possible to comprehensively explain the case research findings using the derived model and when new data could neither dispute the model nor reveal new themes (Eisenhardt, 1989; Pan & Tan, 2011). Overall, our findings revealed three distinct phases; in each phase, a common identity of social media emerged when social media was actualized to span a specific boundary in practice. We present our case background and elaborate on our findings in sections that follow.

## CASE DESCRIPTION

In 2011, Thailand experienced the worst flooding disaster in five decades that engaged the entire nation in combating the relentless floods. Heavy monsoon rains started in July 2011, leading to flash floods that eventually swamped 65 of Thailand's 77 provinces (Winijkulchai, 2012). Flooding persisted until mid-January 2012, affecting over 900 000 families and seven major industrial estates and resulting in a death toll of over 800. The World Bank estimated the total economic damage to be THB 1.43 trillion (around US\$45.7bn) and referred this flooding disaster as the world's fourth most costly natural disaster in terms of the total economic loss (World Bank, 2011), placing it below the 1995 and 2011 Japan earthquake and tsunami, and 2005 Hurricane Katrina in the United States. Figure 1 presents the timeline of key events, organized into three phases, as described by our interviewees.

While people in Thailand are accustomed to annual floods that hit the country during the seasonal monsoon every year, the flooding crisis in 2011 was an unusual, extreme event that caught the entire country off-guard. Numerous voices emanated from the chaos, demanding up-to-date information and a channel to stay connected. Traditional disaster response technologies failed to fulfil these critical requirements. As a result, social media emerged as the alternative disaster response platform.

Communities in Thailand resorted to social media platforms, particularly Facebook, Twitter and YouTube, to acquire information. Disappointed by the slow, restricted and sometimes ambiguous news from the traditional media (e.g. TV, radio and newspapers) and the often undermanaged official websites, people in Thailand turned their attention to social media for informational support. More than 50 Facebook pages and groups emerged at this stage as

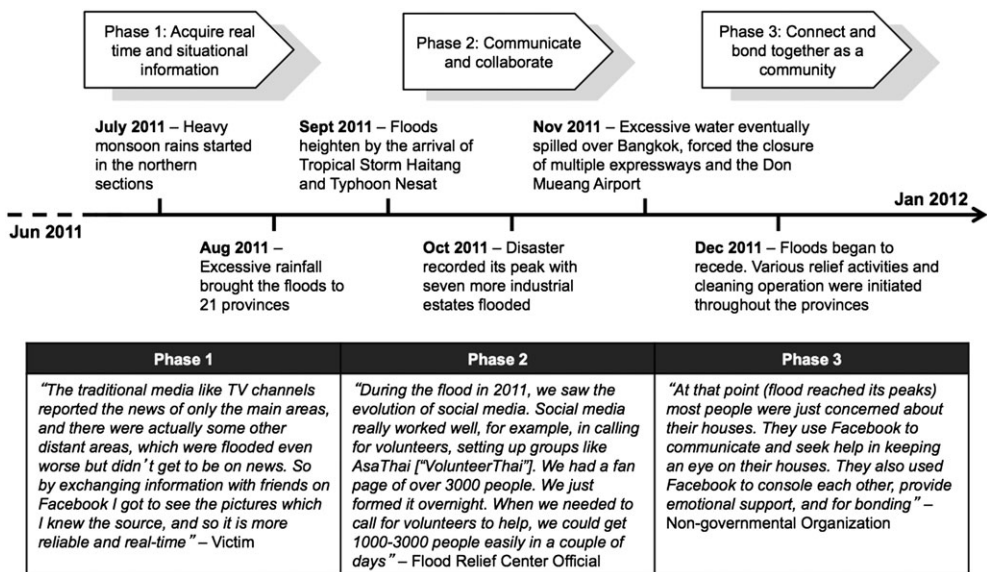


Figure 1. Timeline and summary of key phases.

## Exhibit 1. Reflecting situation on the ground

By September, floods continued to increase on account of the arrival of the Tropical Storm Haitang and Typhoon Nesat. Excess rainwater started to flow southward, eventually flooding several industrial estates in the north of Bangkok. In October 2011, Thammasat University in Bangkok was also flooded as a result of persistent rain. The university acted as the evacuation centre for the flood victims, before getting submerged by two metres of floodwater.

Dr Somkit Lertpaithoon, the rector of Thammasat University, explained how social media allowed him to keep students and staff informed during the crisis:

*Facebook is real time, you know. When I take a photo and post it on Facebook, people will know everything at the time as the director of Thammasat University knows about the situation. We can get a lot of information from them also.*



Figure 2a. Thammasat University was under water (Image source: [https://www.pinterest.com/ajarn\\_donald1/bangkok-floods-2011/](https://www.pinterest.com/ajarn_donald1/bangkok-floods-2011/))



Figure 2b. Dr. Somkid was given a portrait of him for his contribution during the disaster (photo taken during interview)

Dr Somkit used social media, particularly Facebook and Twitter, to disseminate firsthand information to the students. As Dr Somkit explains, during the flood, he received a large number of information requests on social media. By disseminating localized information to the impacted communities, social media allowed Dr Somkit to fulfil his responsibility to take care of the impacted citizens:

*During the flood, when I post the photo of the Building A, some students who live in the Building B 'Facebook' me and ask: 'Can you take the photo of Building B that I live, I would like to see the Building B'. This kind of situated information is quite helpful, because in such situation everyone was nervous. They think about their own house, they wanted to know what will happen to them.*

people recognized the usefulness of social media in filling the informational void. Social media enabled the acquisition and dissemination of firsthand announcements during the flooding crisis. More importantly, it provided a channel for the sharing of situational information that might not be covered by mainstream media. Several flood-related experts and community leaders in Thailand adopted social media to accumulate and disseminate localized information that is critical yet often unavailable from traditional media. As Exhibit 1 illustrates, social media was adopted by local response agencies to fulfil on-the-ground information requests from the impacted citizens.

