18TH INTERNATIONAL COMMAND AND CONTROL RESEARCH AND TECHNOLOGY SYMPOSIUM
C2 IN UNDERDEVELOPED, DEGRADED AND DENIED OPERATIONAL ENVIRONMENTS

CROWDSOURCED DECISION SUPPORT FOR EMERGENCY RESPONDERS

Suggested Tracks:
Topic 5: Experimentation, Metrics and Analysis
Topic 4: Collaboration, Shared Awareness and Decision Making

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Abstract

Real-time citizen interaction has the potential to transform society's response to crisis situations. New systems and processes must be developed to support citizen involvement and first responders must be trained in their use. The Citizens' Emergency Response Portal System (CERPS) Simulation Experiment (CERPS SIMEX) evaluated examined the role of public interaction through social media during emergency situations. The SIMEX was conducted over five days in October 2012 at the Net-Centric C4ISR Experimentation Lab (NCEL) housed at The MITRE Corporation's McLean, Va., headquarters and on the George Mason University (GMU) campus in Fairfax, Va. No actual emergency activities occurred on the campus; the SIMEX was conducted behind a firewall to avoid unintentional public panic. The SIMEX brought together emergency response personnel from federal, state, county and city jurisdictions in the National Capital Region of Washington, D.C. Emergency operators used real command and control systems with simulated reporting and sensor systems. Citizen participants were volunteers recruited from the GMU student body. The primary purpose of the SIMEX was to examine the hypothesis that citizen participation via social media in crisis response decision-making can improve the outcome of a crisis. This SIMEX was intended to establish a baseline for future research on crisis response decision support employing citizen participation.

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1. Introduction

Crowdsourcing promises to be a game-changing technology for crisis response. A recent survey by the American Red Cross found that, after television and local radio, the Internet is the third most common source of emergency information for the public in crisis situations (ARC, 2010). A recent United Nations Foundation report states, "Powered by cloud-, crowd-, and SMS-based technologies, individuals can now engage in disaster response at an unprecedented level… This trend toward communications driven by and centered on people is challenging and changing the nature of humanitarian aid in emergencies," (OCHA, 2011). The report describes how Haitian citizens used social media and mobile technologies to call for help during the 2010 earthquake, and how volunteers collated and analyzed the data to generate maps depicting regions in urgent need of relief. Social media figured prominently in the Government response to Hurricane Irene in August 2011 (Greenberg, 2011). Nanfuka (2012) and Bharania (2012) describes numerous grassroots efforts exploiting the Internet and social media to assist victims of Hurricane Sandy. These and other examples demonstrate the power of social media and communications technology to focus and target crisis response efforts.

To achieve the full benefit of citizen involvement, new systems and processes are needed to exploit the power of modern information and communications technology. Grassroots efforts are powerful and important, but if they are not properly coordinated, overloaded responders and mis-allocation of resources can result. Research is needed to design, implement, evaluate and refine systems and processes that effectively integrate grassroots citizen participation within Federal, State and Local crisis response. With any new technology come problems and pitfalls – some already identified (e.g., Lorenz et al., 2011) and others yet to be discovered. Experimentation is needed to discover points of failure, build in safeguards, and capitalize on what works. Training is needed for responders to integrate crowdsourcing technology into crisis response plans.

As an early step in this direction, MITRE Corporation and George Mason University (GMU), in coordination with government sponsors, conducted the Citizens Emergency Response Portal System (CERPS) Simulation Experiment (SIMEX). The CERPS SIMEX was conducted over five days in October 2012 at the Net-Centric C4ISR Experimentation Lab (NCEL) housed at The MITRE Corporation's McLean, Va., headquarters and on the George Mason University (GMU) campus in Fairfax, Va. No actual emergency activities occurred on the campus; the SIMEX was conducted behind a firewall to avoid unintentional public panic. The primary purpose of the experiment was to examine the hypothesis that citizen participation in crisis response decision-making can improve the outcome of a crisis.

