Social media and disasters: A new conceptual framework

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ABSTRACT

Conceptual frameworks which seek to integrate social media uses into disaster management strategies are employed in a range of events. With continued variations to social media practices, developments in technology, and changes in online behaviors, it is imperative to provide conceptual frameworks which are relevant, current and insightful. This paper conceptualizes a range of recent literature through an inductive methodology, and presents the themes of Web accessibility and online information reliability as broad and emerging considerations for the identification of social media uses during disasters. It presents a new conceptual framework of current social media uses which may be used to supplement existing frameworks. The framework has been applied to a dataset of Tweets from the 2015 Nepal earthquake to demonstrate its validity. Suggestions for future applications are discussed.

Keywords

Social media, conceptual framework, disaster management, Web accessibility, information reliability.

1. INTRODUCTION

In the past decade social media has played an increasing role in disaster situations, primarily offering a means of two-way, reliable and accessible communication (Huang et al., 2010). Social media use during disasters may be conceptualized into two broad categories: disseminating information and receiving communications, or as a management tool (Lindsay, 2011). The effective use of both categories may lessen the effects of a disaster (Rodríguez et al., 2007). Examples of social media include Facebook, Twitter, and blogs such as WordPress. Uses of social media channels during a disaster range from individuals passing on warning information, to governments distributing real-time updates during an event (Blaikie et al., 2014). The effective use of social media in such situations has led to an increased adoption to management strategies, and to improvements in its applications (Huang et al., 2010). It represents a radical change in communications where information can now be accessed from any location, at any time, and with little or no authentication. As such, developing effective disaster communication systems and their integration into disaster management strategies has been a priority for many disaster bodies (Blaikie et al., 2014).

However, the impact of social media in disaster situations is still reliant on a number of underlying factors. Two such factors often fail to be included in existing conceptual frameworks, and subsequently remain overlooked when applying analysis to disaster events (Smith, 2012). It is proposed that the first factor is *accessibility* to the Web, and by implication to social media, which directly impacts the effectiveness of online disaster management strategies (Smith, 2012). Secondly, the *reliability* of online information shared on social media has strong links to the level of risk an individual is subject to (Cottle, 2014). This paper discusses the emergent considerations of *accessibility* and *reliability*, employing an inductive methodology to recent disaster social media literature to identify and summarize (i.) social media uses, and (ii.) recent disaster social media applications, behaviors and technologies. The preliminary results section presents the new conceptual framework. The potential insight of the framework is demonstrated by application to the case study of the 2015 Nepal earthquake and future applications discussed.

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2. BACKGROUND

This study uses the definition of McFarlane and Norris (2006) that a disaster is 'a potentially traumatic event that is collectively experienced, has an acute onset, and is time-delimited'. Disasters generally have natural, technological, or human causes, and are conceptualized in life-cycle phases, which are pre-event, event, and post-event.

2.1. Understanding Web accessibility during disasters

Accessibility is dictated by the factors which may shape how an individual uses the Web and the ease with which an individual may achieve a desired state. The Web is defined as a network of hypertext files which are accessed through a Web browser (Berners-Lee et al., 2006). Social media are defined as computer mediated-tools or applications which are made accessible through the Web. They are used to develop online communities or networks through the sharing of, creation, and exchange of information. The Web brought with it the ability to connect, and to share information with, another individual in real-time (Berners-Lee et al., 2006). This represented a paradigm shift in the way that disasters are both managed and perceived (Cottle, 2014). Accessibility to online information as well as offline is now an observed factor in reducing risk posed by a disaster (Blaikie et al., 2014). The Web is vital to the understanding of social media in disaster contexts; theories such as online identities, perception of the Web, and understanding how offline and online worlds differ, are examples of recent developments that have yet to be addressed in the field. Despite heightened global connectivity there are still considerable factors which affect an individual's access to the Web. Particularly the factors of social class, gender, race and economic standing may still be subject to higher levels of risk during a disaster (Fothergill et al., 1999).

2.2. Online information reliability during disasters

Information reliability is a major concern for risk reduction during disasters, and is dependent on may aspects (Shklovski et al., 2008). The potential effectiveness of individuals sharing information online through a desire to help others is reduced as a large proportion do not cite a credible source, which makes determining credible information from official bodies difficult and unclear (Mendoza et al., 2010). Anonymous social media profiles similarly cause information verification issues: this has been observed in Tweets at the time of the Fukushima nuclear disaster, 2011, where anonymous profiles on caused untraceable information spread (Thomson et al., 2012). To combat this, many disaster bodies are encouraging the use of standardised protocols when sharing information online. This places emphasis on the individual to tag, state or link to the source of the information. This firstly ensures that the information is sourced, and secondly it enables information tracing which can be investigated by officials (Mendoza et al., 2010). Identifying whether an individual has deliberately shared false information is tricky (Thomson et al., 2012). An individual may have been subjected to any number of situations which causes distorted information (Hughes & Palen, 2012). As a result, evaluating the subtle and constant flow of political, emotional and marketing influences that effect the use of the Web is difficult (Shklovski et al., 2008).