In early October 2011, the flooding disaster was worsened with the arrival of Typhoon Nalgae. By the end of October 2011, the floods reached Bangkok. The disruptions of transportation and telecommunication infrastructure further aggravated the chaos. Expressways and bridges went under water. The secondary airport in Bangkok (i.e. the Don Mueang airport), which had previously been used as a flood relief operation centre, ceased operations because of flooding. As a result, mandatory evacuation notices were given to more than two million residents in Thailand. At this stage, traditional communication channels, such as landline communication, were damaged by the disaster. Other formal communication platforms such as official websites do not afford two-way communication that is critical during a crisis. In the absence of a reliable communication system, response agencies in Thailand used social media as the communication apparatus to assist in their relief mission (Exhibit 2).

Around mid-November, large parts of Bangkok were inundated by floodwaters. With millions of residents left homeless or displaced across the country, emotional support and companionship became critical ingredients of the recovery process. According to the Ministry of Public

#### Exhibit 2. Reaching people in need

Response agencies harnessed the power of social media as a two-way communication during the flooding disaster. In one example, flood relief centre official, Mr Vittayen Muttamara, explains how social media significantly improved his response actions:

*What was different now is that in the past, we only communicated through the website. So communication was more or less one-way communication. But now it's very easy. Anyone can be a local reporter. Everyone can look and see what has happened and take a picture and send it to us to say that this province or this village needs help. We can see that in real time.*

Mr Vittayen further elaborated on how social media helps to bridge the communication gap between victims and responders:

*We used social media to distribute help. We have our staff monitoring all the channels, including Facebook and Twitter. When people wrote to us and asked for help, we could evaluate and respond. I remembered when there was a flood in Hat Yai, there were about 10–15 pregnant women in labor pain. That time, we used social media to send messages and collaborate with police and our people in that area. Eventually we successfully sent them to a hospital in time. This is just one example of how we used social media during the crisis.*



Health, a large number of flood victims were reported to have suffered high levels of stress, depression, and harboured even suicidal tendencies after experiencing such a severe flooding disaster (GFDRR, 2012). In responding to these devastations wrought by the flooding crisis, communities in Thailand started to enact social media as a means to promote connections among all the impacted individuals. As Exhibit 3 illustrates, social media was adopted to

### Exhibit 3. Building back better

During the flooding crisis, The Royal Thai Army assigned 56000 army, naval and air force personnel to assist in the disaster response efforts (GFDRR, 2012). To facilitate their response actions, the army used social media intensively. As the magnitude of the flood increased, traditional tools such as radio and cell phones, which have always been the primary communication channel for the army, could no longer help them to connect with the impacted citizens.

"The army needed to look for something new that can reach the citizen", Lieutenant Colonel Wanchana Sawasdee, who was one of the most active members in the army to use social media for flood rescue, explained. "This social media flood project is the first one that we use for such disaster (Figure 3)".



**Figure 3a and 3b.** Lieutenant Colonel Wanchana Sawasdee in his military disaster response mission (Image source: <http://www2.manager.co.th/AstvWeekend/ViewNews.aspx?NewsID=9540000140803>)

*The result of using social media during the flood is that we had a lot more connection. Direct connection with the people. Those connections help us even today. Our public image improved quite a bit after the flood.*

Not only did the use of social media allow the army to engage in relief measures to the citizens, the connection established was also mutual. Social media allowed the army to get encouragement from the communities during the flood, which served as the key emotional support for the army to continue its challenging disaster response tasks. 'There are many fan page groups that were created to give us will power', added Colonel Wanchana Sawasdee.

establish mutual connections. Not only did the victims receive emotional comfort through the connections established on social media but the relationship built on this platform also helped the responders to cope with the difficult times.

In all, our case study has shown that response agencies and impacted communities in Thailand harnessed the untapped power of social media to span critical boundaries that restrict disaster response. The flooding crisis in 2011 was the first flooding crisis in Thailand where social media was employed extensively for disaster response. The adoption of Twitter, for example, had increased 20% within 1 month as it served as one of the most widely used information platforms during the disaster (Perry, 2011). This novel phenomenon of social media-enabled disaster response provides an opportunity for understanding the power of social media in serving important societal purposes. In the following section, we present the findings of our in-depth analysis from a boundary object perspective.

## DISCUSSIONS

In this section, we present the 'thick description' from our analysis, organized into three phases. We summarize findings in each phase before moving on to the next. We conclude this section with a summary section and a table to further illustrate how our findings could inform existing research. Taken together, our in-depth analysis illustrates how social media acquired local usefulness and common identity in practice, and emerged as boundary objects-in-use to span different boundaries in each phase.

### Phase 1: Social media as compendium of information

#### *Information boundary*

During disasters, access to information is as essential as access to food and water. Information sharing has long been recognized as critical for effective disaster responses (Chen *et al.*, 2013; Wakolbinger *et al.*, 2013). Information is required to recognize the impending hazards, conduct critical preparations and even establish mental readiness. However, communities often find themselves struggling in information vacuums following the onset of a disaster. Before the emergence of social media, 'the traditional information management model for disaster response is centralization' (Yates & Paquette, 2011, p. 7). Communities and responders often rely on the authorities to manage and disseminate information in silos. Information channels available are limited: for impacted communities, collecting information involves only watching television and monitoring updates from print and Web publications; for responders and authorities, disseminating information involves releasing media advisories and conducting press conferences (Crowe, 2012).

In such a period of uncertainty, traditional disaster response systems in Thailand have unfortunately failed to supply timely information to keep the communities informed. Slow and inaccurate information as well as ambiguous announcements from the officials contributed to the worsening of the flooding disaster. While policymakers often assumed their preplanned information channels such as official websites and newspaper could take on the role of keeping impacted communities informed, in practice, such information was of little use to the

communities. For example, Arjarn Wanchai, the leader of Parichart Village (a village that was severely flooded), explained the ineffectiveness of traditional media:

*"The first couple of days, I tried to contact people in the village but no one was using the web board to communicate. The web board was empty and inactive. The web board was ineffective".*

Authorities and responders also faced difficulties in understanding the unfolding situation on the ground with their traditional disaster response systems that relies on formalized network and centralized information flow. Acting upon the widely dispersed, localized information is critical but difficult for bureaucratic institutions. Officials were struggling to keep pace with the unfolding situations and convey important messages to impacted communities in real time. For example, one of our interviewees, The Secretary in the Office of the Prime Minister, Mr Wim Rungwattanaajinda, explained the reasons for adopting social media to disseminate information:

*"The good thing of social media is when we want to circulate news, information or warning, we can do it very quickly compared to other traditional media such as TV or newspapers. Also, for information on newspapers or TV sometimes we have to cut some parts out. It's not 100% like original message that we wanted to convey. But with social media we can post whatever we want, so it is exactly what we wanted to say".*

In all, our analysis shows that an information boundary exists and restricts disaster response. A boundary refers to any difference that leads to discontinuity in action or interaction (Akkerman & Bakker, 2011). In defining the information boundary, we refer to the barrier to awareness, understanding and knowledge of the situation, which leads to discontinuity in response actions.

