#trapped! Social Media Search System Requirements for Emergency Management Professionals

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ABSTRACT

Social media provides a new and potentially rich source of information for emergency management services. However, extracting the relevant information from such streams poses a number of difficult challenges. In this short paper, we survey emergency management professionals to ascertain how social media is used when responding to incidents, the search strategies that they undertake, and the challenges that they face when using social media streams. This research indicates that emergency management professionals employ two main strategies when searching social media streams: keyword-centric and account-centric search strategies. Furthermore, current search interfaces are inadequate regarding the requirements of command and control environments in the emergency management domain, where the process of information seeking is collaborative in nature and needs to support multiple information seekers.

Categories and Subject Descriptors: H.3.3 [**Information Storage and Retrieval**]: Information Search and Retrieval

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1. INTRODUCTION

"*Building 9 has collapsed. I'm stuck, help please! #trapped*" More often than not, when an emergency or disaster strikes victims and onlookers use social media platforms such as Twitter, Facebook, Instagram, Flickr to communicate with friends, family and others [9, 8, 11]. However, unlike the opening message which makes a specific request for help in a particular location, most communications about an incident are not as specific, nor as informative when it comes to using this information to support and aid emergency responders. During the early stages of an incident, emergency responders are often faced with more questions than answers. Information like this may be invaluable in saving someone's life, but it may also be a hoax. Consequently, teams of experts from various domains have to collate and filter information about the event, e.g. location, severity, and magnitude, from many different sources (traditional, i.e. phone calls from citizens, incoming CB radio communications from police officers, etc as well as new sources coming from social media platforms). The response team must cooperate to make sense of the situation, by considering context, as well as their experiences and skills. Any errors made during this process may lead to an inappropriate response to the incident; putting lives and property at risk.

It has been argued by Palen, Vieweg and others [9, 8] that social media platforms provide new and potentially valuable source of information, which if harnessed correctly could be of tremendous benefit to emergency response teams. With the real-time nature of social media platforms and an internet enabled mobile phone in the hands of most citizens there is an abundance of information now flooding in when a crisis occurs. However, as alluded to already, most of this data is not useful for emergency responders, it is potentially unreliable, uncorroborated, vague, misleading, obvious and already known, or otherwise irrelevant. This means that emergency response teams need to deal with the abundance of potentially relevant and actionable information, and then sort through the information carefully to determine its quality, authoritativeness, specificity, and ultimately its utility and usefulness in responding to the situation.

Emergency responders work in time-critical and safety-critical environments, thus decisions made in command and control will affect the outcome of an adverse event (i.e. where to dispatch and allocate the finite resources at hand). During an incident, or if one is imminent, the information needs will be determined by the context of that event. Emergency management services will need to know what type of hazard or crisis they are faced with, what is the severity of the event, where is its occurring location, and how many people are likely to be affected. Therefore, the collation of information from various official and unofficial sources, such as social media platforms, plays a pivotal role in supporting their situation awareness [2].

To date there have been numerous works that have shown the utility of social media to help in particular situations [6, 3, 12], for example, providing flood warnings, mapping fire out breaks and so on. However, most of the time this research is done post-hoc, and outwith the context of emergency response teams. Other work has focused on the development of IR systems that follow, filter and map events in real-time such as Twitcident [1] or Crisees [7]. Such tools aim to provide emergency responders and the public with an overview of an event, however, again such tools have been developed without a deeper appreciation and under-

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standing of the users that will be using these tools. Also in order to develop appropriate, context-sensitive systems that support the process of gathering, filtering and analyzing the publicly available social media information streams, a better understanding of the users, their search needs and the larger context of handling an emergency response is required.

Consequently, this paper aims to provide an insight into current search behavior of emergency management professionals. To this end, we undertake a survey of such professionals to ascertain how they rate the importance of social media information, what problems they face when dealing with large information streams, what actors are involved in their processes, and how information from social media platforms can be incorporated within their current emergency management procedures.

2. METHOD: REQUIREMENTS SURVEY

To ascertain the needs and requirements of emergency response and management teams we devised an online survey instrument to capture how social media was being used within organizations responding to such incidents. The survey was designed for individuals who are involved in emergency management (EM). The survey contained 64 questions which were divided into five sections:

1. demographic information and expertise,
2. organizational and individual use of social media,
3. information seeking behavior,
4. technology acceptance of social media platforms, and
5. open ended questions on social media platforms for emergency management.

2.1 Survey Structure and Background

Part 1 of the survey contained standard demographic questions along with questions about their current position, how long they have worked in that position/organization, which department/organization and at which location. Since previous studies on cognitive aspects of information seeking processes observed substantial differences in search behavior between novices and experts [4, 10]. We also included questions regarding the participants level of IT expertise, their usage of social media, level of seniority and experience in their current position. In part 2, participants were asked about which social media platforms they used during a crisis, how they utilized them, and how useful each platform was. We specifically asked about: Twitter, Facebook, LinkedIn, Google+, YouTube, MyVideo, Flickr, Instagram, Pinterest, Personal Blogs, and others.

