"Interaction with Citizens" Experiments: From Context-aware Alerting to Crowdtasking

Denis Havlik and Jasmin Pielorz
AIT Austrian Institute of Technology GmbH.
Denis.havlik@ait.ac.at,
Jasmin.pielorz@ait.ac.at

Adam Widera
Westfälische Wilhems-Universität Münster
adam.widera@wi.uni-muenster.de

ABSTRACT

The EU FP7 project DRIVER is conducting a number of experiments to assess the feasibility of addressing known deficiencies in crisis management. In this paper, we introduce experiments that investigate two-way communication solutions between crisis managers and citizens or unaffiliated volunteers.

In the so-called "Interaction with Citizens" experiments we are testing the usability and acceptance of the various methods and tools that facilitate crisis communication at several levels. This includes: informing and alerting of citizens; micro-tasking of volunteers; gathering of situational information about the crisis incident from volunteers; and usage of this information to improve situation awareness.

At the time of writing this paper, our "Interaction with Citizens" experiments are still under way. Therefore, this paper reports the lessons learned in the first two experiments along with the experimental setup and expectations for the final experiment.

Keywords

Crisis management, unaffiliated volunteers, decision support, crowdsourcing, micro-learning, crowdtasking, micro-tasking, personalized alerting

INTRODUCTION

The rise of social networking has allowed ad-hoc groups of citizens to organize large-scale activities in a flexible manner. From a crisis manager's point of view, the appearance of such loosely coordinated groups of unaffiliated volunteers is, both, a blessing and a curse, as they do not fit into the hierarchical procedures existing in crisis management and are difficult to control.

Unlike first responder organizations, such as firemen or medical first responders, these ad-hoc groups lack a command structure, mechanisms to distinguish information from misinformation, as well as procedures to prioritize and split tasks among themselves. The merit of unaffiliated volunteers has been demonstrated on various occasions (Reuter, Heger, & Pipek, 2012). Nevertheless, the absence of efficient coordination can render such groups inefficient. This happens in particular when (too) many volunteers are concentrating on few, evident tasks, while omitting to address equally important, but less visible needs. In the worst case scenario, the positive energy of the ad-hoc volunteers could even turn into the potentially very destructive energy of the smart mob (Rheingold, 2009) and even increase adverse effects of the crisis. Whether in order to profit from resources offered by unaffiliated volunteers, or simply in order to avoid the worst case scenario, crisis management professionals need to improve their ability of communication with citizens.

Many organizations already use social networks for crisis communications (Pan American Health Organisation, 2009). However, the type of information that is posted through social media is often not very different from what is posted through mass media. The one notable exception from this rule is provided by interactive web-

based crisis maps. Such maps allow citizens to easily obtain relevant information according to their geographic position, e.g. reports on crisis situations and needs in their neighborhood.

A more crucial problem is that the general-purpose social media does not facilitate many-to-one communication. This is a major shortcoming from the point of view of first responders. In crisis situations, these organizations can allocate only a small number of people for monitoring social media and communicating with their users. A related issue is the one of trust and validity of information. In social networks, real information and misinformation is posted alike so that distinguishing between the two is difficult. A recent discussion of the various ways to use the (information received from) volunteers, ranging from passive social media data mining, over use of dedicated crowdsourcing tools to crowdtasking of the volunteers as described in (Schimak, Havlik, & Pielorz, 2015).

The need for improved crisis communication is addressed by the European project "Driving Innovation in Crisis Management for European Resilience" (DRIVER, http://driver-project.eu/). DRIVER evaluates emerging crisis management solutions in three key areas: civil society resilience, responder coordination as well as training and learning. These solutions are evaluated in a series of experiments targeting various gaps in the European crisis management that were previously discovered by the "Aftermath Crisis Management System-of-systems Demonstration Phase 1" (ACRIMAS) project team (Vollmer, Hamrin, Pastuszka, Missoweit, & Stolk, 2012).