The MITRE Net-Centric C4ISR Experimentation Lab (NCEL) has sponsored 41 SIMEXs over the past ten years. Each SIMEX uses real command and control systems, simulated reporting and sensor systems, and actual military and civilian operators executing various crisis action scenarios. The SIMEXs address interoperability among systems and support concept of operations development, tactics development, and insertion of new technologies. This SIMEX was unique in its involvement of ordinary citizens as an integral part of the operation. The citizen participants were volunteers from the GMU student body who monitored and participated in the decision making process through crowd-sourcing technology. The SIMEX established a baseline for future research to examine the causal factors leading to successful crisis response outcomes. The experience gained during the SIMEX will support the design of future tools and processes to incorporate crowdsourcing technology into crisis response.

2. Citizens Emergency Response Portal Simulation Experiment

The Citizens Emergency Response Portal System Simulation Experiment (CERPS SIMEX) examined command and control processes, technologies, decision-making theory, and socio-cultural issues associated with employing CERPS in a military/civilian contingency operation. The purpose of the SIMEX was to investigate the impact of CERPS on the execution of that operation. The SIMEX employed a "dirty bomb" scenario set in the National Capital Region (NCR). The simulated detonation occurred on the campus of George Mason University (GMU). The scenario's notional military and civilian emergency managers collaborated in response to the event. Military and civilian emergency management staff employed their respective command and control systems in conjunction with CERPS to collaborate and make response decisions from their respective operations centers, which were emulated at NCEL. NCEL participants included representatives from the Department of Defense, Law Enforcement, and State, County and campus emergency response organizations. First responder reporting systems and events on the GMU campus were simulated via the Emergency and Disaster Management Simulation. Volunteers from the GMU student body played the role of citizens.

The origins for the CERPS SIMEX come from Presidential Policy Directive (PPD) 8 and the National Strategic Narrative. PPD-8 states "Our national preparedness is the shared responsibility of all levels of government, the private and nonprofit sectors, and individual citizens. Everyone can contribute to safeguarding the Nation from harm" (Obama, 2012). The National Strategic Narrative reiterates this view saying, "…[the Nation] requires a strong and unshakable economy, a more diverse and deployable Inter Agency, and perhaps most importantly a well-informed and supportive citizenry" (Porter and Mykleby, 2011). Thus, there is a solid basis in national policy to examine the role and impact of citizen participation during a crisis.

2.1. Hypothesis

The hypothesis investigated by the SIMEX was:

> *The real-time interaction of the American citizenry in the planning and execution of a military/civilian contingency operation would improve its result. A viable method of including American citizens in the decision making process would be through the employment of a version of crowdsourcing technology.*

2.2. The Citizens Emergency Response Portal System

CERPS is a prototype set of social media and social media analysis tools developed to provide crowdsourcing technology for use during this experiment. When combined with a virtual Emergency Operations Center (EOC), CERPS was provided a conduit for interaction between the public and emergency managers. The goal of the CERPS experiment was to understand the impact of this interaction on the public and on emergency operations.

The CERPS has six components:

1. CERP, a variant of the Ushahidi crowdsourcing platform that provides distributed situational awareness between citizens and the operations center (see Figure 1 for a screen-shot);
2. The Simulated Sensory Environment (SSE), a simulation of GMU in the virtual world of the scenario (see Figure 2 for a screenshot;
3. Chirp, an emulation of the twitter output from citizens and operations center;
4. The Social Radar Analytical Toolset (SRAT) that analyzes and interprets citizen input from CERP and Chirp;