3. METHOD

Technology, applications, and uses of social media are rapidly developing and evolving in potential uses (Yates & Paquette, 2011). Consequently, developments have not been incorporated into existing frameworks (Lindsay, 2011), for example the encouragement to adopt a standardized disaster hashtag on Twitter (Robinson et al., 2015), meaning that existing explanations may be reduced in their range and relevancy. The study of the Web may contribute new insights into social media use during disasters, and have relevancy to future applications (Palen et al., 2007).

3.1. An inductive methodology

An inductive methodology was used to produce a new conceptual framework. Firstly, an online literature search was employed with the aim to select the most relevant and recent publications. Literature was identified using Google search and Scholar through a set of key term searches using themes discussed throughout a previous literature review. These are: disaster, crisis, disaster communication, framework, social media, and web. Selected literature totaled 59 sources. Secondly, inductive coding, which seeks to condense extensive and varied text into a summative format (Thomas, 2006), was employed on sources. This allowed the identification and summary of themes or concepts. Thirdly, a constant comparative method was used, in which the researcher identified a specific concept or phenomenon of interest from the range identified through inductive coding (Fereday & Muir-Cochrane, 2008); in this case that of recent disaster social media use. The researchers then

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identified and collected themes relating to the concept with a goal to generate theories seeking to explain why disaster social media uses occur, or change over time (Glaser & Strauss, 2009). A collection of categories forms a conceptual framework which represent summaries of the concepts within the range of literature. Finally, grounded theory was used to aid analysis through a set of rigorous research procedures (Corbin & Strauss, 2014).

3.2. Case study

To demonstrate its validity, the framework has been applied to a Twitter dataset collected by the Southampton Web Observatory during the Nepal earthquake in 2015 with a sample size of 10,000 Tweets. Twitter has been selected due to the character limit which allows analysis to be succinct but demonstrative. A selection of key terms commonly attributed to disaster social media content, discussed by Palen et al. (2007) and other related studies, was used to identify relevant hashtags present in the data. The terms are: help, aid, safe, support, rescue, disaster, crisis, government, relief, earthquake, and Nepal earthquake. Only tweets written in English (totaling 1,000) were analyzed to avoid translation errors. This meant that a proportion of social media uses are represented rather than 100% of the dataset. Tweets which featured a selected term were contextually analyzed by the researchers, which served to identify whether any framework concepts fit. It is important to note that the application of the framework has been used to demonstrate initial insight, rather than to illustrate a full case study analysis. Preliminary findings suggest that focus on Web accessibility and online information credibility are indeed relevant to current events, and are present in the dataset.

3.3. Suggested sequence for application

The suggested sequence for applying the framework to future disasters may follow two procedures. The first is to integrate it with other existing frameworks used for planning and contextual understanding. Examples include Houston et al. (2012 and Eisner et al. (2012), with the aim of supplementing the knowledge base throughout all stages of the disaster lifecycle. The integrated framework may then serve as an updated general guide for resource allocation, decision making, risk reduction and general management to bodies such as governments and the emergency services. The second sequence for application is to integrate the framework into the preliminary steps of social impact assessments (SIA) and social risk assessments (SRA) of events, such as Mahmoudi et al. (2012). This provides an extended dimension for predicting probable social impacts and uncertainties in a particular event.

4. PREMLININARY RESULTS

Examining literature indicated that the users of social media during a disaster include the following groups: governments, non-profit organizations, corporations, news media, social media channels, researchers, communities, and individual citizens. As highlighted by previous examples such as Houston et al. (2012), the users are also creators of content throughout a disaster; this indicates that a majority of social media communication activities are two-way, a process that has been accounted for in the method.

The framework features two columns; the first column is conceptualized across the disaster lifecycle phases, which are: pre-event, during the event, post-event, and throughout all stages. These correspond to the disaster social media uses by way of grouping them they emerge throughout an event. The second column lists the disaster social media uses. Each of these represent a summary of a concept which is present in the literature. Uses cover a range of two-way communication activities which may be open-ended and have several aspects or steps associated with them, unlike static categories alone. Some, however, do not have clearly defined boundaries due to their conceptual nature (i.e. some aspects may overlap with one another). Unsurprisingly, well-documented concepts such as re-connecting community members remain a large part of the composition of the literature, and therefore the structure of the framework. Developing themes such as the concepts of Web accessibility and online information reliability, however, are more prominent in table 1 compared to that of similar frameworks such as Houston et al. (2012).

