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# Priceless Tweets! A Study on Twitter Messages Posted During Crisis: Black Saturday

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## Priceless Tweets! A study on twitter messages posted during crisis: Black Saturday.

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### Abstract

*Twitter has been regarded as an outstanding social media application due to its immediacy in communication. Twitter has experienced exponential growth and been used for various purposes including crisis communication. However, there have been less empirical studies on Twitter messages (tweets) posted during crisis. In this paper, we analyse the tweets that were posted during Australia's worst fire disaster - Black Saturday. We propose a new coding scheme for tweets during crisis and propose further research into how Twitter can be used as an alternative communication tool during crisis to support official communications, in particular, reflecting ground level conditions. Further, we find that tweets made during Black Saturday are laden with actionable factual information which contrasts with earlier claims that tweets are of no value made of mere random personal notes.*

### Keywords

Twitter, fire, crisis, emergency communication, Black Saturday

### INTRODUCTION

De Longueville et al (2009) described Twitter as a micro-blogging platform, a new breed of social networking tool that operates on simplicity and openness. As of 2009 there were three billion tweets worldwide and these were increasing about 9000 tweets a minute (O'Brien 2009). Despite claims of triviality directed at tweets (Naaman et al, 2010), Twitter offers more than just the ability to send 140 character messages. It has been noted that Twitter can be used to communicate alongside other social networking applications in times of crisis (Sutton et al. 2008, Hughes et al. 2009, Starbird et al. 2010, Palen et al. 2010). This demonstrates how the ICT revolution has changed the way we communicate and access information. However, despite the potential of these technologies none of them were actually considered as part official communications during the recent 2009 Black Saturday bush fires in Australia. The royal commission into the disaster highlighted some of the key areas of shortfall, which mainly addresses the vagueness of information at ground level and the inability to provide useful advice at the time of crisis (VBRC 2010). Could the inclusion of social networking applications as part of the official communications provided some light to this? Interestingly, Palen et al suggests that large scale crisis could not be handled by traditional communication methods, which echoes the inability of state fire communication systems to function during the bush fires due to heavy usage leaving society with no credible source of information (VBRC 2010). Thus, our paper attempts to look at how tweets during Black Saturday could have been used as part of official communication in reflecting ground level conditions and further, used as an additional communication channel. This paper, in parts, addresses the larger research question on citizenry communication (Palen et al. 2010) i.e. how social networking applications can support in events of large scale crisis. The paper is organised as follows. In the next section, we have explained Twitter in the general sense followed by how it is used as a communication tool including in times of crisis. This is followed by the research methodology, analysis and finally conclusion and future research.

## TWITTER IN GENERAL

Twitter is one of the fastest growing web 2.0 technologies with approximately one hundred and ninety million users worldwide and growing (TechCrunch, 2010). The appeal of Twitter is in the ease of use; there is no need for a title or complex narrative as is the case with traditional blogging. The user relies more or less on a series of 'stream of consciousness' comments restricted to 140 characters or less. The immediacy of Twitter allows fast spread of ideas as they flow through the interconnected networks of friends and followers (Stilgherrian cited Le May 2009). Patterns of growth in Australian's use of Twitter resemble patterns of growth in many other countries, including the United States. Observations on the geographical growth of tweets indicate that there has been stronger growth outside the U.S pointing to steady Twitter penetration and usage (Sysomos, 2010). Figures generated from different studies organised by Hitwise between 2007 and 2008 show an incredible increase of 518 percent in Twitter usage (Hanchard, 2008). It also provides evidence of 'stickiness' hinting that it is possible that many of those who start to tweet continue using Twitter making it a compelling tool for communication (Sysomos, 2010).