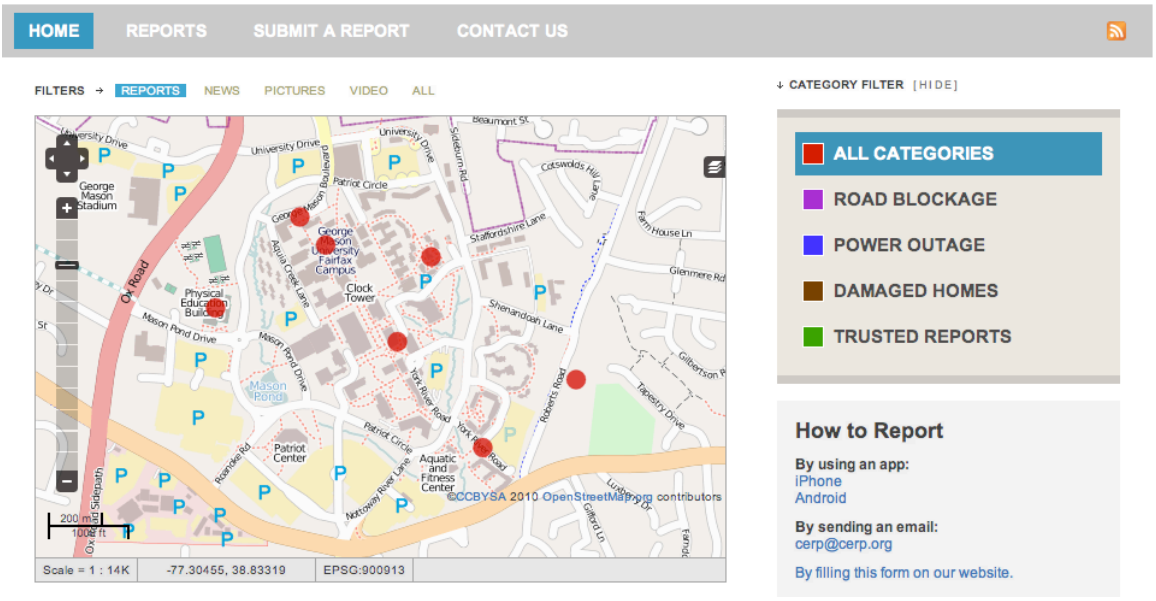

Figure 1: Screenshot of CERP (from Ludwig, et al, 2012)

5. The Virtual Citizen Operational Presence (VCOP) that is the analytical output of SRAT; and
6. The evolving Crisis Response Decision Space (CRDS) that dynamically portrays decisions and options being considered by the operations center.

Citizen participants logged into CERPS via laptops from locations on or near campus to comment on their perceptions of the unfolding crisis and the planned response decisions depicted in CRDS. The experiment evaluated ease of use, how well CERPS facilitates and encourages citizen participation, and how clearly and simply the crisis operation center's decision process was depicted to the citizenry during the crisis.

2.3. Objectives

The objectives of the CERPS SIMEX are listed below. The primary and general objectives were of interest to all participants. Additional focused objectives related to more specific concerns of one or more groups of participants.

- *Primary objective*. Examine the impact of CERPS and citizen involvement on tactical / operational decision-making and execution.
- *General objectives*. (*a*) Observe state/local participation/response and the interaction with federal response; (*b*) Evaluate the use of federal level resources for the radiological disaster; (*c*) enhance awareness for a Radiological Dispersal Device (RDD) scenario; and (*d*) Avoid public panic by controlling the public message.
- *Social media objectives*. (*a*) Observe integration and sharing of crowd-sourced social media information with local and regional first responders, decision makers and leadership; (*b*) Determine how to layer the use of crowdsourcing on top of current operations; (*c*) Observe how operators fuse social media indicators; and (*d*) Assess the utility of social media information (CERP, Chirp, CRDS, polls, and VCOP) for local/regional emergency operations and the military staff assessment process.