### *The enactment of social media as boundary object-in-use*

In our case study, social media was enacted as a boundary object-in-use to span information boundary. This boundary spanning competence of social media emerged when its local usefulness in providing informational support was recognized by communities in Thailand. More specifically, during the onset of the flooding disaster, communities in Thailand turned to Facebook, Twitter and YouTube to access rich, real-time and situational information that would otherwise not be easily obtained. The decentralized form of information sharing enabled by social media was unfeasible in the past when only the authorities were responsible for gleaning and presenting relevant information to the communities. For example, our interviewee, a director of flood relief centre, Mr Vittayen, explained how responders harnessed the power of social media to obtain localized information:

*"Social media helped in many ways. First, it enabled us to gain more information from micro level. We can know which area needed help or what happened in which area. Then we can use this information to compare with information we have got from traditional channels".*

In this example, social media was enacted as a common information ground, which spans multiple social worlds (i.e. between the response agents and the impacted communities) and enables information exchange between them. Mr Vittayen further explained how social media was used as a shared object for all parties involved in the disaster:

*"We perceived social media as a very good channel to receive news and information from local people. This is important because we can't physically go to everywhere. In some distant districts or villages people can send us their status via social media using their mobile phones. This allowed us to have a wider reach to information on the faraway areas".*

In addition to serving as a common information ground, social media was also recognized and enacted as a means of translation. For instance, flooding experts in Thailand have enacted social media to translate domain-specific knowledge (e.g. findings from their flooding analysis) for common use. They took advantage of the information representations enabled by social media (e.g. videos and images) to convey information that is often difficult to comprehend by the general public. For example, Mr Arjarn Sasin Chalearmarp, an environmentalist and academic, used social media to translate domain-specific information to inform the general public:

*"It all started from the very first YouTube video I posted and it became the talk of the town and it spread out like wildfire... I usually release Facebook post with only three lines. If I release long information, no one will read it... I gathered all of the information from various sources; I even use a lot of GISTDA (Geo-informatics and Space Technology Development Agency of the government) and then explained the flood situation in layman's terms via social media. I used all the resources to make it easy to understand".*

In a nutshell, the use of social media during the onset of the disaster demonstrated the ability of social media not only in strengthening information flow but at the same time also be flexible to the changing informational needs of the communities. We suggest that social media was serving as a boundary object-in-use; it satisfies the information demands of multiple parties involved in the disaster. On the one hand, social media was enacted to fulfil the urgent information need of the impacted communities. Communities resorted to social media for time-critical information that was otherwise hard to obtain. In other words, social media helped to address the information void from traditional top-down model of information dissemination (Sutton *et al.*, 2014). On the other hand, social media was enacted as a shared information space. It allowed previously passive information consumers to contribute and participate as 'powerful creators, transmitters, and discussants of information' (Lee *et al.*, 2013, p. 792). It also served as a means of translation for information to be conveyed between different groups. It helped the domain experts to 'transform domain-specific knowledge so that it can be used towards a shared goal' (O'Mahony & Bechky, 2008, p. 426).

In all, we suggest that communities in Thailand recognized the local usefulness of social media in serving as a reliable information channel. Social media acquired its common identity, i.e., it transformed into 'an artifact serving as a common symbolic resource for diverse agent' (Levina, 2005, p. 112). As a result, social media emerged as a boundary object-in-use – a

compendium of information that spans information boundary and redefine what people can learn about each other during disaster.

## Phase 2: Social media as channel of intercommunication

### *Communication boundary*

As the flooding persisted, transportation and communication infrastructure in Thailand sustained a major damage. Limited communication channels could provide the availability and reachability required during the disaster. Anxiety and stress were mounting in the chaos, as communities in Thailand did not have the capacity to remain in contact with each other. Authorities and response agencies also faced difficulties to remain effective in making critical decisions and in allocating scarce resources. For instance, Lieutenant Colonel Wanchana Sawasdee explained the challenges facing the army during the disaster:

*“Once the flood moved closer to Bangkok, a lot of people panicked and didn’t know what to do. Also, in the army, we usually use radio and cell phone as a major tool to communicate with one another. Once the floods hit, the army needed to look for something new that can reach the citizen”.*

At this stage, communication boundary, i.e., communication impedance separating multiple entities or social worlds (Ciborra & Andreu, 2001; Nevo *et al.*, 2012), arises and restricts disaster response.

### *The enactment of social media as boundary object-in-use*

The need for spanning such communication boundary is clear: no one could afford to be left out during a crisis. Not only do communities need to reach out to seek for help, but for responders, the need to communicate and quickly collaborate is also immediate. At this stage, communities in Thailand leveraged on social media to support their critical communication needs. Along with the increasing use of social media in sharing information and updates, communities in Thailand recognized the pervasiveness of social media in enabling communication while other conventional communication channels were disrupted. At this stage, we observe a snowballing effect – the local usefulness of social media actualized in the previous phase, leading to more recognition and acceptance of social media. For instance, our interviewee, the former deputy governor of Bangkok Dr Teerachon Manomaiphibul, explained:

*“People who came to my Facebook page were looking for information at the beginning. Once they got the information, they started sharing. So sharing helped my page to become more active. I would say that starting from 500 views a day, it became 10000 views a day. At that time, it went up very quickly and it came from sharing. Once people trust the information, they just share”.*

In another example, we also observed how the enactment of social media generates more common agreement on the affordances of social media. The enactment of social media for communication purposes allows its local usefulness and common identity to be recognized, which further encourage the communities to enact social media for subsequent communication support. Mr Wim Rungwattanaajinda explained this emergence process:

*"It all started when A asked for help from B, and then B tried to contact the government to help A. We [the Prime Minister and her team] saw this and thought this [social media] could be useful. Social media could allow everyone to reach the government. During that time [the disaster], the Prime Minister alone cannot help everyone. We can't just use helicopter to fly to help everyone or to give boats to everyone. We needed to contact the volunteer groups and this can be done through social media as well".*

Another interviewee, Dr Teerachon, further explained the power of social media as a communication channel. He explained how the flexibility of social media enabled two-way communication between responders and impacted communities:

*"Social media is very active because you can know everything immediately. You don't have to wait for the reporter to go to the sites and report on the television or the newspaper or radio station. If people need help, they can use the iPad or iPhone to send a message to ask for help".*

Taken together, these examples have demonstrated the power of social media in reorganizing access across multiple social worlds and thereby facilitate collaboration. Social media offers a means of communication that is applicable across multiple social worlds involved in the context (e.g. response agencies and impacted communities). Not only that responders could harness the power of social media during the disaster, the impacted communities in Thailand have also enacted social media as a common ground for collective action. For instance, a young girl created a disaster response page on Facebook named 'Nam Kuen Hai Reeb Bok' (When Water Rises, Quickly Post) with an aim to provide a common ground for victims to report their situation right from the scene. This page was started on 6 October 2011, when the flooding crisis was at its peak and had since then accumulated more than 200 000 'Likes' (i.e. followers) in less than a month. This Facebook group is just one of the many groups that have been established over the period of the flooding disaster. Such initiative shows how social media could be enacted as a shared structure (i.e. a space for impacted communities to come together and share the narrative of what was happening on the ground) towards facilitating communication and collaboration, which are particularly crucial in the context of a disaster. One victim, who was also a member of few Facebook disaster response groups, explained to us how social media provides a trustworthy common space for communication during the disaster:

*"Through Facebook I got to know where was flooded and where was safe. It came from friends who I know so it was the real situation from where they stayed".*

To sum up, social media was serving as a channel of intercommunication that spans different but dependent problem-solving contexts, and it provides a common ground to facilitate collaborations between them. As shown in our case study, social media was enacted as an alternative to traditional top-down coordination to allow for communication between different constituencies. We suggest that social media was enacted as a boundary object-in-use to span communication boundary. A boundary object could allow for the development of shared understanding and enable communication between disparate groups of individuals (Carlile, 2002). From our



findings, we have seen how response agencies and communities in Thailand appropriated and reappropriated social media in practice to achieve different collaboration goals.

### Phase 3: Social media as catalyst of immersion

#### *Relational boundary*

Natural disasters are traumatic events that cause damage beyond the physical. Disaster disrupts the daily order of things and shatters communities' sense of security. It triggers alienation and the collapse of resilience, and creates emotional distress (James *et al.*, 2011). As evident in our case study, communities in Thailand suffered emotional trauma as the flooding disaster unfolded. Many lost a lifetime of belongings and lived with the catastrophic floodwaters for months with no sign of it receding. In such period of uncertainty, it becomes vital for people to stay connected and support each other. Unfortunately, given the geographical barrier and a lack of support structure, staying connected during disaster is often difficult. As Mr Vittayen explained, people in Thailand lacked a means to connect with each other during such difficult time:

*"Well, comparing to website, social media allowed us to build a wider network. During the tsunami in 2004 we had web boards, for example Pantip.com. Through these sites I can gather volunteers but still it was more difficult to connect to people comparing to using Facebook. Eventually the sense of community (by using web boards) would become less and less strong".*

During this period of uncertainty, the disruption of the daily order of things caused a sense of being under threat and gave rise to unsettling thoughts and dissociation. We observed that a relational boundary, i.e., discontinuity in connection and association, existing during the disaster. And such dissociation left the impacted communities in vulnerable and desperate condition.

#### *The enactment of social media as a boundary object-in-use*

Driven by the desire to maintain a sense of community, communities in Thailand embraced social media for emotional support. A remarkable example in our case study was that of a YouTube video series 'Roo Su! Flood' (Know and Fight the Flood) created by a group of volunteers. One volunteer in the group explained how they recognized and enacted the local usefulness of social media to connect and reconnect the communities following a disaster:

*"First, as a citizen, it was probably the first time when a regular person can do some kind of social innovation and help others in the society. We felt that a lot of people were really stressed with the flood, so we wanted to produce the 'emotional support video' to lighten up the community and we had great success with the video. People watched a lot of our videos because they got the inspiration message from it".*

Many more encouraging examples in our case study demonstrated that the use of social media does not stop at facilitating resources. It was also used to provide emotional support that was equally important. In one example, volunteer group used social media to not only to assure the victims that 'help is on the way' but also to exemplify 'we are all in this together'. One of the volunteers described the experience:

*“At that point [when flood hits its peak], most people use Facebook to communicate with others – to look after their houses, to console one another, to share story, provide emotional support and bond together over Facebook. At first people are very stressful then we learn to live with the water and we had recreational activities like boat racing, snorkelling, scuba diving and party”.*

The volunteer further explained that social media was enacted as an emotional support tool during the flooding disaster, and it facilitated connections even between people who did not know each other:

*“At one point, we decided to make things less stressful. We even created our theme song for the flood just to release stress. The funny thing was we share everything on Facebook. Some of us never had seen each other, even though we work together every day [on Facebook]. Some might say that Facebook is a good tool to get us city-folk to connect together since our lifestyle is very individualistic. It was like we were in a virtual deserted island together on Facebook and we had to help each other to survive”.*

Eventually, social media was perceived as a common space for individuals to convey emotional concerns and respond to emotional appeals. Another volunteer in the group described:

*“I think it [Facebook] is the most effective tool to use during the flood. It has great networking features to pull people together and can be used to share information very effectively. It can be used to build connection and sense of community among group members. Actually after the flood, our community became closer. We also created many sub-groups after the flood, such as bicycle, pet book and music Facebook page. Before the flood, we don't know a lot of people in the community but after the flood we did. It is the evolution of our community through the use of Facebook during the flood”.*

In a nutshell, this was the phase in which Thai communities recognized the local usefulness of social media in facilitating engagement and enact it to establish connection among all impacted parties in the crisis. Social media was perceived as a common space that binds different parties together, as well as a channel to reconnect with the world after a disaster. Once the local usefulness of social media was understood, accepted and enacted in practice, social media was actualized as a boundary object-in-use – a catalyst of immersion that spans relational boundary. The actualization of social media as a catalyst of immersion is significant because during and after a crisis event, emotional support and companionship are critical to assist the victims in recovery (Perez-Lugo, 2004; Ahmed & Sinnappan, 2013). In our case study, impacted communities in Thailand recognized the dialogic and open nature of social media and enacted it as a common space that allows for the accumulation of ‘human voices’, i.e., personal messages that engender emotional understanding and empathy in ways that the official statements cannot. In other words, the interactive nature of social media to cultivate relationships (Briones *et al.*, 2011) was understood, accepted and enacted in practice. This enactment of social media demonstrated that social media is more than a messaging tool – it is a boundary object-in-use that could span relational boundary and promote social connection.