In this paper, we concentrate on experiments with methods and tools that improve two-way crisis communication with citizens and unaffiliated volunteers and address the following gaps: (1) informing and involving the society via improved crisis communication; (2) coordination and tasking of unaffiliated volunteers; (3) dissemination of disaster alerts and other relevant information to citizens ; and (4) collection of information relevant in crisis situations, such as e.g. needs and observations from citizens. The paper starts with the experimental setup and methodology of the planned experiment campaign. First results and lessons learned in initial experiments are reported in the next section, followed with the outlook on future work.

EXPERIMENT SETUP

The experimental setup for the DRIVER "Interaction with Citizens" experiment campaign concentrates on the following functions:

- provision of context-aware[1] and timely information tailored to specific needs of different societal groups over various channels, in order to improve their understanding of the crisis situation and to minimize the adverse impacts;
- context-aware (micro-)tasking of non-affiliated volunteers to perform real and virtual tasks;
- efficient gathering of situational information about an incident from volunteers; and
- Efficient usage of the received information from volunteers to improve the situation awareness of crisis managers and consequently their handling of the crisis.

The underlying hypothesis behind the experiment campaign is that modern ICT technology can be used to improve crisis communication between crisis managers and citizens. On the one hand, citizens can profit from context-aware communication and become more resilient. On the other hand, crisis managers can use the citizens as human sensors to improve their situation awareness or use their workforce. Additional hypotheses are: (1) this can be achieved without overwhelming crisis managers; and (2) that the tested methodologies and tools are complementary rather than overlapping.

In early 2015, a selected number of crisis management tools was presented and evaluated within the DRIVER community, by both tool providers and practitioners. Based on a structured evaluation regarding the availability, relevance and maturity of specific crisis management functions, like the gathering of situational awareness, appropriate tools were identified for the current experiments. The main tools utilized in the experiments include:

- **DEWS** (Esbri, Esteban, Hammitzsch, Lendholt, & Mutafungwa, 2010). The DEWS system has initially developed as Distant Early Warning System for tsunamis and provides mechanisms for extracting the information from multi-sensor systems. From this information specific alerts for various classes of users are generated based on the severity of the event, user profiles and geographical

[1] Context is defined by combination of the users profile, position, situation on ground and needs of the crisis managers.

locations. In our experiments, only the alerting part of the DEWS system is used to distribute alerts based on user profiles and their positions.

- **Safe Trip** (http://www.hkv.nl/en/products/apps/231-apps.html) is a mobile application that aims to give travelers and tourists within Europe information on their actual safety within the immediate vicinity of their current location. In DRIVER, Safe Trip will be used to inform the "tourists" on the current and expected situation in their vicinity. In addition, Safe Trip will also provide an easy to use way for tourists to inform the embassies of their respective locations, needs and conditions.
- **GDACSmobile** (Hellingrath et al. 2012; Link et al. 2015) is a tool that facilitates self-organization of the volunteers and improves the situation awareness of citizens by sharing an easy-to-understand overview of the situation. At the same time, GDACSmobile also provides a feedback mechanism to the crisis manager/control center. In this way, GDACSmobile also contributes to improved situation awareness of the crisis managers.
- Finally, the **AIT CrowdTasker** backend and mobile application (http://crowdtasker.ait.ac.at) realizes the crowdtasking concept that has been introduced in (Havlik, et al., 2013). CrowdTasker facilitates targeted one-to-many communication of the crisis management professionals with the "crowd" of pre-registered volunteers, micro-tasking of these unaffiliated volunteers and collection of structured responses. CrowdTasker can be used in several ways: as a micro-learning tool for the volunteers, as a microtasking tool for virtual and real-world tasks and as a tool for soliciting and collecting information from the citizens.

Each of the tools represents one of the increasingly more powerful methodologies for crisis communication with the population – from one-way emergency alerting to dedicated microtasking (Figure 1).