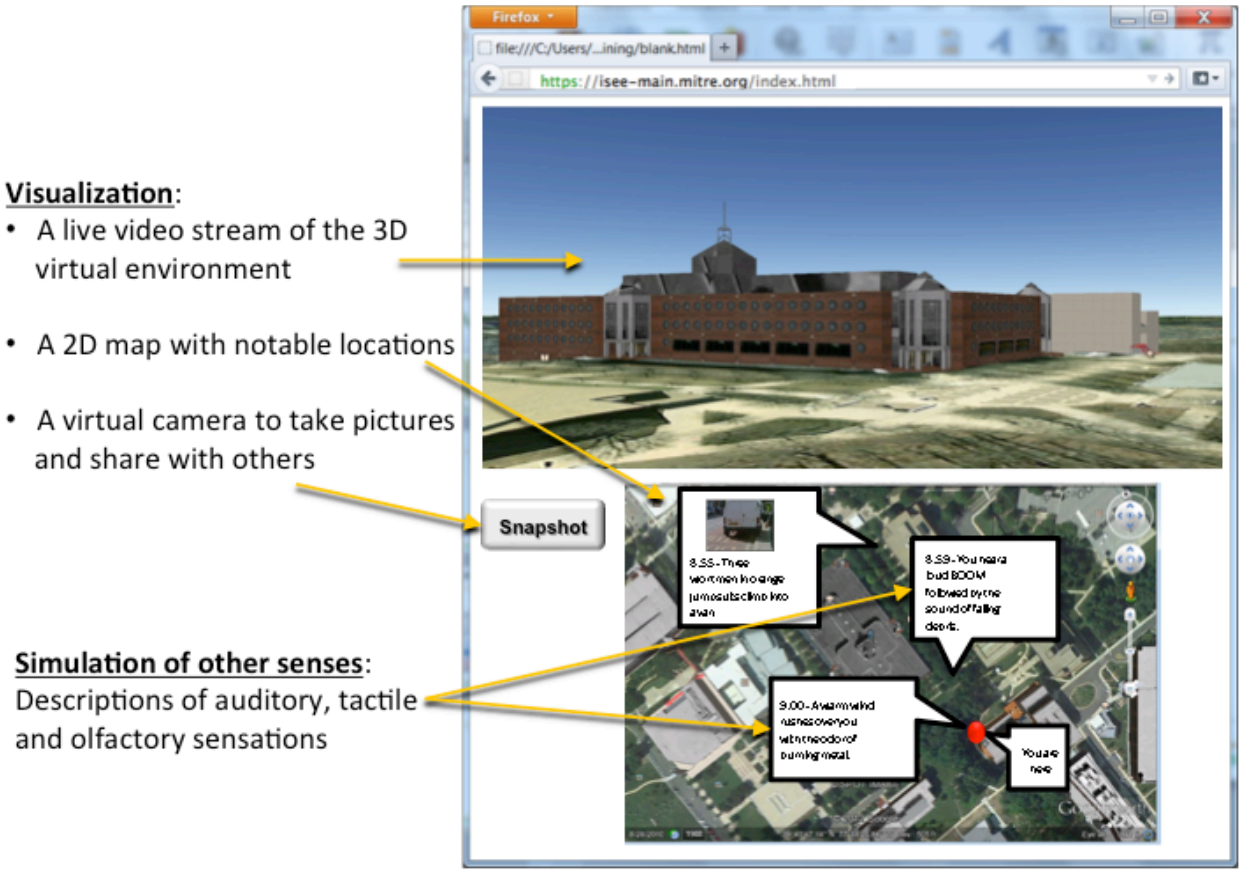

Figure 2: Simulated Sensory Environment (from Ludwig, et al, 2012)

- *Federal agency objectives*. (*a*) Assess NCEL experimentation methodology for use in National Emergency Management-driven exercises; (*b*) Support a simulation cell in the EOC for interagency use during SIMEX; (*c*) Examine the value of human simulation in exercise to represent general public for use in National Emergency Management-driven exercises; and (*d*) Examine the logistics (e.g., distributed data input locations) of mass human simulation in National Emergency Management-driven exercises.
- *Law Enforcement Objectives*. (*a*) Determine the type of information received from citizen input and how it relates to investigation; and (*b*) Observe public reaction to law enforcement engagement in scenario and determine how to utilize this reaction.
- *George Mason University Objectives*. (*a*) Empower students to be engaged in the experiment and become active SIMEX participants; (*b*) Protect the privacy and safety of students; and (*c*) Obtain student feedback on value of CERPS from their perspective.

2.4. Command Structure

The command structure for the SIMEX was based on the National Incident Management System (NIMS) (DHS, 2008) and the Incident Command Structure, shown in Figure 3. The Incident Commander (IC) was in charge of managing the on-scene response from a virtual Incident Command Post (ICP). The EOC Manager held overall authority for the event and was responsible for multi-agency coordination (McKernan, 2011).