Twitter has gone beyond a purely social activity tool to become a means of communication across many sectors of society. The Pew Internet survey conducted on the use of Twitter in the United States by Fox et al (2009) found an increase in usage from 11% of Internet users in December 2009 to 19% between August 18<sup>th</sup> to September 14<sup>th</sup>. The study identifies three main groups who are driving the growth of Twitter (or another service) to "share updates about themselves, or to see updates about others". These three groups, taken directly from Fox et al., are; social network users, those who connect to the Internet via mobile devices, and younger Internet users under the age of 44 years. The group who uses social network sites are more likely to use Twitter or another updating service, "independent of other factors such as age or use of mobile device to connect online" (Fox et al. 2009). It would appear from this survey that connectivity and portability are important factors in the growth of updating services such as Twitter. A second factor that appears to be significant in driving the growth of Twitter is the increasing level of engaging across a variety of social media devices. For example, the more devices the user utilises the more likely they will utilise Twitter (Fox et. al. 2009).

There are many Twitter applications available for Twitter users to add graphics, video and other forms of media as well as offering the potential for building social network communities. Some examples include uploading photos (2 tweet, img.lyto, twitdoc flick-to-twit and twitpic), providing voice and sounds (chir.ps) through to real-time tracking of Twitter hashtags (hashtags.org), the monitoring a set of 3 keywords to watch what people are saying (monitter) and an application that collects all tweets with the phrase *Does Anyone know* (AskOnTwitter). Many of these applications provide interconnective software that enables the user to connect Twitter to other social media platforms such as Facebook, Flickr, Delicious as well as email and mobile phones. Twitter users are also able to use software applications to measure their sociability and influence compared to the tweets and retweets of other users. Sites such as Twitalizer, Twitter Grader and Twinfluence all allow the user to conduct some form of analysis of their tweets (Jonas, 2009).

## THE RISE OF TWITTER AS A COMMUNICATION TOOL

Like many social media platforms, Twitter started out as a social tool for 'ordinary' people. However, gradually Twitter has become a major communication tool for politics, business, mainstream media and celebrities (Evans, 2009). According to Tumasjan et al. (2010) Twitter has stamped its authority as a genuine communication channel in the political arena as a result of the 2008 US Campaign and "shortly after his victory, Obama used Twitter to let the web community know how he felt: This is history". Similarly, a study conducted by Sysomos on Twitter identified one hundred and sixty eight politically focused accounts from the Canada, the US and the UK (Cheng and Evans, 2009). They found that users of the political 'Twittersphere' comprise three categories; politicians, political strategists (including bloggers and media personalities) and news organisations that cover politics. The rise of Twitter as a communication tool was clearly demonstrated on the 24<sup>th</sup> June, 2010 during the leadership spill of Australian Labor Party. It was expected that the Deputy Prime Minister would challenge the Prime Minister in a secret ballot. While the meeting was in progress and before the traditional media had a chance to report the news, a tweet (Bennpackham) appeared on a major daily newspaper's online site declaring that the Deputy Prime Minister had prevailed without contest. The tweet, "RT @samanthamaiden: It's Julia no ballot #spill" broke the story 11 minutes before the broadcast news sources as a member of parliament had sent a text from inside the party room which was then re-tweeted (send) to the general public. The online newspaper in this instance served as a platform for a Twitter user to break a news story at grassroots level (Herald Sun 24<sup>th</sup> June 2010). Many portals have followed suit in facilitating Twitter communication due to the potential traffic and other common profitable opportunities presented by social media tools.

Businesses are beginning to see Twitter as a viable marketing tool and branding agent. For example, journalists are increasingly aware of the impact Twitter has on their readers (Posetti 2009). They themselves see the effect that new media is having in shifting the way news is produced, reported and consumed. Burgan of Sky Digital

News contends that “the space between the news producer and news consumer has collapsed”. Twitter is used in this context for producers to communicate with and invite feedback from readers. Readers are then able to extend on the stories and provide social commentary as citizen journalists. Another example of Twitter being used in the business domain involves brand management, which in many ways is of critical importance to any business. Businesses have been known to allocate huge amount of budgets to manage and spruce their respective brands online. Many companies utilise Google alerts amongst other tools to monitor people’s perception and reaction in the cyberworld towards their brands (Hawkins, 2009). To mitigate and curb negative perception, businesses need to resort to immediate and effective communication tools. As such, Twitter’s interactive features meet those requirements by allowing businesses to respond to the individuals personally. This micro level communication is considered as more valuable than the offerings by traditional media.