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Disaster lifecycle phase	The uses of disaster social media
All stages	1. Evaluate the reliability of information 2. Identify and/or contain false information
Pre-event	3. Provide and seek general disaster preparedness information 4. Provide and receive general national and regional disaster warnings
Pre-event → During	5. Detect and warn of disasters and specific hazards locally 6. Identify the differences between actual and potential uses of social media
During event	7. Send and receive requests for help or assistance 8. Inform others about ones condition and location
During → Post-event	9. Provide, receive and analyze big data generated by the event 10. Provide, receive and encourage information sharing in multiple formats 11. Document what is happening during a disaster online and offline 12. Consume or create news coverage of the disaster 13. Provide and receive location based real-time warnings 14. Express public and/or individual emotion or empowerment; reassure others 15. Raise and develop awareness; donate and receive donations; list ways to help or volunteer 16. Seek to inform and support existing disaster management strategies 17. Provide and receive specific disaster response, rescue and evacuation information 18. Seek and assess mental, behavioral and emotional health support 19. Filter, categorize critically analyze information 20. Understanding how online and offline situations differ 21. Provide and receive information regarding disaster response, recovery and rebuilding; tell and hear stories from the disaster 22. Understand how ones access to the Web has had an effect on their experiences
Post-event	23. Discuss socio-political causes, implications and responsibility 24. Re-connect community members 25. Discuss the accessibility of the Web as an intermediary to social media 26. Discuss the accessibility and reliability of specific social media; discuss perceptions
Post-event → Pre-event	27. Consolidate lessons learnt to develop new/improved social media applications

Table 1. A conceptual framework showing the uses of social media during disasters, focusing on the issues of Web accessibility and online information reliability with reference to disaster life-cycle phases.

4.1. Application to the Nepal earthquake, 2015

Application seeks to demonstrate that the disaster social media uses, concepts and themes regarding Web accessibility and online information reliability discussed in recent literature are identifiable in a recent case study, thus justifying the suggested future application sequences discussed in section 3.4. of the method. The terms used in the application are stated in section 3.3. of the method.

The terms '#support' and '#rescue' were prevalent in the dataset which corresponded to social media uses discussed by Imran et al. (2015), and represented the use from table 1 'Consume and create news coverage of the disaster'. Predominately the term '#rescue' was used in the context of communicating rescue attempts, representing the use 'Provide and receive information regarding disaster response, recovery and rebuilding; tell and hear stories from the disaster'. Factors which affected rescue attempts were also broadcast, which included intermittent internet reliability, and a divide in the population via network location and by social status.

The term '#earthquake' was used in a high volume, which indicates that basic awareness for the event was spread online. The content of these tweets mainly fell into the category 'Document what is happening during a disaster'. '#Earthquake' was used in more instances than '#NepalEarthquake', showing that general discussion regarding the situation was more dominant than the adoption of a standardised Twitter hashtag. Instead, this may represent issues with online information reliability, as encouraged online standards were not consistently adhered to. This represents the categories 'Discuss socio-political causes, implications and responsibility', and 'Identify the differences between actual and potential uses of social media'.

Tweets featuring the term '#government' may represent political unrest. Although expected to be in the context of spreading governmental advice, a majority criticized the organization of the Nepalese government. Many tweets subverted calls for donations with corruption claims, and instead urged global citizens to donate directly to charities. thus representing underlying social tensions. Tweets fell into the categories 'Assess one's perception of safety or situation', 'Raise and develop awareness; donate and receive donations; list ways to help or volunteer', and 'Discuss the accessibility and reliability of specific social media and its uses; discuss perceptions'.

5. CONCLUSION

In summary the study has reviewed literature in the field of disaster social media, highlighted limitations of existing analysis frameworks, and has sought to address them. This has resulted in the creation of a new conceptual framework which takes into consideration (i.) Web accessibility, (ii.) online information reliability, and (iii.) developments in social media uses, technologies and applications. The validity of the framework has been demonstrated by its application to the case study of the Nepal earthquake (2015) using a dataset of 10,000 tweets collected by the Southampton Web Observatory. Preliminary findings illustrate that the themes of Web accessibility and online information credibility are indeed present in the dataset. Initial Web accessibility issues were evident firstly by the discussion of divides in network coverage, and secondly by the divide in the social status of individuals in the disaster area. Reliability issues were shown by the lack adoption of a standardized disaster hashtag '#NepalEarthquake' when sharing information online.

5.1. Future applications

Future applications may supplement existing disaster management frameworks which serve as regulatory guidelines for planning and contextual understanding. Such frameworks include Mahmoudi et al. (2013), Houston et al. (2012), and Eiser et al. (2012). The new framework may act as a further means of clarifying the range of uncertainties during crises which affect complex systems, allowing wider mitigation options for system architects. The rapidly changing landscape of social media may subsequently contribute to flexible and evolutionary system designs. A standard measurement for Web accessibility and for online information reliability should be developed for more detailed future applications.