## Summary

Table 3 presents a summary of our data analysis. In a nutshell, our case study demonstrates how social media could be enacted as boundary objects-in-use to span various boundaries that restrict disaster response. As shown in our analysis, social media presents interpretive flexibility, i.e., the capacity to sustain divergent needs and interpretations (Doherty *et al.*, 2006). It provides enough flexibility to allow for different interpretations, yet provides sufficient common structure for relevant actors to carry out boundary spanning tasks. More importantly, however, our findings pinpoint the emergence process of boundary spanning competence. Our findings demonstrated that social media acquired different common identity and emerged as different

**Table 3.** Summary of findings

Phase	The emergence of social media as boundary objects-in-use		
	Types of boundary	Enactment of social media	Types of boundary object-in-use
Phase 1	Formal disaster response systems could not provide situational information in real time: <b>Information boundary</b> (i.e. barrier to awareness, understanding and knowledge of the situation) emerged	Social media was enacted for: Collection and distribution of critical disaster notifications and situational information	Social media emerged as a <b>compendium of information</b> : It became <i>locally useful</i> for the accumulation of information and the translation of domain-specific knowledge It acquired a <i>common identity</i> as an informational boundary object: it inhabits 'several intersecting social worlds and satisfy the information requirements of each of them' (Star & Griesemer, 1989, p. 393)
Phase 2	Formal disaster response systems could not offer the required availability and reachability: <b>Communication boundary</b> (i.e. communication impedance separating multiple entities or social worlds) emerged	Social media was enacted for: Flexible communication Collaborations between diverse occupational communities	Social media emerged as a <b>channel of intercommunication</b> : It became <i>locally useful</i> for the transfer of understandings across multiple communities towards supporting a shared task or goal It acquired a <i>common identity</i> as a communication boundary object: it provides the malleability to support multiple interpretations and applications, thereby serving as the common ground for multiple social worlds to collaborate together (Brand & Jax, 2007)
Phase 3	Formal disaster response systems could not offer personal contact or build emotional bonds: <b>Relational boundary</b> (i.e. discontinuity in connection and association) emerged	Social media was enacted for: Development of a sense of community Engagement and association	Social media emerged as a <b>catalyst of immersion</b> : It became <i>locally useful</i> for the transcendence of barriers (e.g. geographical barrier) towards cultivating relationships It acquired a <i>common identity</i> as a relational boundary object: it serves as a common space that allows for development of understanding (Levina & Vaast, 2005)

types of boundary objects when its local usefulness in providing important humanitarian assistance during disasters was understood, accepted and enacted in practice by the relevant actors. More specifically, our findings show that social media was functioning as three types of boundary objects-in-use during the flooding disaster. In the onset of disaster, social media became locally useful for several critical informational purposes. Response agencies and communities enacted social media for the dissemination and exchange of information. Through the enactment process, social media acquired a common identity to serve as an informational boundary object, i.e., it emerged as a compendium of information that satisfies the information requirements of multiple communities. Next, during the peak of the disaster, social media was enacted and became locally useful in facilitating collaboration towards supporting a shared task or goal. In other words, social media attained an identity as a communication boundary object – a channel of intercommunication that serves as a common space for multiple social worlds to collaborate together. Finally, when preparing for recovery, social media was enacted mainly for engagement and relationship building. In particular, social media become locally useful for cultivating associations among impacted communities. It acquired a common identity as a relational boundary object – what we regard as a catalyst of immersion that is capable of transcending barriers and build support across multiple social worlds.

In line with the conclusion drawn from a handful of existing studies (e.g. Levina & Vaast (2005) and Ribeiro Soriano *et al.* (2012)), this conceptualization signals a shift of attention in understanding the roles of boundary objects not in terms of their intrinsic technical features but as being embedded in the practices of the individuals using them. In other words, we promote a view of objects 'not as static and fixed, but as unfolding and dynamic' (Scarborough *et al.*, 2015, p. 199). This conceptualization of boundary objects is attractive because it accounts for how technological artefact could be used in ways that allow for a different boundary spanning competence to emerge (Levina, 2005; Iorio & Taylor, 2014). This conceptualization acknowledges the interpretive flexibility and collaborative capacity of boundary objects and emphasizes that the use of boundary object is constantly being negotiated in practice (Barrett & Oborn, 2010). In this present study, this conceptualization helps to shed light on how social media could be enacted in practice to serve important roles in disaster response. While most of the existing disaster response studies have been focusing on discussing the different properties of disaster response technologies (Nan & Lu, 2014), our research elucidates the emergence process of boundary objects, i.e., how different boundary spanning competences of social media emerged in practice. In the remainder of the paper, we further discuss the theoretical and practical insights generated from this conceptualization and propose areas for future research.