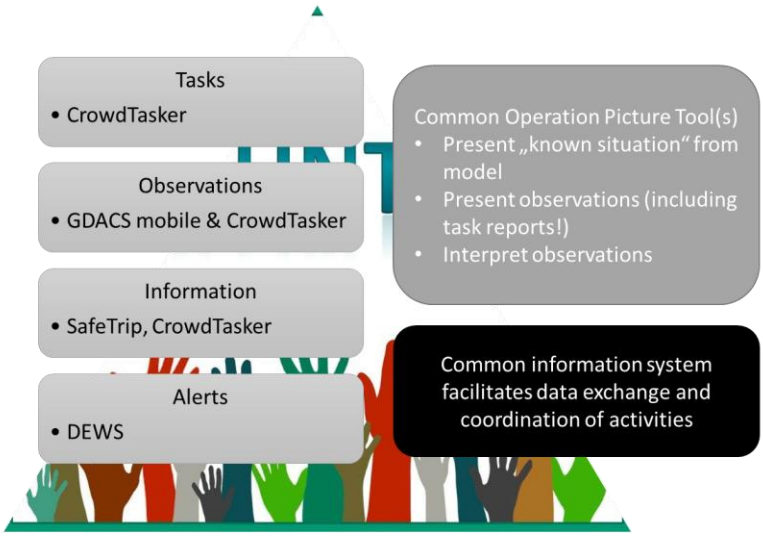

Figure 1: Overview of the tools and functions tested in "Interaction with" Citizens experiments

Moreover, they provide some functionality that is important for volunteers or crisis management professionals but seldom found in other tools.

- GDACSmobile features Twitter integration. That is, GDACSmobile messages are exchanged over Twitter and new messages can even be posted using a standard twitter client instead of the GDACSmobile app (Link, Hellingrath, & De Groeve, 2013).
- Both, GDACS and AIT CrowdTasker, provide mechanisms for improving the trust in volunteers and validating the information they provide.
- AIT Crowdtasker provides an easy to use mechanism for choosing the most appropriate volunteer(s) for a task at hand from a large group of unaffiliated volunteers.

In our experiments, these tools and methodologies will be tested both, as stand-alone solution and as a combined solution that addresses different needs of citizens and crisis managers. More precisely, the first two experiments

in Israel and Austria are dedicated to the testing the CrowdTasker[2] tool, whereas the final experiment in The Hague, Netherlands will feature testing all tools in a simulated coastal flooding scenario – first separately on a tool-by-tool and methodology-by-methodology basis and then as a combined solution. The scenario setup or the storyline of the experiment is designed by practitioners figuring as experiment platform providers. Hence, instead of a tool-provider friendly experiment setup, the objective of creating a relevant or "appropriate" scenario (Whitworth et al. 2006) is ensured through defining all relevant components by the practitioners' realities. Accordingly, the evaluation approach has to cover both mission related indicators (like the assessment results provided by unaffiliated volunteers) and tool related variables (like the utilization of available reporting forms). For this purpose a set of research questions, success indicators and evaluation methods was identified.

The overall goal of the experiments is to test the concepts and applications for context-aware informing and tasking of volunteers as well as to evaluate the value of these activities for, both, citizens and crisis managers. With this in mind, experiments are evaluated separately by the volunteers using the apps, by the professionals involved in experiments and by the dedicated observers according to the following matrix:

	Volunteers	Professionals	Observers
Methodology acceptance	Citizens' perspective: usability of information, performing tasks, posting reports.	Professionals perspective: informing, alerting, tasking, situation awareness	X
Impact on crisis management	Informing, Involvement and tasking of citizens	Situation awareness, information dissemination and crisis management	X
Tool Usability	Citizens perspective (mobile apps)	Professionals perspective (backend applications)	X
Tool reliability	Mobile apps	Backend applications	X
Experiment setup	-	-	X

FIRST RESULTS AND LESSONS LEARNED

At the time of writing this paper, the first two of the three planned experiments have been conducted. These two experiments involved only the CrowdTasker tool, whereas the next experiment will involve all tools. The experiment setup for the first two experiments is illustrated in Figure 2.

