An Analysis of the use of Cognitive Surplus in Disaster Relief Scenarios

Mark Roddy[1]

[1]*Telecommunications Software and Systems Group (TSSG), Waterford Institute of Technology, Waterford, Ireland, mroddy@tssg.org*

Abstract. In an increasingly connected world, can the cognitive surplus of the online community be effectively harnessed to help in the assistance of managing global disasters? Does this community even want to assist with disaster relief? The relief experts on the ground are continually being confronted with life and death scenarios, so how can they trust the veracity of any assistance provided by the online community? By providing examples of existing disaster management systems that have successfully leveraged the online community to assist in disaster relief, this paper suggests that online philanthropy exists, albeit this assistance does need to be manually verified. The paper goes on to use the results from an online survey to hypothesize a collective intelligence model for trusting this assistance. The potential impact of this could be to reduce the burden that the disaster relief teams have to exert in order to verify and validate this assistance.

1 Introduction

On the 26th December 2004 an earthquake in the Indian Ocean resulted in one of the most destructive tsunamis ever to hit the islands of Indonesia. Within the first hours of this tragic event some 150,000 people had died or were declared missing, and millions were left homeless. Emergency services were fully stretched in trying to come to the aid of the victims.

1.1 Objectives

The objective of this paper is to suggest to the reader a model for a next generation disaster management system, which would be used to help alleviate the suffering of future disaster victims.

The key objectives are to provide:

- Examples of the state of the art for disaster management systems
- Recommendations for the design of future disaster management systems

2 Cognitive Surplus and the Wisdom of Crowds

Shirky (2010) describes cognitive surplus as people's free time and offers insights into how this might be leveraged to impact changes around the globe. This free time is separate from people's work time, where the expectation from the former is not necessarily market driven - people do not expect to be paid for any activity they are engaged in during their free time.

The social scientist Dan Ariely (2008) explores this further - he discusses a scenario of a Thanksgiving dinner where the son-in-law stands up at the end of the meal and offers his mother-in-law payment for the services rendered, it was an artificial scenario but served to highlight the dichotomy between free time and work time - people in their free time do things for free, while people in their work time do things for payment.

But the question still exists - how to harness this cognitive surplus and in particular how can it be leveraged in disaster relief scenarios?

Watching television is an activity usually carried out in our free time, and Shirky (2010, pp.9-10) writes, "imagine treating the free time of the world's educated citizenry as an aggregate, a kind of 'cognitive surplus'". Shirky uses the creation of Wikipedia as a model to measure how big this surplus might be and estimates that the creation of Wikipedia represents "something like one hundred million hours of human thought". He compares this to watching television, which in the US alone is about two hundred billion hours every year, which is roughly equivalent to two thousand Wikipedia projects every year from cognitive surplus.

Through the introduction of innovative online networking technologies it could be possible to transition the passive usage of our cognitive surplus (e.g. watching television) to more active engagement to help and support those in need.

The hit television game-show "Who Wants To Be A Millionaire?" asks contestants to answer a question from four possible answers. If the contestant is unable to answer the question they are able to rely on three lifelines: 'Fifty-Fifty', 'Phone a Friend', or 'Ask the Audience'. An interesting statistic[1] is that the 'Ask the Audience' lifeline has a 95% success rate.

Why is this? It is an example of a phenomenon known as wisdom of the crowd. Surowiecki (2004, p.70) cites, "The idea of wisdom of crowds also takes decentralisation as a given and a good, since it implies that if you set a crowd of self interested, independent people to work in a decentralised way on the same problem, instead of trying to direct their efforts from the top down, their collective solution is likely to be better than any other solution you could come up with".

[1] http://en.wikipedia.org/wiki/Who_Wants_to_Be_a_Millionaire%3F "Who Wants To Be A Millionaire?"

Wisdom of crowds resonates with the cognitive surplus ideas. On the one hand there is the potential to leverage the online communities' cognitive surplus to assist in disaster relief and on the other hand there is the ability to aggregate the crowd's (taken here to mean the online community) responses to arrive at the correct result. Combining these concepts strongly suggests that a collective intelligence model might exist that further increases trustworthiness and information veracity, which will be discussed later in this paper.

3 Disaster Management Systems

This section provides some best in class examples of organisations (all voluntary) that are using online tools to assist in the relief of disaster management scenarios. Some of these organisations use collaborative cognitive surplus to provide online support back into the disaster zone.