## IMPLICATIONS FOR RESEARCH

Our research aims to contribute to IS literature in two ways. First, our research has provided a number of insights into how social media could be used as boundary objects during disaster response. In particular, our relational view of boundary object has allowed us to draw conclusions about the dynamics of social media and its efficacy in spanning different boundaries that restrict disaster response. In doing so, we shed light on the mechanism with which IT artefacts could be

usefully incorporated in practice; and more specifically, on the mechanism with which boundary spanning competence emerged in practical use (Levina & Vaast, 2005). This conceptualization helps to provide theoretical contribution centred not on the *functionality* of the boundary object alone but on the *process* in which the object is enacted. Our findings extend the existing literature that has been primarily concerned with the types of boundary objects (Carlile, 2002; Bechky, 2003b; Pawlowski & Robey, 2004) and their characteristics (Star & Griesemer, 1989), to further explore how boundary object could be effectively used in practice. While boundary object literature has suggested that boundary objects are dynamic and may serve different purposes in different contexts, limited research exists to empirically investigate *how* technological artefacts could be enacted in practice to serve different boundary spanning purposes (Carlile, 2004; Star, 2010). In all, our research suggests that further insights could be gained if our research attention could be shifted from *what* is a boundary object to *how* a boundary object is used in practice (Levina, 2005).

Second, in recent years, we have seen several calls for research that encourage scholars to examine the use of technologies in addressing critical societal challenges (e.g. Majchrzak *et al.* (2012) and Winter & Butler (2011)). Among all the complex challenges facing our societies today, natural disasters pose one of the most critical challenges that bring about devastating impacts on our society. Nevertheless, while IS research has contributed much to our understanding of digitally enabled collaborative actions in different organizational contexts, the phenomena generally studied by IS scholars rarely respond to the level of urgency, unpredictability and dynamics required in the context of disaster response (Park *et al.*, 2015). By conceptualizing the boundary spanning process of social media in assisting with disaster response, our research contributes an in-depth understanding on the use of technologies in this unique setting. More generally, moving beyond the context of disaster response, our research puts in place the use and implications of social media with an aim to encourage a new wave of research into how social media could be used to serve important societal purposes. We suggest that, as social media evolves in the direction of solving societal challenges, an in-depth understanding on how social media could be used to provide solution to the society's most challenging problems is more important than never before. It is thus our hope that this research could ignite discussions among practitioners and scholars on the use of social media in contributing to the solutions for a variety of complex social problems. We have summarized the implications of our research in Table 4.

## IMPLICATIONS FOR DISASTER RESPONSE PRACTICE

*I think in the next 10 years, social media usage would become much more widespread. The number of smartphone users surely would increase a lot more, and more people would be accessing social media on their smartphones. Also, the government is developing a single database, so that information can be fed into social media much faster and easier. Therefore, in the future, social media should be more useful during the disaster for both government and the people.*—The Secretary of the Office of the Prime Minister, Mr Wim Rungwattanaajinda

**Table 4.** Overview of existing research focus and contribution of this study

	Existing research focus	Contribution of this study
Topic	<i>Finding 1: social media as boundary object</i>	
Properties of boundary object	<p><i>Boundary object in theory</i></p> <p>Focused on discussing how certain technological artefacts could be valuable in boundary spanning due to their design and properties (Levina, 2005)</p> <p>Discussed the designated properties of boundary object, i.e., a boundary object should possess 'boundary-spanning features,' such as modularity, abstraction, accommodation, and standardization (Star &amp; Griesemer, 1989; Wenger, 1998)</p>	<p><i>Boundary object-in-use</i></p> <p>Promotes a view of boundary objects not as static and fixed, but as 'plastic' and emerging (in line with calls from existing studies, e.g. Levina &amp; Vaast, 2005 and Star, 2010)</p> <p>Demonstrates the interpretive flexibility of boundary object, i.e., boundary object's role could change over time depends on the way in which it is used (Levina &amp; Vaast, 2005)</p>
Emergence of boundary object	<p>Technological artefact could potentially function as boundary object if it possesses boundary spanning features:</p> <p>Focused on discussing the roles of organizational IS as potential/ designated boundary object but explained little about when and why do technological artefacts become boundary objects (Carlile, 2004; Ewenstein &amp; Whyte, 2009)</p>	<p>Technological artefact emerged as boundary object-in-use when it acquired local usefulness and common identity in practice:</p> <p>Sheds light on how social media emerged as boundary object-in-use, thereby address the under-attended question of how different types of technological artefacts emerged and act as boundary objects (Ewenstein &amp; Whyte, 2009)</p>
	<i>Finding 2: social media for disaster response</i>	
Digitally enabled disaster response	<p>Designated technologies for disaster response:</p> <p>Focused on discussing the roles of designated disaster response technologies, but consider little about the efficacy of traditional systems in satisfying the complex requirements, which arise in a highly volatile and unpredictable disaster environment</p>	<p>Social media for disaster response:</p> <p>Uncovers the mechanism behind social media-enabled disaster response</p> <p>Calls for scholars to enhance our understanding on the roles of emerging technologies in global disastrous events</p>

Our findings also generated important practical insights. Today, an in-depth understanding on how to embrace the power of emerging technologies is essential, if not critical, to deriving effective disaster response actions. In recent years, an increasing number of organizations are entering the disaster communication space and rolling out their social media disaster response strategies. Giant internet companies such as Google, Facebook and Twitter have recently rolled out relevant initiatives. For instance, Facebook has recently introduced a 'Safety Check' function – a new tool for users in disaster-affected areas to quickly notify their friends of their safety. Twitter has its 'Twitter Alerts' function that allows emergency management and government agencies to send important disaster-related alerts to their followers. Google has also been



helping people to reconnect with families and friends during the outbreak of disaster. Its 'Person Finder' feature has demonstrated the efficacy of social media in a range of disaster events, such as the 2010 Haiti earthquake and 2011 Japan earthquake (Dorasamy & Raman, 2011). These advances are exciting as they offer previously unprecedented opportunities to improve future disaster response. However, it also implies that failure to understand the affordances of emerging technologies and the new forms of digitally enabled disaster response portends a future where crises are ineffectively managed. It is therefore our aim to conduct research that accumulates knowledge and experiences towards guiding policymakers, disaster responders and impacted communities in harnessing the power of social media for disaster response. We emphasize that social media could be used as a life-saving tool during disasters if an understanding of how it works in practice is available. In the present paper, we unveiled the mechanism behind social media enactment in disaster response. In particular, we identified several critical obstacles during a disaster and the usefulness of social media in