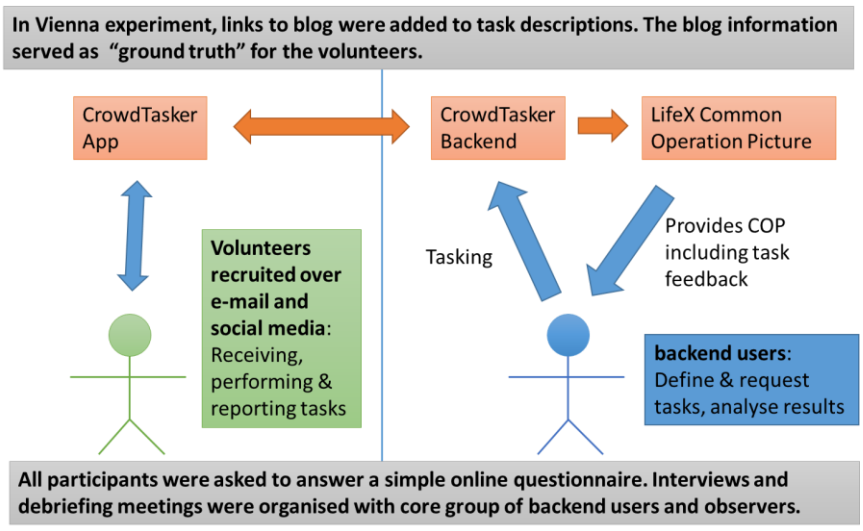

Figure 2: Experiment setup for first two experiments. In the first experiment no background story was used.

The first experiment was organized as a side-event on the IPRED IV conference in Tel Aviv (January 10-13 2016) and hosted by Magen David Adom in Israel. The experiment consisted of two parts: two days of

[2] Crowdtasker is both the most complex and the least mature of the tools.

"registration and learning how to use the app" followed by simulation of the application use in a crisis situation during the final IPRED IV exercise. We are presenting the lessons learned at this experiment as overview of "good", "bad" and "ugly" experiences:

- The "good" part is the high level of acceptance of the crowdtasking method as such. Both the volunteers and the MDA experts in charge of the tasking were fully convinced that the possibility to easily choose a dedicated subgroup of volunteers from a larger pool, instruct them, assign tasks and receive feedbacks in a structured way is important and beneficial in a crisis. Likewise, the experiment participants had a positive impression on automated "tutorial" functionality for new users of the app and the MDA experts considered the tasking interface adequate and easy to use.
- The "bad" part of the lessons learned is that the crowd manager does not have enough time to formulate the information and tasks during the exercise. This issue is already addressed by the possibility to pre-generate the "task templates", but the number and variety of templates we prepared this time was too low. Likewise, the visualization and analysis of the results received from the volunteers has to be improved on order to allow the crisis managers to understand the situation at a glance.
- Finally, we had to endure two "ugly" moments. First, the majority of the conference participants were from US. As Crowdtasker is only available for Android, prevalence of iPhone owners on the conference has limited the number of volunteers among the conference participants. Second, some of the app functionality, most notably event popups, has failed at some of the Android phone models.

At the end of the day, we have managed to involve only 15 volunteers but nevertheless received very valuable feedback and suggestions for improving the usability and reliability of the mobile app. Even more importantly, the feedback forms for collecting the information from app and backend users were proven adequate and will be used in the future experiments with slight improvements.

Second experiment was organized a month later in Vienna Austria. This time, we organized a stand-alone event and the volunteers were solicited by the Austrian Red Cross among their existing pool of volunteers. As a result, more than 200 volunteers from all of Austria and even some volunteers from Germany joined the experiment. Most of the technical issues that were encountered at IPRED were resolved and we were able to successfully assign tasks to different groups of volunteers based on their positions and skills and received hundredths of responses within minutes of posting the tasks. This success has exposed a next major shortcoming of the CrowdTasking tool. Since arbitrary task response forms can be defined by the operators, the received information cannot be interpreted by the Common Operation Picture (COP) tools. The result is shown on figure 3a. While a way to quickly analyze the results of the single task has already been implemented (Figure 3b), the map view is not informative enough and the operators do not have time to analyze the task results task-by-task during the crisis.