3.1 Ushahidi

Ushahidi[2] is a not for profit organisation "that specializes in developing free and open source software for information collection, visualisation and interactive mapping". Ushahidi was a response to the violence in the aftermath of the controversial Kenyan elections of 2008.

Ushahidi started as a collaborative website set up by a group of Kenyan journalists and was used to aggregate and map the reports of these violent events. It was seen as an extremely powerful communication tool, and with over 45,000 users was the catalyst for the design and development of today's platform. The platform was successfully used in many recent disasters, including as a relief response tool for the Haiti earthquake, when it was used by online volunteers to create a visual crisis map of the disaster zone, by clustering data mined tweets emanating from the disaster site.[3] The volunteers then used Skype to relay the cluster details of their map back to relief teams.

3.2 The Sahana Software Foundation

The Sahana Software Foundation, established in 2009, is another not for profit organisation whose mission "is to help alleviate human suffering by giving emergency managers, disaster response professionals and communities access to the information that they need to better prepare for and respond to disasters through the development and promotion of free and open source software and open standards".

[2] http://ushahidi.com/about-us "The Ushahidi Project"

[3] http://usatoday30.usatoday.com/tech/news/2011-04-11-japan-social-media_N.htm "USA Today"

Sahana originated in Sri Lanka as a response to the Indian Ocean tsunami disaster in 2005.[4]

The platform has had numerous deployments, including the 2011 earthquake in New Zealand where it was used to help as a people locator.[5]

3.3 Crisis Commons

CrisisCommons[6] is another example of a voluntary collaborative online community, whose aim is to support the management of disaster and crisis relief. The community emerged from so-called CrisisCamps, which are modelled on the BarCamp/CodeCamp[7] concept, to "connect a global network of volunteers who use creative problem solving and open technologies to help people and communities in times and places of crisis". They provide an example of a Voluntary Technical Community (VTC)[8] and are supported directly by the US Federal Emergency Management Agency (FEMA).

This community has also been very active in supporting disaster relief efforts, a typical example being the collective support of the volunteers during the 2011 earthquake in Turkey where they successfully helped the relief agencies with support response and recovery efforts.

4 Design Recommendations

The European Union Seventh Framework project, SOCIETIES9 has conducted some initial evaluations with the European Union's Civil Protection Mechanism (CPM), using paper prototyping techniques. The objective of SOCIETIES is to design and evaluate a next generation mobile platform that integrates existing Social Networking sites with emerging Pervasive Computing frameworks, so as to create likeminded, purpose driven communities. The paper prototypes were designed to receive feedback from the CPM's disaster experts on their views about using the cognitive surplus of the online community to aid in the disaster relief. The experts were presented with sample scenarios that attempted to describe how this online community might be leveraged in a disaster. For example, one scenario described the disaster team being

[4] http://wiki.sahanafoundation.org/doku.php "The Sahana Foundation"
[5] https://pl.nlm.nih.gov/christchurch/index.php?mod=inw&act=default "People Locator for the ChristChurch Earthquake"
[6] http://wiki.crisiscommons.org/wiki/Main_Page "Crisis Commons"
[7] http://en.wikipedia.org/wiki/BarCamp "Crisis Commons Bar Camp"
[8] http://www.emergencymgmt.com/emergency-blogs/campus/Crisis-Commons-Monitors-Turkey-Earthquake-102311.html "Voluntary Technical Community"
[9] http://www.ict-societies.eu/ "FP7 SOCIETIES Project"

confronted by some street signage that they were unable to translate. A digital photograph of the signage was taken and uploaded to the online community for translation. Another example asked the volunteers to spot the difference between satellite images of the disaster zone taken before and after the catastrophe, so roads or bridges that were destroyed could be identified in advance and alternative routes coursed. Two key findings[10] resulted from this research:

- **Trust**: how could the experts in the field trust the veracity of the results that they were receiving back from the online community?
- **Automated decision-making**: the experts said they would have to be very wary about handing over life or death decision making to machines, but were open to experimentation through simulation. They saw the benefit of automating some of their processes but were sceptical about where the veracity line would be drawn between automated services and the traditional manual verification process, particularly where lives are at stake.

In addition to this an online survey was undertaken in March 2012 (Roddy, 2012) and the results showed that a strong willingness does exist for a community of online volunteers to assist with disaster relief, and that this community would be willing to offer significant amounts of their cognitive surplus to this philanthropic activity. The survey also showed that this online community would be willing to provide personal profile information and that they would also be prepared to operate as part of a community of volunteers.