**Table 5.** Roles of Social Media and Lessons Learned for Response Agencies and Impacted Communities

Roles of social media	Lessons learned for response agencies and impacted communities
<b>Phase 1 (Readiness and Rescue)</b> Social media serves to overcome information-related challenges Accumulate timely and situational information (e.g. public safety information, alert and real-time updates) that are otherwise difficult to obtain	<b>Response Agencies</b> Disseminate <i>critical information</i> , i.e., situational updates, firsthand emergency notifications and alerts Harness the flexibility of social media to provide information in <i>quickly digestible and shareable format</i> (e.g. brief and pertinent texts, photos, and videos) Establish a group or page to <i>crowdsource information</i> from the ground <b>Impacted communities</b> Identify and participate in relevant, <i>well-monitored, and active groups/pages</i> Raise <i>questions and express specific needs</i> to committed response agencies (through groups/pages)
<b>Phase 2 (Rescue and Relief)</b> Social media serves to overcome communication-related challenges Serves as a two-way communication channel that addresses the limitations and fragility of mainstream communication infrastructure	<b>Response Agencies</b> Encourage <i>active communication</i> and <i>monitor requests</i> from the ground. Provide <i>quick response as assurance</i> Mobilize <i>expertise and resources</i> by harnessing on the power of network effects (establish and maintain a reliable, trustworthy network is the key) <b>Impacted communities</b> Familiarize with different platforms and <i>proactively enact them</i> (e.g. microblogging platforms such as Twitter is effective for frequent news and updates; Facebook for community-building, <i>discussions, and collaboration</i> )
<b>Phase 3 (Relief and Recovery)</b> Social media serves to overcome connection-related challenges Serves as a platform that moves beyond conventional, top-down approach to enable conversation, provide affirmation and support	<b>Response Agencies</b> Provide assurance and show commitment through <i>consistent and frequent social media updates</i> (the social media group or page should be seen as a reliable network for the impacted communities) <b>Impacted communities</b> Reach out and participate in relevant, <i>well-monitored, and active groups/pages</i> Convey <i>emotional support</i> to cultivate community resilience

different phases of a disaster. Taken together, these findings present applicable knowledge that could help practitioners and impacted communities to harness the power of social media to collect and disseminate the right information, coordinate resources and execute shared missions effectively during disasters. We have summarized the specific lessons learned in Table 5.

## LIMITATIONS AND CONCLUSION

This paper adopts the theoretical lens of boundary object to examine the use of social media in disaster response. More specifically, this paper describes an in-depth analysis of how social media was initially introduced in the crisis, how its roles as boundary objects emerged and matured during the crisis event, and how it spanned boundaries to facilitate effective disaster response. Our case study of the 2011 Thailand flooding serves as a powerful instance that demonstrates how social media can be enacted as boundary objects-in-use to provide important humanitarian assistance during disaster. More specifically, our research showed that social media is capable of functioning as three different types of boundary objects-in-use to span information, communication and relational boundary that inherently restrict disaster response. In all, our findings address the research question of how an increasingly pervasive technology – social media – enables disaster response.

Nevertheless, the contributions of this study should be viewed within the context of its limitations. First, the findings of the study are by no means exhaustive. We have focused only on three boundaries, which were salient in our case study. Further analysis on the effects of social media in spanning different boundaries as well as on the possible interrelations between different boundaries would be illuminating. Second, disaster response is a comprehensive and challenging problem. Certainly, research on social media-enabled disaster response is also about managing the negative unintended consequences. We need to be concerned about the potential failure of internet access, problematic rumours and difficulty in coordinating bottom-up actions (Palen *et al.*, 2007; Oh *et al.*, 2013). In this present paper, we focused only on the positive implications of social media in enabling disaster response. Addressing the potential drawbacks and unintended consequences of social media is beyond the scope of the paper, but would be an important next step for future research. In a nutshell, it is our hope that this paper could stimulate more interest among scholars to explore both the challenges and opportunities associated with social media-enabled disaster response and more generally, social media for addressing societal challenges.

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## APPENDIX A: LITERATURE REVIEW PROCESS

Our literature review process adheres to the guidelines suggested by Webster and Watson (2002). The following table summarizes the details of the process.

Activity	Description
Phenomenon of interest	Social media-enabled disaster response
Theoretical lens	Boundary object
Initial sampling frame	<p>First, we focused on collecting our initial sample from leading IS journals to identify major contributions in the topic of interest (Webster &amp; Watson, 2002). Our initial searches were focused on (1) digitally (and in particular, social media) enabled disaster response and (2) boundary object.</p> <p>Next, to prevent omission of quality research in other journal outlets, we then conducted structured search (go backward and forward, see following) to further expand the sample (Webster &amp; Watson, 2002). The decision to include or exclude newly found articles was based on our accumulating understanding of the phenomenon and theory, and our 'contextually sensitive judgement of studies' relevance and contribution' (Boell &amp; Cecez-Kecmanovic, 2015, p. 164).</p> <p>Social media-enabled disaster response is a relatively under-researched topic in IS field. In order to ensure sufficient contextual understanding, we expanded the scope of our searches to include keywords such as 'extreme events', 'emergency', and 'crisis'. We then manually refine the sample by reviewing each identified paper to determine its relevance to our phenomenon of interest. We have also reviewed some high-quality reports from corporates and practitioners to gather important background information about the phenomenon of interest (Pan &amp; Tan, 2011).</p>
Go backward	We go backward by reviewing citations for the articles identified in our initial sample to determine prior articles that should be included (Webster & Watson, 2002)
Go forward	We go forward by identifying articles that are citing the key articles in our initial sample (Webster & Watson, 2002)
Synthesize and conceptual mapping	Articles are logically grouped based on concepts and/or perspectives (Webster & Watson, 2002). See Appendices B and C for lists of selected studies resulted from our literature review.