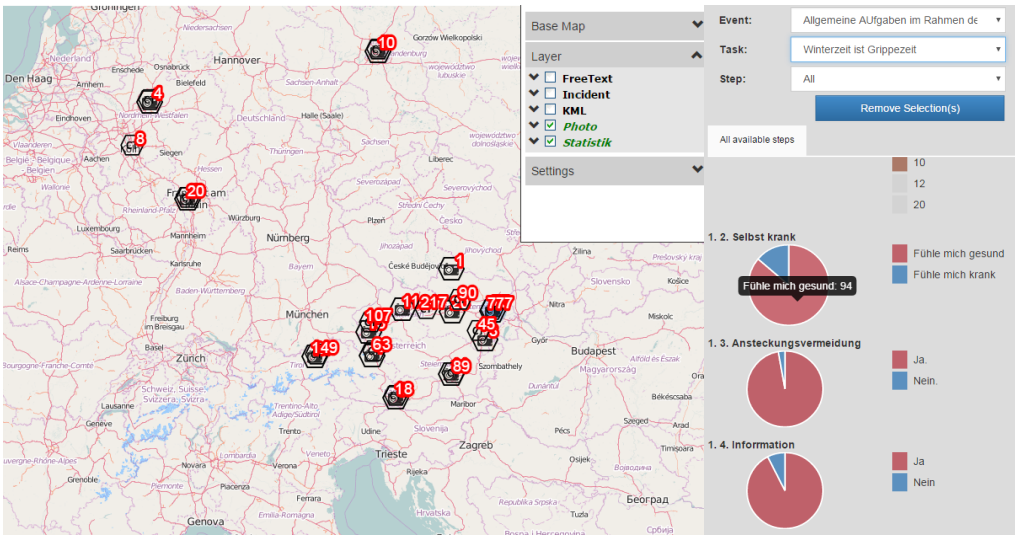

Figure 3: (a) map showing the information received from volunteers; (b) analysis of responses for a single task

The proposed solution to this issue is to allow CrowdTasker operators' to associate semantic information (e.g.

"good", "bad", "urgent", etc.) to selected options in task response forms. This in turn would allow COP tools to automatically choose icons and color-codes for specific task responses and produce far more informative maps. For example, an "I urgently need help" response in a single choice or multiple choice step of a task response form could be marked as "urgent" and visualized accordingly on the map. In this way, the first responders would be immediately able to spot the map areas where help is urgently needed.

OUTLOOK AND CONCLUSION

Results of the first DRIVER "Interaction with Citizens" experiments are encouraging in terms of the acceptance of the crowdtasking methodology and usability of the experiment assessment methodology. Nevertheless, the first two experiments have also clearly demonstrated technological and organizational shortcomings that need to be addressed. Most notably, they have demonstrated a need for robust alerting mechanism and improved presentation of the responses on the map.

In the final experiment scenario, the professional crisis managers will have a task of resolving the simulated flooding crisis in the city of The Hague. During the experiment, they will use a combination of professional tools and resources as well as the additional means of communication with the volunteers by using the Safe Trip, GDACSmobile or Crowdtasker mobile applications. Since DEWS does not provide any dedicated user interface for volunteers, this application will be used to distribute alerts to various types of volunteers and professional crisis managers.

Moreover, the volunteers will be given a slightly different version of the situation than the one that is initially known to crisis managers. In this way, the volunteers' feedback will generate a conflict with the official information and the professional first responders will have to take this feedback into account in order to correctly manage the crisis.

The planned experiment in The Hague will allow us to test the acceptance of four concepts for context aware informing and alerting of citizens: over standard communication channels such as e-mail or SMS (DEWS), using a special-purpose application for tourists that does not require high level of user involvement (Safe Trip), with a help of a shared awareness map (GDACSmobile) and using a platform that facilitates profile- and position- specific pushing of information and contextual micro learning materials (CrowdTasker).

Likewise, it will allow us to test the usability and acceptance of both solicited and unsolicited informing of crisis managers by citizens (Crowdtasker/ GDACSmobile) as well as to confront the crisis management professionals with the possibility to optimally deploy unaffiliated volunteers for various tasks.