6. REFERENCES

1. Berners-Lee, T., Hall, W., Hendler, J., Shadbolt, N., & Weitzner, D. (2006). Creating a Science of the Web.

2. Blaikie, P., Cannon, T., Davis, I., & Wisner, B. (2014). *At Risk: Natural Hazards, People's Vulnerability and Disasters*. Routledge.

3. Corbin, J., & Strauss, A. (2014). *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*. SAGE Publications.

4. Cottle, S. (2014). Rethinking media and disasters in a global age: What's changed and why it matters. *Media, War & Conflict*, *7*(1), 3–22.

5. Eiser, J.R., Bostrom, A., Burton, I., Johnston, D.M., McClure, J., Paton, D., Van Der Pligt, J. and White, M.P., 2012. Risk interpretation and action: A conceptual framework for responses to natural hazards. *International Journal of Disaster Risk Reduction*, *1*, pp.5-16.

6. Fereday, J., & Muir-Cochrane, E. (2008, November 26). Demonstrating Rigor Using Thematic Analysis: A Hybrid Approach of Inductive and Deductive Coding and Theme Development. *International Journal of Qualitative Methods*.

7. Fothergill, A., Maestas, E. G. M., & Darlington, J. D. (1999). Race, Ethnicity and Disasters in the United States: A Review of the Literature. *Disasters*, *23*(2), 156–173.

8. Glaser, B. G., & Strauss, A. L. (2009). *The Discovery of Grounded Theory: Strategies for Qualitative Research*. Transaction Publishers.

9. Houston, J. B., Hawthorne, J., Perreault, M. F., Park, E. H., Goldstein Hode, M., Halliwell, M. R., … Griffith, S. A. (2012). Social media and disasters: a functional framework for social media use in disaster planning, response, and research. *Disasters*, *39*(1), 1–22.

10. Huang, C.-M., Chan, E., & Hyder, A. A. (2010). Web 2.0 and internet social networking: a new tool for disaster management?--lessons from Taiwan. *BMC Medical Informatics and Decision Making*, *10*(1), 57.

11. Hughes, A. L., & Palen, L. (2012). The Evolving Role of the Public Information Officer: An Examination of Social Media in Emergency Management. *Journal of Homeland Security and Emergency Management*, *9*(1).

12. Imran, M., Castillo, C., Diaz, F., & Vieweg, S. (2015). Processing social media messages in mass emergency: a survey. ACM Computing Surveys (CSUR), 47(4), 67.

13. Lindsay, B. (2011). Social Media and Disasters: Current Uses, Future Options, and Policy Considerations.

14. Mahmoudi, H., Renn, O., Vanclay, F., Hoffmann, V. and Karami, E., 2013. A framework for combining social

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Tapia, Antunes, Bañuls, Moore and Porto, eds.

impact assessment and risk assessment. *Environmental Impact Assessment Review*, *43*, pp.1-8.

15. McFarlane, A., & Norris, F. (2006). *Methods for Disaster Mental Health Research*. Guilford Press.

16. Mendoza, M., Poblete, B., & Castillo, C. (2010). Twitter under crisis. In *Proceedings of the First Workshop on Social Media Analytics - SOMA '10* (pp. 71–79). New York, New York, USA: ACM Press.

17. Palen, L., Vieweg, S., Sutton, J., Liu, S., & Hughes, A. (2007). Crisis Informatics: Studying Crisis in a Networked World.

18. Robinson, B., Power, R., & Cameron, M. (2015). *Twitter: A Digital Socioscope*. Cambridge University Press.

19. Rodríguez, H., Quarantelli, E. L., & Dynes, R. R. (2007). *Handbook of Disaster Research*. New York, NY: Springer New York.

20. Shklovski, I., Palen, L., & Sutton, J. (2008). Finding community through information and communication technology in disaster response. In *Proceedings of the ACM 2008 conference on Computer supported cooperative work - CSCW '08* (p. 127). New York, New York, USA: ACM Press.

21. Smith, G. (2012). *Planning for Post-Disaster Recovery: A Review of the United States Disaster Assistance Framework*. Island Press.

22. Thomas, D. R. (2006). A General Inductive Approach for Analyzing Qualitative Evaluation Data. *American Journal of Evaluation*, *27*(2), 237–246.

23. Thomson, R., Ito, N., Sudo, H., Lin, F., Liu, Y., Hayasaka, R., … Wang, Z. (2012). Trusting Tweets: The Fukushima Disaster and Information Source Credibility on Twitter.

24. Yates, D., & Paquette, S. (2011). Emergency knowledge management and social media technologies: A case study of the 2010 Haitian earthquake. *International Journal of Information Management*, *31*(1), 6–13.

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