While there is evidence that Twitter is being utilised by organisations, it is also allowing for the individual to use as a means of connection with like minded citizens. “I am finding more and more Australians on Twitter everyday... there’s also Twitter groups and meet-ups all the time” (Tech.au.tv). Stilgherrian (cited Le May, 2009) claims “with Twitter everyone’s view is slightly different. You will see someone message people you don’t know, but it might spark your interest – and you end up encountering someone new.” New communities can potentially form and reform as interests and incidents occur and flow through networks of people in a serendipitous way; and all in ‘real’ time. This makes Twitter an excellent platform for communication and information dissemination.

### **Crisis coverage by Twitter**

Twitter has been monumental in covering on current events. Owing to its light weight nature of broadcasting in 140 characters Twitter has been known to out do live reporting in numerous occasions. Reliance on media such as television, radio and newspapers on disaster coverage often varies and at times too late up to 24 hours in certain cases (O’Brien, 2008). This shows that mainstream media has probably given way to uprising communication tools as Twitter. The events unfolding in Sichuan earthquake was first reported by Twitter users beating the first US Geological Survey (USGS) report by two minutes (Gabarain, 2008). A study on crisis emergency by Mills et al (2009) found that Twitter had profound impact in distributing crisis related information. Twitter was instrumental during events such as the Californian fires (Wagner, 2008), New England Ice Storm (Ragan, 2009), Gulf of Mexico Hurricane (Janega, 2008), Cyclone Nagris in Myanmar (Palatino, 2008) and Mississippi Hurricane (Brown, 2009). Apart from these, other major incidents such as the Red Shirt protest in Bangkok, Iran election violence, 2008 Mumbai terrorist attacks, Reuters journalist shot down by the US army, aid ship in Gaza attacked by the Israeli commandos has also been widely documented and shared. Messages exchanged on Twitter reflect the immediacy and recency on crisis events in a chronological order as it unfolds.

The success of Twitter probably lies in its two notable factors. First is the low bandwidth requirement and second is the strength of crowd sourcing. The founder of Twitter, Biz Stone, has openly acknowledged that it was inspired by short messaging services (SMS) and the 140 character limit also allows Twitter messages to be sent via other complementary technologies such as RSS (Stone, 2008). Given, the conciseness of the messages and reliability of packet-based text information transfer, Twitter is seen to be at the forefront in sharing brief messages in rapid concessions. Wills et al (2009) noted that this light weight packets are more “likely to get from computer to cell phone and from cell phone to computer and from cell phone to cell phone “. Further an additional advantage is that these text messages will not be erased or purged when the system is down at either ends, rather the message are stored in a queue contrast to landline or cellular phone when the network is congested. This form of store and forward approach is very favourable in a crisis situation where by one could expect the communication network to be temporarily down or having battery or power problems at reported during Black Saturday (VBRC 2010).

The second driving success of Twitter is due to crowd sourcing. Crowd sourcing is a term used to describe collective intelligence harnessed from social networks. This is one of the most fundamental value of web 2.0 approach, where by inputs from disparate users collectively provides a far fetched value (O’Reilly and Battelle, 2009). It is a very sustainable approach increasingly leveraged by businesses in remodelling their business models to suit current business environment (Hempel, 2006). Examples of these are very obvious with successes as Wikipedia, YouTube, Facebook or the creations of marketplaces such as eBay or Craigslist and the list goes on. They provide a common platform in such a manner where users can contribute, consume and create a market by the mass. Twitter undoubtedly falls into the same category. Given the nature of Twitter and the amount of information (tweets) that is generated it will be valuable to analyse what kind of information is being transmitted and if they relevant to an event of crisis. In following section we analyse tweets that were used to share and reflect Australia’s worst fire incident (known as Black Saturday) which recorded over 170 fatalities and countless damage emotionally and economically.