In part 3, we asked several questions regarding their information seeking behavior. Specifically, about the difficulty, value, quantity, reliability, and verifiability of the information on social media platforms. Also, we wanted to know how easily or possible it was to share and communicate their findings within their team/organization. With recent natural and man-made adverse events, such as Virginia Tech Shooting (2007) or the Japan Earthquake (2012), highlighting the role of social media platforms as a way to mediate global, real-time communication, allowing the public to create and comment on such content, we were particularly interested in how this surge in information affected emergency response teams. For example, reports in the aftermath of the Haiti Earthquake (2010) and the public disorder events in England (2011) made it clear that the volume of user-generated content (UGC) created on social media platforms could support emergency response agencies to increase situation awareness. However, it also has the potential to overload decision makers with too much information [5]. So we included a number of questions asking participants whether they felt overloaded by the abundance of information, and how they perceived the quality and usefulness of the user-generated content. In part 4, we examined how accepting such organizations are in using social media platforms and how user-generated content could improve their current processes.

For sections 2-5 questions were either open ended or asked participants to indicate their level of agreement on a seven-point Likert scale. When presenting our results, we have reduce the seven-point Likert scales for agreement to three categories: (i) disagree, (ii) neutral i.e. neither agree nor disagree, and (iii) agree. The survey was designed to take participants approximately 30 minutes to complete. Three follow-up interviews were then conducted with selected participants to gain further insights into their search behaviors.

2.2 Representativeness and Sample Size

The emergency management domain consists of many different types of organizations, such as police forces, fire and rescue services (FRS), or ambulance services. In order to obtain a large and representative sample of participants from the EM domain, the survey was sent to (i) organizations with statutory duties as emergency responders as well as to (ii) other professional EM bodies, such as the Emergency Planning Society (EPS). Overall using a number of mailing lists, the survey was distributed to approximately 350 individuals within the United Kingdom. Within three weeks we received 100 responses, of which 70 were fully completed, and the other 30 only partially completed which we excluded from this analysis. The resulting response rate was approximately 20%. Participants reported to work in positions such as media manager, public communications officer, civil contingency coordinator, and emergency planning officer and were linked to a variety of organizations, such as council/local authority (37.14%), police force (31.43%), FRS or government department (14.28%), health board (5.71%) and other (e.g. maritime and coastguard agency) (11.43%).

3. RESULTS

In presenting the results from the survey, we will focus mainly on presenting our findings from part 2 and 3 of the survey on information seeking behavior of emergency management professionals.

3.1 Demographics

Most participants (N=70) reported to be in their current position for more than three years (64.29%) and working in their current organization for more than three years (21.43%), more than 5 years (21.43%) and more than 10 years (42.86%). It is therefore assumed that a majority of the participants is well aware of their roles and responsibilities in the emergency management environment. In regards to their self-assessed IT experience, participants (N=69) reported to be competent (46.38%), proficient (33.33%) and expert (10.14%). When asked about their level of social media experience, participants (N=69) reported to be competent (34.78%), proficient (28.99%) and expert (5.8%).

3.1.1 Perceived Value of UGC during Incidents

In order to understand the motivation to search for user-generated content during incidents, we asked participants about the perceived value of information exchanged on social media platforms. When asked if there is too much valuable information 13.23% of the participants agreed, 19.12% neither agreed nor disagreed and an overall of 67.65% disagreed with the statement (N=68). During a follow-up interview one participant said that "*there can never be too much valuable information*". However, when asked if there is not enough valuable information 35.82% agreed - a further 19.40% of the participants were undecided (N=68). Interestingly 44.78% perceived social media platforms to contain enough valuable information during an incident. These results may seem contradictory but suggest that while valuable information exists within UGC finding the right information poses a significant challenge.

3.1.2 Finding UGC during Incidents

Before asking the professionals to detail their search strategies, we asked them about the difficulty they had in finding information about an incident. 11.76% of the participants perceived it to be hard or very hard to find any information at all (N=68). However, 69.11% perceived this task as easy, while 19.12% neither agreed nor disagreed about the statement. This seems at odds with the previous findings, however, this was clarified during the interviews when participants pointed out it was easy to find general and causal information about an incident, but not specific, relevant, and useful information, which could be used to inform decision-making. When asked about the ease to formulate their information needs, 38.24% of the participants found it easy to express their needs, while 23.53% perceived it to be difficult (N=68). During the follow-up interviews, participants noted that they had a very clear picture of their information needs and felt confident in expressing them most of the time.

Search user interfaces for social media search provide numerous ways to search/query for information. Table 1 provides an overview of the types of search functionality used by emergency management professionals to formulate their search queries.

Looking at the results, there seemed to be two general methods of findings information. The first one is through the formulation of a query expressing information needs, similar to standard web search interfaces. Additionally, content is followed by using social media specific syntax such as hashtags in the micro-blogging platform Twitter. The second method appears to be acccount-centric, meaning that the search for information starts with a specific account or a list of accounts, rather than a search query.