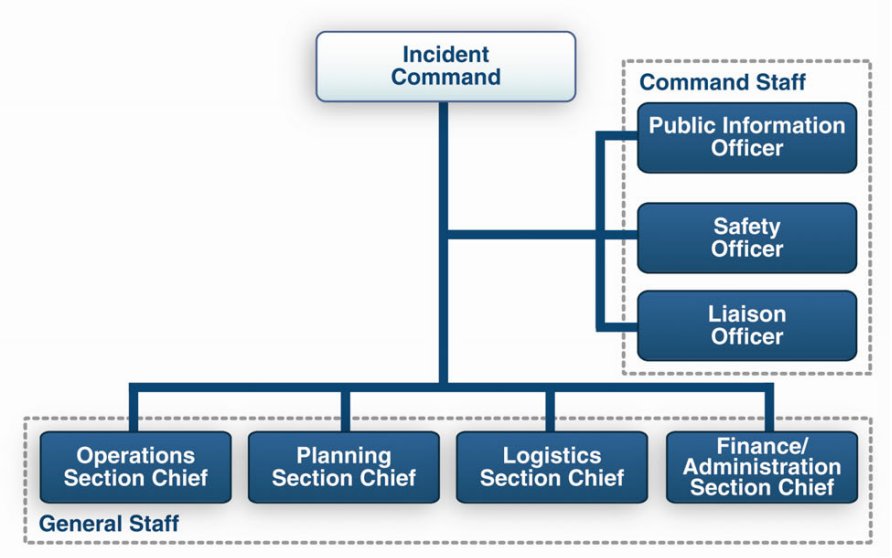

Figure 3. Incident Command Structure (from Ludwig, et al, 2012)

Typically, each participating organization operates from its own EOC. For this SIMEX, a notional unified EOC was established allowing all the organizations to be present in a single facility. This increased the interaction between participants and may have reduced the response times for questions or requests. Figure 4 shows the layout of the virtual EOC established for this experiment.