## RESEARCH ON TWEETS

Though there are a handful of studies involving Twitter in crisis situation such as (Sutton et al. 2008, Hughes et al. 2009, Starbird et al. 2010, Palen et al 2010), less empirical studies have been done to meaningfully categorise tweets in an event of crisis. However, there have been previous attempts to generally analyse tweets such as Java et al (2007) and Krishnamurthy et al (2008) who provided the descriptive statistics on Twitter usage. The latter, claimed that the frequency of updates correlates directly to the number of followers if they were also friends. Humber et al (2008) on the other hand studied the activeness of a user based on individual's social circle and concluded that there are three types of distinct user activities; information seeking, information sharing and social activity. A content analysis on '@' the reply/mention function in Twitter was also done by Honeycutt and Herring (2009) which lead to categorisation of tweets. Similarly, Naaman et al (2010) analysed 3379 tweets and produced nine message categories by extending work done by Java et al (2007) to evaluate message content. The categories were: information sharing (IS), self promotion (SP), opinions/complaints (OP), statements and random thoughts (RT), me now (ME), question to followers (QF), presence maintenance (PM), anecdote me (AM) and anecdote other (AO). The study found that typically there are two types of Twitter users. First group, which is made of eighty percent of the users are engrossed in disseminating messages about themselves while the second group of twenty percent are far more informative, conversational and more involved with their followers. The latter proved to be more interesting thus attracted more followers given the benefits of information sharing, chance of discussion and chances of being heard by a larger crowd. However, the limitations of this study were due to the absence of the social network structure or context in which the tweets were posted.

The authors found Naaman et al to be closely aligned in terms of approach and methodology, and thus it was chosen as the foundation for this study. Drawing from Naaman et al's limitations, we aim to approach tweets with context to gain further insight on the transacted messages. The objective of the study was two fold. First, to identify categories of tweets made during a crisis and if they had more meaning than mere random 'all about me' tweets as reported by Naaman et al. Secondly, to qualify if Twitter can be approached in times of crisis as an alternative communication tool carrying invaluable ground level information. This study was motivated by the need for alternative communication tool during crisis and also the lack of research on the quality of information carried by tweets in an event of crisis.

### Analysing the Dataset

Given the study required a context, the messages posted during the Black Saturday served as communication transacted during crisis i.e. natural disaster - fire. The dataset were collected via Twitter's default search facility. To provide further context for the study only tweets from users registered within or near Melbourne were considered as part of the study. This was because these users would be affected by the incident either directly or indirectly as compared to someone who barely knows about Australia or Melbourne. Also, only those tweets which were transacted using the text 'fire' were chosen. Similar to Heverin and Zach's (2010) approach, authors found that the word "fire" was used to address the crisis better than other words by Twitter users. A total of 1684 tweets were collected over a week as the event unfolded from February 6-14 in 2009. Currently, the tweets are considered to be priceless given the inability of Twitter or even Google to maintain and record Twitter data pre February 2010 due to the enormous amount of information constantly posted on Twitter. Despite huge Twitter following world wide, to this date, only two weeks of tweet data are retrievable on Twitter and hence these are the only record of tweets of Black Saturday available.