This is important because it indicates a potential model for establishing diversity. An assumption can be made here that a diverse community of online volunteers exists, which is at the heart of Surowiecki's (2004) premise that diversity in the crowd will provide more accurate results than an expert.

The next steps would be to prove the above through future experimentation. That experiment would involve establishing an online user community of volunteers. These volunteers would provide their profile information at a granularity level that correlates to diversity; call this a '**diversity factor**'.

In total there are three components to be designed into this platform:

i. Firstly the platform will need to have some process for deciding whether to send the data to an expert group or a diverse group. This could be done using a '**task tagging profile**' and an ontology or semantic algorithm.

ii. Secondly the platform needs a process that discovers the appropriate list of diverse volunteers; labelled as a '**diversity factor**'. Again, this could be done using ontology assessment of the volunteer's profile tags.

[10] http://www.ict-societies.eu/files/2011/11/D8.1_public.pdf "SOCIETIES Paper Trial Evaluation Report"

iii. Thirdly the platform needs to be able to predict the '**certainty or veracity level**' of the results, which is at the heart of Surowiecki's 'Wisdom of Crowds' model. The problem here is to work out how many volunteer responses are needed to solve just one problem. The platform is trying to avoid: a) any mistakes being made, and b) volunteers deliberately providing false responses. By asking 'x' amount of volunteers to work on a problem and aggregating their responses, increases the veracity of the feedback.

An example is summarised in the message sequence chart below:

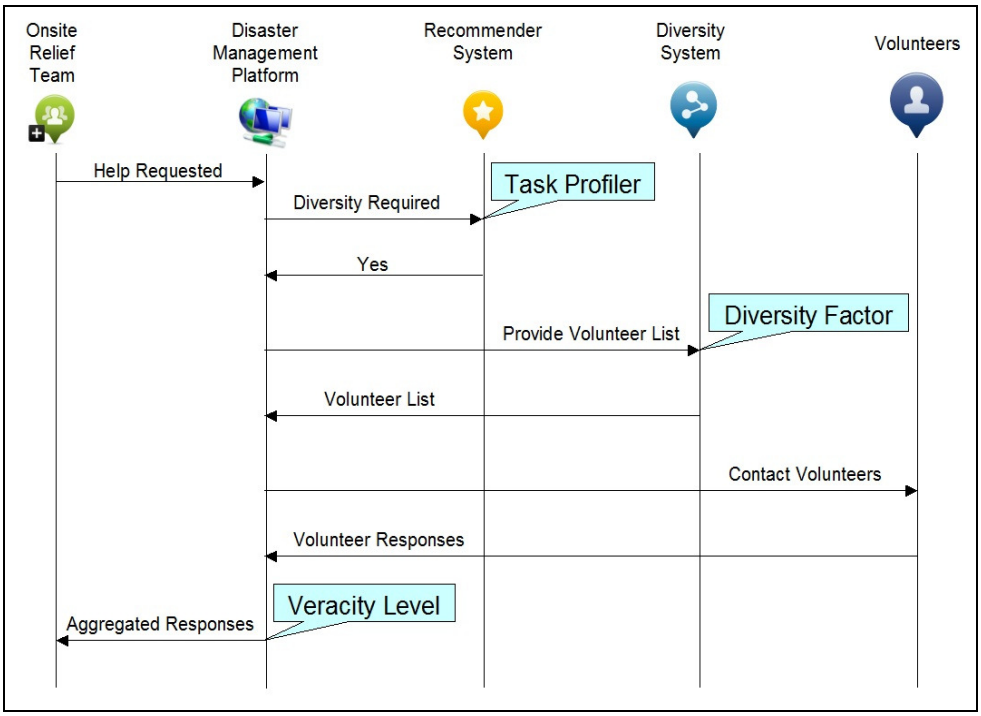

Figure 1: Message sequence chart showing the three design components

The chart starts with a help request from the relief team working in the disaster zone. This could be something like help with parsing through satellite images of the disaster zone before and after the disaster, and reporting back on the amount of damage that has been done. So these images are uploaded to the Disaster Management Platform with a "Help Requested" tag, and a brief description of the profile of the task that they need help with. In this particular example help is needed parsing the satellite images for damage.