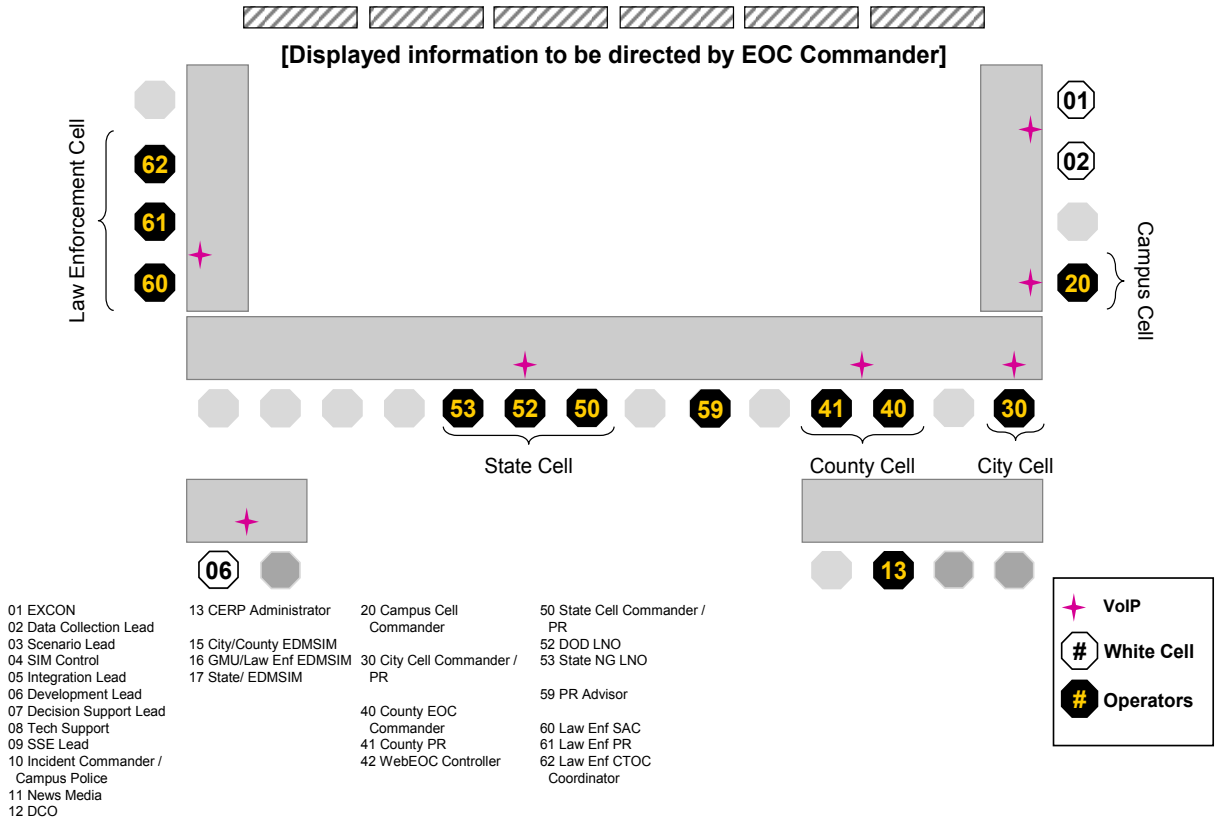

Figure 4. EOC Layout (from Ludwig, et al, 2012)

2.5. Concept of Operations

The subset of emergency response and recovery operations of particular interest to this SIMEX involves those activities that occur within the EOC, in the instance of a RDD incident. The specific procedures involving the response to a RDD event can be found in FBI/CDC (2011).

In addition to their usual duties, the public relations participants were the primary users of CERPS in the various command centers represented at this SIMEX. These participants utilized CERPS in two main cases: situation awareness and decision support. After the start of the experiment, the public relations emergency managers at the local, state and federal levels monitored their systems and lines of communication for any reports. Reports from the public were collected, aggregated, and analyzed through the Virtual Citizens Operational Presence (VCOP), which public relations staff reviewed and incorporated into their common operating picture of the incident. Public relations then formed a report on their situation awareness and shared it with the citizens via the Citizens Emergency Response Portal (CERP) or Chirp, a stand-in for Twitter.

During SIMEX execution, public relations staff worked with the emergency managers to determine possible courses of action and assessed the desirability of some of the courses of action through the Crisis Response Decision System (CRDS). Some potential courses of action necessitated engaging the public on options such as the deployment of fire trucks. In some cases, the options under consideration were released as Chirp messages and/or Polls to get specific feedback on the course of action under consideration. This was done to obtain input to narrow down the possible decisions.

Figure 5 depicts the interactions between CERPS and the public performed by the EOC staff.