The dataset contained general information such the name of the user, day and time of when the tweet was made, location of which is user is registered and the tweet message itself. A brief analysis on the tweets revealed that there were 705 unique users who exchanged messages during this period of a week. The highest number of tweets came from 774melbourne (63 tweets), an account setup by ABC Radio Melbourne with 13,845 followers. The top ten tweet generators are as shown in Table 1. Even though not all tweets pertaining Black Saturday were collected but it is suffice to state that there were only two official sources of communication during the time of the incident and both accounts were held by ABC Radio Melbourne (user no 1 and 10). This demonstrates the lack of state or government based initiatives to use social media tools for official communication purposes. Perhaps the growth in Twitter usage for political campaigns will force policy makers to reconsider. Generally, in Twitter the numbers of followers indicate how active or involved a user is. Here, *prologger* is clearly engaged in Twitter compared to other users. These figures also indicate that official communication channels are not proficiently engaged in microblogging which demands more effort and varied approach compared to more traditional communication channels.

Table 1: Top 10 generators of tweets during Black Saturday

No.	User Name	No. of Tweets	No. of Followers (as of 19 July 2010)
1	774melbourne	63	13,845

2	geehall1	49	655
3	retrogrl	29	1,223
4	SassyCupcakes	20	148
5	tellyworth	20	91
6	duncanriley	19	8,525
7	problogger	19	100,859
8	stephenedgar	18	1,331
9	wolfcat	18	2,585
10	abcnewsMelbrne	16	3,996

There are many Twitter applications that offer free analysis on tweets. One such application is Trendistic.com. Trendistic.com provides a timeline series on the number of tweets that were posted based on keywords. This series could be over a period of time such as 24hrs, a week, 30 days, 90 days or 180 days. Having a timeline series is extremely useful in this study particularly to reflect the immediacy of a crisis and pattern of communication. To investigate the authenticity of the tweets collected on Black Saturday we needed to compare with other major crisis incidents. Incidents that happened recently will suit as a benchmark to ascertain if the data will generate the same patterns.

Cable News Network (cnn.com), a site which is known for its ability to effectively cover crisis was as a rational choice for this exercise. A quick review of cnn.com revealed that the bombing in Uganda on soccer world cup revellers was still listed as breaking news. To test we entered the text 'Uganda' in Trendistic.com and derived a timeline series over 30 days as shown in Figure 1. The timeline showed a sudden spike in relation to the immediacy of the actual event on 12<sup>th</sup> July. This however later reduced but was continual probably due to ongoing investigations related to the event. We then plotted a timeline series on Black Saturday tweets and saw the same effect of sudden spike as when the event occurred i.e. 7<sup>th</sup> February 2009. Both series showed that Twitter data had spiked when the event occurred, which helped to prove that the data we obtained was reflective of a crisis situation.

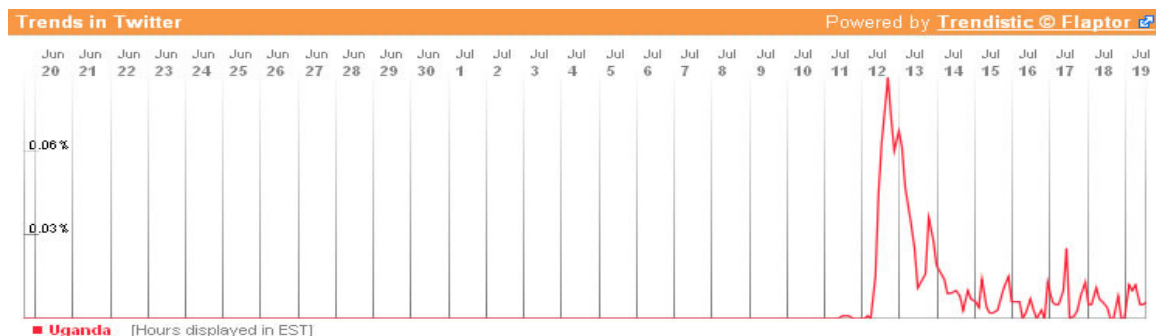


Figure 1: A timeline series generated by Trendistic.com using the text 'Uganda'