Using the "Task Profiler" component the platform now needs to figure out whether this particular help request requires the attention of an expert group or a diverse group

and so sends the task profile to the Recommender System. The Recommender System parses through the task profile information and because this particular task does not require any particular skill advises back to the platform that a diverse group rather than an expert group is required to solve this task.

The platform now sends a request to the Diversity System to supply a diverse list of volunteers. So what does diverse mean here? The precise design of this component will be a next step but at a high-level the "Diversity Factor" algorithm will data mine the profiles of the complete list of volunteers (could be from their online social media profiles) and present back a subset list that is diverse. Diversity here could include:

- 50% of the list could be women
- The age profiles could be evenly spread
- Their ethnicity could be evenly spread
- The educational profile could be evenly spread

The platform will now send the task to this volunteer list and collate back their responses. Having aggregated the collated responses, which forms the "Veracity Level" of the task, the platform forwards the task solution back to the disaster team.

5 Conclusions

This paper has made some recommendations that could aid the design of a collective intelligence emergency responder tool (this could also be a plug-in to existing systems, such as the Ushahidi platform). Use cases now need to be defined that list typical problems encountered in disaster relief, and these use cases would be used as input to the system design requirements.

The implemented design could be tested in a simulated environment, by setting up an experiment with actual relief workers and asking them to send their simulated help requests into the platform.

The experiment would continue by engaging on a real user (the online community) evaluation that compared the results that used the '**diversity factor**' with those using the existing system (i.e. the manual verification process). Another important test will be to prove whether or not diversity is actually needed at all. This could be tested by setting up a controlled experiment that tests the use cases with the Recommender System turned 'off' and then repeating this again with it turned 'on'. The overall objective here is to conclude that the system provides accurate enough results for the onsite disaster experts to be able to trust the feedback given, and as such remove the labour intensive manual verification process, thereby freeing up the valuable resources of the relief teams in the disaster zones.

References

1. Ariely, D., (2008) "Predictably Irrational: The Hidden Forces that Shape Our Decisions", London, HarperCollins Publishers

2. Chesbrough, H.W., (2003) "Open Innovation: The New Imperative for Creating and Profiting from Technology", United States, Harvard Business Publishing Corporation

3. Crisis Commons (2012) 'Crisis Commons' [WWW]. Available from: http://wiki.crisiscommons.org/wiki/Main_Page [Accessed 08/08/2012]

4. Lucus-McEwen, V., (2011) 'If You Haven't Heard About Crisis Commons Yet…' Weblog [Online] 23rd October. Emergency Management. Available from: http://www.emergencymgmt.com/emergency-blogs/campus/Crisis-Commons-Monitors-Turkey-Earthquake-102311.html [Accessed 05/06/2012]

5. People Locator for the ChristChurch Earthquake (2011) 'Sahana deployment example' [WWW]. Available from: https://pl.nlm.nih.gov/christchurch/index.php?mod=inw&act=default [Accessed 25/10/2012]

6. Roddy, M., (2012) 'An Analysis of the use of Cognitive Surplus in Disaster Relief Scenarios' submitted to the Atlantic University Alliance as part of the Diploma programme in Innovation Management

7. Shirky, C., (2010) "Cognitive Surplus: Creativity and Generosity in a Connected Age", London, Penguin Books

8. Sahana Software Foundation (2012) 'Sahana Software Foundation Wiki' [Online]. Available from: http://wiki.sahanafoundation.org/doku.php [Accessed 14/02/2012]

9. Sternberg, S., (2011) "Japan crisis showcases social media's muscle" [WWW]. Available from: http://usatoday30.usatoday.com/tech/news/2011-04-11-japan-social-media_N.htm [Accessed 25/10/2012]

10. Suroweicki, J., (2004) "The Wisdom of Crowds: Why the Many Are Smarter Than the Few", London, Abacus

11. Ushahidi (2008-2012) 'The Ushahidi Platform' [WWW]. Available from: http://ushahidi.com/products/ushahidi-platform [Accessed 27/02/2012]

12. Wikipedia (2012) 'Bar Camp'. [Online]. Available from: http://en.wikipedia.org/wiki/BarCamp [Accessed 05/06/2012]

13. Wikipedia (2012) 'Who Wants To Be A Millionaire?' [WWW] Wikipedia. Available from: http://en.wikipedia.org/wiki/Who_Wants_to_Be_a_Millionaire%3F [Accessed 16/08/2012]