3.1.3 Filtering UGC during Incidents

There is also the need for additional filtering of information. A piece of user-generated content considered to be topical relevant, e.g. by matching a number of keywords, may actually be irrelevant for considering in the emergency management environment. Information can also be classified as misinformation and disinformation and thus should also not be considered in the decision-making process. When asked if there is *too much misleading information* on social media platforms during an incident 42.65% of the participants (N=68) agreed, 27.94% disagreed and 29.41% neither agreed nor disagreed. Subsequently the majority of the participants reported the assessment of importance and veracity of user-generated content to be difficult - see Table 1.

In order to understand the process of verification and relevance judgment better, we asked what role the user account/profile of the message creator plays during the assessment - see Table 1. From this we conclude that the majority of emergency management professionals surveyed (74.63%, N=68) not only base their relevance judgment on factors related to topic, geography or time, which are mainly describing the context of the incident, but also to the notion of trust of the information provider. The specific factors, that are usually taken into consideration during the assessment of a user profile were not surveyed and may be part of future research, as it would be important for future systems design to understand what these judgments are based on. However, when looking at search strategies 71.46% of the participants (N=68) reported to search for information by looking at *already known* accounts. This leads to believe that previous positive or negative experiences with an account effects the trust assessment for future incidents. Other methods mentioned to assess information in regards to relevance, trust and veracity were visualization using geographical information systems to detect accumulation of similar content in a close proximity of the incident site and cross-validation of information across multiple information sources.

3.1.4 Collaborative Work with UGC during Incidents

The exchange of information relevant to assess the situation and to facilitate informed decision-making is another key requirement for any information processing system in the emergency management domain. The ability to exchange information with other organizations during an incident was perceived to be important by 46.16% of the organizations (N=31). We therefore asked participants about the ease to transfer findings into other systems and the ease to exchange social media search results with colleagues inside and outside their organizations.

During incidents every organization involved in the response will only have limited information processing resources available. In order to use these resources more efficiently, tasks such as filtering, annotating or assessing information should be conducted in a collaborative manner. However, when participants (N=67) were asked if they are relying on other organizations to filter information only 28.37% agreed, whereas 37.31% were neither agreed nor disagreed and 34.33% disagreed. This is surprising given that the majority of emergency management professionals surveyed indicated to conduct account-centric information filtering.

4. SUMMARY AND CONCLUSION

In this paper we surveyed 70 professionals working in emergency management and response environments to ascertain requirements for using social media search systems. Despite the low signal-to-noise ratio in social media streams, user-generated content was seen by professionals as a timely and potentially useful source of information that could inform the decision-making process. However, in order to incorporate data from these information streams, professionals sought information that was not only topically relevant, but also geographically and temporally and perhaps most importantly that it was verifiable and from a credible source. Due to the complexity of this task, participants reported that this assessment of user-generated con-

When looking for relevant/important information during an incident...	Disagree	Neutral	Agree
...I am mainly using keyword search to find information	10.45%	13.43%	**76.13%**
...I identify specific keywords/hashtags to follow an incident	8.95%	17.91%	**73.14%**
...I filter information on the basis of geo-locations	31.35%	31.34%	**37.31%**
...I look at for reliable sources/users and track their account	10.44%	17.91%	**71.64%**
When searching for information on social media platforms during an incident it is hard to...	**Disagree**	**Neutral**	**Agree**
...identify important information	38.24%	16.18%	**46.00%**
...verify information	23.52%	17.65%	**58.83%**
When searching for relevant/important information during an incident I am looking at the profile of the message creator to ...	**Disagree**	**Neutral**	**Agree**
...judge the relevance of information	8.95%	16.42%	**74.63%**
...judge the trustworthiness of information	7.46%	17.91%	**74.63%**
When searching for information on social media platforms during an incident it is easy to...	**Disagree**	**Neutral**	**Agree**
...transfer my findings into other systems	29.42%	32.35%	**38.24%**
...share my findings with colleagues inside my organization.	25.37%	23.88%	**50.76%**
...share my findings with colleagues outside my organization.	26.87%	23.88%	**49.25%**

Table 1: Search strategies and tactics employed when information seeking (N=68).

tent in regards to relevance and veracity was very difficult. When searching for user-generated content, we found that emergency management professionals employed two main strategies: **keyword-centric search** and **account-centric search**. The former relies on the expression of information needs by formulating search queries using keywords or platform specific syntax, such as hashtags. Additional search operators, e.g. to filter on the basis of geo-information, though, were not routinely used. Account-centric search for user-generated content entailed finding a reliable source then following that user's experience of the incident. The majority of professionals (74.63%, N=68) reported that this assessment of user-generated content regarding trust and relevance was based on the profile of the content creator. Therefore, future social media search systems will also need to provide functionality to support emergency professionals in this assessment.

Emergency management environments also bring together a number of actors from various backgrounds and organizations. Thus, in order to establish a joint understanding of the situation, the information seeking and processing needs to be collaborative. This was regarded to be very important to facilitate the sharing and communication of findings within response teams. Thus, search interfaces for emergency management need to be collaborative. In future work, we shall explore the specific needs of collaborative information seeking and sharing in order to design and build a search system tailored to the emergency management environment.

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