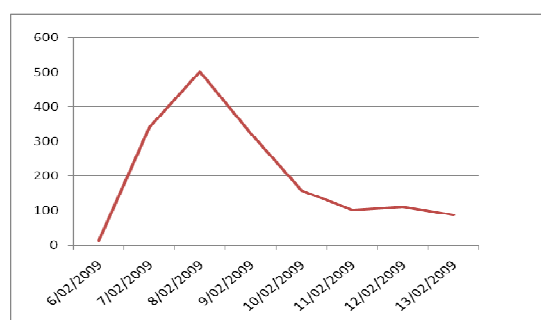


Figure 2: Timeline series of Black Saturday tweets over a week

Given that there has been no reported study on decoding and categorising tweet messages during crisis. We employed action research based methodology in approaching the messages to meet our objectives. We used categories from Naaman et al. (2010) as an initial base to decode the tweets while referring to (Sutton et al. 2008, Hughes et al. 2009, Heverin and Zach, 2010). Table 2 shows the categories that were found by Naaman et al in their study which was based on random tweets. As we decoded the dataset we found that these categories were not applicable in most occasions and in other occasions the categories were not exclusive enough to stand alone. This especially, with the noticeable absence of 'about me' tweets which lead us to form new categories. In

operationalising new categories we decided to review tweets in batches of hundreds. If a tweet did not fall in any of Naaman et al's categories then a new logical category needed to be created. This process reached a stable set of categories by the fourth iteration and all the 1684 tweets were categorised. During the process two categories were merged i.e. *Opinions/Complaints* and *Statements/Random Thoughts* this was due to the inapplicability of the categories to the dataset. Similar to the approach taken by Naaman et al, each tweet was allowed to be categorised into more than one category. This is due to two factors. First, the perspective of a tweet could be multifold, and second, the posted message could have several parts applicable to different meaningful categories. As with any technology it is understood that the more proficient a user becomes the more literate one gets with communication. This sort of behaviour is readily seen amongst passionate mobile users in the way SMS messages are transacted. Advance Twitter users are able to squeeze more information as compared to new users within a single tweet of 140 characters. This could be achieved by using applications such as snipurl.com or tiny.cc that allows a user to shorten url links, which in turn creates space for other characters. There were obvious signs within the dataset that some of the users are regular twitterers and compared to others.

Table 2 shows the new categories of tweets which were formed based on Black Saturday. On average each tweet had 1.98 or two categories. This finding was double of Naaman et al mainly due to the amount of information each tweet contained as found by Herevin and Zach (2010). This was also coinciding with the significant absence of tweets from categories like *me now* (281 tweets or 6.5%) and *presence maintenance* (3 tweets or 0.09%). This is a huge contrast to non-crisis tweets where eighty percent of the data were largely attributed to these two categories. Further, there were no tweets under categories of *anecdote me* and *anecdote others*. This demonstrates that tweets made during crisis are more meaningful than random tweets and perhaps the absence of context while decoding a tweet message would make it rather meaningless. By decoding information laden tweets and forming new categories for tweet messages we achieved our first objective.

Our second objective was to find out if Twitter can be approached in times of crisis as alternative communication tool carrying invaluable ground level information during crisis and if the messages transacted during a crisis such as Black Saturday were actionable. A closer analysis on the messages was required to establish this. It was concerning in the sense that these tweets were not actually analysed or captured for any purposes nor were they reported by any state or government authorities post incident even during the royal commission. From Table 2 it could be said that 65 percent of the data had factual details or more than three of every five tweets had useful information. Twelve percent carried links (url) to websites such as Google maps, Country Fire Authority updates, Weatherzone.com, Bureau of Meteorology, ABC.net.au, Incidentalert.com.au, TheAge.com.au and social sites such as Flickr and Photobucket. Most of the websites displayed graphical status of the fire; current active fire regions, wind directions and the trail of the damage. Almost 22 percent of the tweets had geographical data thus identifying location of the incident which is critical in crisis reporting - "*Ah, too late. Yackandanda is under alert, and the Beechworth fires are heading south-east. 100+ homes gone, 14+ dead. #bushfires*". Further, a quarter of the tweets during Black Saturday carried rich information. This category (third on Table 2) of tweets (other factual data) was found to be the most valuable in this study. It included direction of winds and how individual users encountered the incident - "*My parents have a long night ahead. The wind is blowing the Beechworth fires towards them and they have been told to plan for embers*". "*two routes out of Yea are closed and the other two lead towards other fires*". This ground level information is definitely critical and useful to be passed on the state fire authorities. The following tweets were posted from the same category on the 7<sup>th</sup> February when most of the crisis took place.