To the best of our knowledge, no similar tests have been performed to-date and it is difficult to anticipate which of the functions offered by the various systems will be considered most usable by professional and volunteers. Our initial assumption is that the simpler tools will be easier to accept than the more complex ones, but that the added complexity of GDACSmobile and Crowdtasker will be offset by higher value of the tools for both volunteers and first responders. Most notably, we expect that professional crisis managers will value the information validation capabilities of GDACSmobile and AIT Crowdtasker and the possibility to easily target specific subgroups of volunteers that is most suitable for a task at hand from a potentially large and heterogeneous group.

Finally, we expect that the DRIVER experiments will result in ready-to-use methodology for testing of other "smart" tools for crisis communication with the citizens and facilitate faster acceptance of the unaffiliated volunteers among crisis management professionals.

ACKNOWLEDGMENTS

The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007- 2013) under grant agreement n° 607798. Moreover, the experiments introduced in this paper would not have been possible without active support of the three organizations hosting the experiments: The Magen David Adom in Israel (https://www.mdais.org/en/), the Austrian Red Cross (http://www.redcross.at) and the Security Region Haaglanden (http://www.vrh.nl/). Finally, we thank the DRIVER "Interaction with Citizens" experiment team that has been working together for several months in order to prepare, conduct and finally assess these three experiments.

REFERENCES

1. Esbri, M. A., Esteban, J. F., Hammitzsch, M., Lendholt, M. and Mutafungwa, E. (2010) DEWS: Distant Early Warning System-Innovative system for the early warning of tsunamis and other hazards, Jornadas Ibéricas de Infraestructuras de Datos Espaciales (JIIDE), Lisbon, Portugal.
2. Havlik, D., Egly, M., Huber, H., Kutschera, P., Falgenhauer, M., and Cizek, M. (2013) Robust and trusted crowd-sourcing and crowd-tasking in the Future Internet, Environmental Software Systems. Fostering Information Sharing, Springer, Berlin Heidelberg, pp. 164-175.
3. Hellingrath, B.; Link, D.; Widera, A.; Bubbich, C.; Chasin, F.; Kronimus, S.; Laube, S.; Petersen, H.; Saalmann, P.; Vanauer, M. (2012) Functional specification GDACSmobile. Documentation of the Project Seminar Global Disaster Alert and Coordination System (GDACS) mobile.
4. Link, D., Hellingrath, B. and De Groeve, T. (2013) Twitter Integration and Content Moderation in GDACSmobile, Proceedings of the 10th International ISCRAM Conference, Baden, Germany, pp. 67-71.
5. Link, D., Widera, A., Hellingrath, B., de Groeve, T., Eidimtaite, G. & Kumar, L. M. (2015). GDACSmobile - An IT Tool Supporting Assessments for Humanitarian Logistics, The International Emergency Management Society (TIEMS) 2015 Annual Conference, Rom, Italy.
6. Pan American Health Organisation (2009) Information management and communication in emergencies and disasters: manual for disaster response teams, Washington, D.C.
7. Reuter, C., Heger, O. and Pipek, V. (2012) Social Media for Supporting Emergent Groups in Crisis Management, International Reports on Socio-Informatics (IRSI), Proceedings of the CSCW 2012 Workshop on Collaboration and Crisis Informatics, Bonn, Germany, 9, 2, pp. 84-92.
8. Rheingold, H. (2009) Smart mobs: the next social revolution, Mass: Perseus Publ., Cambridge.
9. Schimak, G., Havlik, D. and Pielorz, J. (2015) Crowdsourcing in Crisis and Disaster Management – Challenges and Considerations. In: R. Denzer, R. M. Argent, G. Schimak, and J. Hřebíček (eds.), Environmental Software Systems. Infrastructures, Services and Applications, Springer International Publishing, pp. 56-70.
10. Vollmer, M., Hamrin, M., Pastuszka, H.-M., Missoweit, M., and Stolk, D. (2012) Improving Aftermath Crisis Management in the European Union, Bonn, Germany.
11. Whitworth, I. R., Smith, S. J., Hone, G. N., & McLeod, I. (2006). How do we know that a scenario is‘appropriate’. 11th International Command and Control Technology Symposium, Cambridge, UK.