## APPENDIX B: SELECTED STUDIES ON DIGITALLY ENABLED DISASTER RESPONSE

Study	Disaster response technology	Key finding
Chou <i>et al.</i> (2014)	Natural disaster management website	Evaluated the comprehensiveness of natural disaster management websites in terms of relative and absolute utilities
Day <i>et al.</i> (2009)	Disaster relief supply chain network	Identified a set of information flow impediments and proposed design principles for reducing or alleviating the impacts of these impediments in future disasters
Leidner <i>et al.</i> (2009)	Organizational crisis management information systems	Proposed a framework of resource deployment to shed light on coordination mechanism during crisis response
Lu & Yang (2011)	Web forum	Outlined the characteristics of virtual communities in the context of natural disaster and proposed a set of design principles for future emergency response operations

*Continues*

## Continued

Study	Disaster response technology	Key finding
Manoj & Baker (2007)	Distributed wireless mesh networks	Identified a set of communication challenges that need to be solved to establish a reliable communication system during crisis situations
Nan & Lu (2014)	Online forums	Explored the power of IT-enabled self-organization as a new alternative that complements traditional centralized plan-and-control model during organizational crisis
Oh <i>et al.</i> (2013)	Social media (Twitter)	Explored the issue of information quality in the context of social crises
Pan <i>et al.</i> (2012)	Organizational crisis management information systems	Discussed the roles of IT in enabling various types of crisis information network structures and proposed guidelines for managers to deploy appropriate information networks during crises
Turoff, Chumer, Van de Walle, and Yao (2004)	Emergency Response Information System	Proposed a set of design principles for the development of emergence response information systems
Wakolbinger <i>et al.</i> (2013)	Interorganizational information sharing platforms	Developed a game-theoretic model for future research on IT-enabled interorganizational information sharing in disasters
Yang <i>et al.</i> (2009)	On-site Emergency Response Information Systems	Proposed basic design principles and practice for emergency responders to use on-site information systems
Yuan & Detlor (2005)	Mobile Crisis Response System (CRS)	Outlined a set of critical tasks and proposed key roles of CRS technologies and websites during a crisis

## APPENDIX C: SELECTED STUDIES ON BOUNDARY OBJECT

Study	Boundary object	Key finding
Barrett & Oborn (2010)	Project management tools	Boundary object facilitates collaboration across knowledge boundaries at one time and constrains knowledge sharing and triggers relational conflict at other times
Bechky (2003a)	Engineering drawings and machines	Boundary object mediates the relationships between different groups of individuals and facilitates problem-solving across boundaries
Carlile (2002)	Computer-aided drafting models	Boundary object provides a concrete way for individuals to learn from each other across specific boundaries and enables transformation of knowledge
Gal <i>et al.</i> (2008)	3D modelling technologies	Boundary object helps to facilitate cross-organizational communication and develops organizational identities
Mark <i>et al.</i> (2007)	System analysis and design artefacts	Boundary object enables the transfer of design knowledge across heterogeneous social worlds
Nicolini <i>et al.</i> (2012)	PowerPoint slides	Boundary object mediates cross-disciplinary collaborations
Puri (2007)	Resource maps	Boundary object makes indigenous knowledge visible, enables dialogue and shared understanding among experts
Rosenkranz <i>et al.</i> (2014)	Project management tools	Boundary object's capacity could change in different brokering situations

Continues

## Continued

Study	Boundary object	Key finding
Sapsed & Salter (2004)	Project management tools	Boundary object tends to lapse as when it is situated in diverse and dispersed programmes
Yakura (2002)	Project timelines	Boundary object allows diverse groups to work together by offering closure as illusion of control

## APPENDIX D: LIST OF INTERVIEWEES

Category	Description	Number of informants
<i>Interview</i>		
Community leader	Mr Vittayen Muttamara and his assistant – directors of flood relief volunteer centres who are also the Members of Parliament (MPs) of an ex-opposition party	2
	Dr Somkit Lertpaithoon – The Thammasat University rector and a very influential social media user who used social media during the flood. Thammasat University was used as an evacuation centre and Dr Somkit was the pioneer in sharing the information through Facebook page	1
	Arjarn Wanchai and his committee members – Leader of Parichart Village – Parichart Village (with more than 2000 households) was deeply flooded under 70cm of water. Social media was used heavily throughout the course of the flood	4
	Dr Teerachon Manomaiphibul – The ex-deputy governor of Bangkok who was heading the crisis department during the flood. He created a new Facebook account and posted numerous critical comments about flood management	1
	Charun Fight Flood community – An online community group set up to fight the flood (founder and cofounder)	2
Community/volunteer	'Roo Su! Flood' (know and fight the flood) – Educational video series that accumulated more than one million hits on YouTube	3
	Mr Arjarn Sasin Chalearnlarp – Secretary General of Seub Nakjasathien Foundation, an environmentalist and the most influential academic who was regularly featured on TV shows and has a large number of followers on social media, including YouTube, Facebook, and Twitter	1
Government	Mr Wim Rungwattanaajinda – Secretary to Prime Minister's Office. Minister who was very much involved in the government's Flood Relief Operations Command and other flood management operations	1
	Lieutenant Colonel Wanchana Sawasdee – A deputy spokesperson of the Royal Thai Army and a popular actor. The Royal Thai Army mobilized almost 4000 personnel to provide aid to flood disaster victims	1
Private corporate	Mr Prasert – Vice President of the Corporate Communications Department of PPT – an organization that aims to secure sufficient energy during a crisis. An Emergency Management Centre was set up during the flood and social media (Facebook, Twitter, and YouTube) was used as the main medium	1
<i>Focus Group</i>		
Victim	Two focus groups of flood victims	11
		13
Volunteer	Student volunteers at evacuation centre	15
	Total	56

## APPENDIX E: EXCERPTS OF INTERVIEW TOPIC GUIDES

### A General questions on interviewees

- 1 Please tell us about your background.
- 2 How did the flood affect you? How do you cope with it?
- 3 Please share your experience (crisis response activities) with us.
- 4 Why did you choose social media?
- 5 How did you use social media during the flood?
- 6 How it is different (or same) compared to crisis response in the past?
- 7 During the crisis response, which portion did you consider to be the most difficult? How were the problems resolved?
- 8 Is there any incident that has left a deep impression to you?

### B General questions on leaders, organizers, and volunteers

- 1 Please tell us about your background.
- 2 How was the flooding situation? What are the challenges in crisis response?
- 3 Please describe your crisis response efforts (who initiated the response, the objective, who was involved?)
- 4 Why did you choose social media?
- 5 How did you (your organizations or your communities) use social media during the flood?
- 6 How is it different (or same) compared to crisis response in the past?
- 7 What are the reactions of the communities? (How many people joined/participate? Why did they join? How were the online and/or offline communities formed during crisis response? How did their participation changes over time? What role did social media play in this?)
- 8 What are some of the things you have learned from this experience?