- "*Bush fires all around us, the hills are glowing red with plenty of smoke around. Hope people are safe and well*"
- "*ADSL has been down all afternoon, Sky was surreal bronze colour, due to fires*"
- "*Fighting fires !*"
- "*The wind's died down. Wonder how long it'll take to get all the fires out and get the mobile phone towers working again? Nightmare weekend*",
- "*fires in narre north, two streets away from my house. shit.*"

These tweets describe the event unfolding while also having crucial information explaining the status of ADSL and power lines, proximity of fires, and current status in dealing the crisis. Even though this information could be 'made up', national emergency protocols would not rule out this information to render help given the chance that this information could be true to save lives.

Table 2: New categories of tweets logically formed based on Black Saturday

No.	Categories of tweets	No. of tweets
1	Web Links to maps, websites, other resources,	400
2	Geographical data i.e. location, name of a place	730

3	Other factual description i.e. Time, Figure, Cardinal directions, Other organisations (formal names), types of crisis (flood, fire, tsunami etc), communication outlets (radio, TV, telephone), climate related information	875
4	Suggestions, request followers to act, actionable information, and current status update	264
5	Seeking information, help or answers	119
6*	Statements or random thoughts – a comment by the user on a situation	331
7*	Me now – current status about the user i.e. ‘tired and upset’	218
8*	Presence maintenance – instant display of user existence i.e. ‘I’m backkkk’	3
9*	Other’s status – informing followers about other’s situation	2
10*	Communication with Followers – reply tweets, forwarding tweets, linking others in a message	491
11*	Self promotion i.e. ‘Check out my blog’	1
12*	Anecdote me – an exciting-funny incident about the user	0
13*	Anecdote others - an exciting-funny incident about others	0

\*Categories taken from Naaman et al. 2010

A way forward will be to formulate a framework to categorically identify keywords sensitive to a particular crisis. For example within a fire affected region words such as wind, smoke, location, communication channels, water source and roads are critical. This information could be automatically sensed from Twitter feeds by bots (software robots) and scrutinised for higher level analysis. Where, in combination with the user’s location, time of tweet and given data a more meaningful action could be taken. The Empowering Public In Crisis (EPIC, 2010) project headed by Palen et al (2010) uses hashtags ‘#’ in similar fashion to facilitate communication. In Twitter, hashtags can be used to readily search tweet contents. Usage of hashtags enables emergency communications to become more machine-readable and thus increasing the chances of the message being noted and acted upon. Terms such as these are used part of EPIC; #name (name), #loc (location) , #num (amount or capacity), #contact (email, phone, link, other) or #con, #photo (link to photo), #source (source of info) or #src, #status (e.g., open, closed, injured, etc.), #date (date or time), #info (other information). More terms describing the nature of the crisis could be created specifically in context to the affected regions and nature of the crisis i.e. flood, fire, storm, terrorist or locusts attacks. However, only a handful of Black Saturday tweets were found to have any hashtags in them indicating that most Twitter users in Australia are not familiar with this format of communication. This signals for the need to educate public on how to disseminate and retrieve information via Twitter is times of crisis for emergency communication. For example a tweet such as “*Anyone have news on whether the fires are near Healesville?*” should be posted as “*#help Anyone have news on whether the #crisis fires are near #loc Healesville?*”. In this example, the tweet has 3 hashtag items - #help, #crisis and #loc. Semantically decoding the tweet will appear that someone is seeking for assistance (information in this instance) on the type of crisis (fire) in Healesville (east of Melbourne). Adopting an approach as this would certainly increase the quality of information found in tweets during crisis making it actionable reflecting ground level information.

From our analysis it was also found that close to 5 percent of the data (or 163 tweets) were directly actionable. Tweet messages from this category seem to directly ask followers to engage in some action and they are all crisis-centric. Examples are as “*@royrussel ABC Gippsland Transmitter burned by fires tune into 531AM , 828AM, 104.7FM, 105.5FM or 90.7FM for local update - @774Melbourne*”, “*RT @maenad\_au: Wildlife Victoria has lost 2 shelters to the fires. Donations needed: <http://tinyurl.com/dhz53s> (expand)*”. Apart from these, about 119 tweets were classified as *seeking information, help or answers* reflect actual need of assistance. The authors found this category to be quite confronting but truly relevant and could be rightfully directed to State Emergency Services (SES):

- “*I’m looking after an evacu-cat from Warburton to help out @firstdogonmoon 's friend. Bush fires affect pets too!*”
- “*Anyone have news on whether the fires are near Healesville?*”
- “*Does anyone know if the fires touched Smith's Gully? Worried about an ex-colleague.*”
- “*Anyone heard from Tony Wakefield @echoshack? Hope he is ok - last tweet 2pm Sat before fires hit #bushfires #socialmelb*”.



The above sets of tweets mimic the contents of possible phone call directed to an emergency operator during crisis which is truly important. From the analysis above it could be seen that tweet messages during Black Saturday was truly informational and meaningful. The analysis has also demonstrated that users have tried to use Twitter as a communication tool to share information, post and answer questions. Further, tweets such as “*CFA urges those not directly affected by the Vic fires to get info from ABC Melbourne <http://bit.ly/MsGj> (expand) rather than the CFA site*” confirms the attempts by authorities to communicate by requesting public to channel their calls to ABC Melbourne rather than the Country Fire Authority (CFA) due to congestion. An overall examination on the tweets made during Black Saturday meets our second objective by confirming that Twitter can be approached in times of crisis as alternative communication tool carrying invaluable information to advice the public apart from relaying information from ground level to the authorities.

## CONCLUSION AND FUTURE DIRECTIONS

We have performed an analysis on crisis related messages posted by 705 unique users in Victoria via a social media tool – Twitter. Our analysis extends work done by Naaman et al. (2010) and borders work done by Herevin and Zach (2010) in identifying meaningful categorisation of tweets in the context of emergency communication. This study had two objectives. First, to identify categories of tweets made during a crisis and if they had more meaning. Secondly, we needed to establish if Twitter can be approached in times of crisis as alternative communication tool carrying invaluable ground level information. The findings demonstrate that tweets made within a context yield more meaning and tweet messages are meaningless when decoded in the absence of a context. We have contributed to this domain of research involving tweets made during crisis. This form of research has never been within the Australian context. Thus, it needs further exploration especially looking at how both public and state authorities could be educated in using Twitter and other social networking applications in emergency communication as an alternative medium.

This study could be extended by looking into other crisis data such as flood, hurricane, terrorist, earth quakes, or other natural disasters such locust attacks. The major limitation in this study involves the inability of retrieving old tweet data to cross validate. This is particularly to identify the amount of noise or spam hidden within those tweets. Authors have formally contacted the Library of Congress, US for more tweet data after a press release which indicated that Twitter.com had passed all old data to the library. We envisage that other similar studies can shed some light into how Twitter can be used as a communication tool during crisis. Finally authors propose the usage of other social networking applications like Facebook in combination with Twitter among others to form citizenry communication as suggested by Palen et al (2010) in dealing with large scale emergency communication.

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