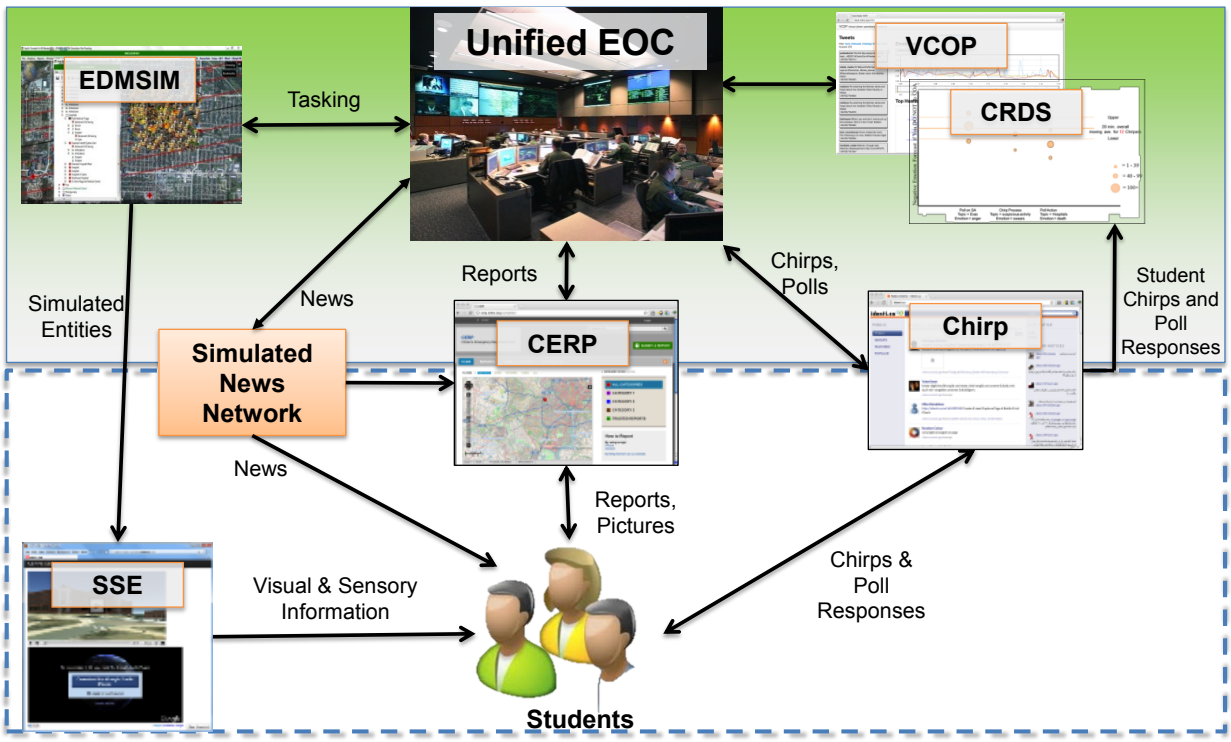

Figure 5. EOC Operational View (from Ludwig, et al, 2012)

2.6. Simulated Public

One-hundred forty-eight GMU students were recruited to participate in the experiment. Their role was to represent the general public as bystanders to simulated events taking place on campus. To understand the events going on around them, the students used the Simulated Sensory Environment (SSE), a virtual environment that depicted the events taking place around them. Students then had several ways to share and get information about events. One source of information was the Simulated News Network (SNN), which contained video and text-based information. Another method was the Citizens Emergency Response Portal (CERP). There, students could create or read reports about ongoing events and see their locations on a map. Finally, students could interact via Chirp, a Twitter-like microblogging service, which had the additional capability of allowing polls to be created. On Chirp, they could read what other users (students and emergency managers) were saying, ask questions, and receive messages directly from the operators. Interactions between the EOC and the simulated public are depicted in Figure 5.

3. Scenario

The focus of the experiment scenario was the response to a radiological dispersal device (RDD) explosion on the GMU campus. Additional events, such as medical emergencies, demonstrations, or secondary explosions were added to stimulate reactions from the emergency managers and the public.

3.1. Initial Conditions

At the start of the event, there was a Boy Scout Jamboree taking place within the county. This was included because it qualifies as a National Special Security Event (NSSE), which was necessary to explain why the EOC was already operational with state and federal resources nearby and available on short notice.

Additionally, two events were scheduled to take place on the GMU campus: a large concert at the Patriot Center, and a speech by a fictional controversial author named Simon Pierce taking place at the Johnson Center. Due to the controversy surrounding the author's planned speech, protesters were expected to gather in front of the Johnson Center.

Separately, the websites of the County and GMU were hacked by a fictional terrorist group called the Anti-Pierce Group. They defaced the websites and posted threatening messages warning of violence should Pierce be allowed to give his speech.

3.2. Emergency Events

The timing, location, and severity of the events were varied between runs to minimize effects from learning the scenario. The typical sequence of events began with a protest in front of the Johnson center that grew and became violent. Sometime later a vehicle based RDD would detonate on campus causing initial blast casualties, later followed by casualties from radiation exposure. During this period of time, the Incident Commander and the EOC would manage the emergency response and make plans for the shelter or evacuation of the campus, plus arrange for decontamination as needed. Once the emergency response was in full operation, additional events such as backpack bombs or gunmen on campus would take place to force the EOC to change its plans for handling the emergency.

In parallel with this, the EOC would be monitoring and interacting with the public over social media. In addition to the physical events, false or misleading information was injected into social media by

obvious adversaries or individuals attempting to impersonate official communications from authorities.

3.3. Control Run

One scenario variant was unintentionally introduced on the morning of the fifth day of the experiment. Due to the actual presence of the President of the United States on the GMU Campus that morning, the United States Secret Service had requested that the students refrain from sending messages about a simulated emergency on campus in order to avoid confusion with any real emergencies that might occur. This led to the introduction of a 'control' run (or base case) where the emergency managers would respond to the simulated emergency in the scenario without the benefit of using social media for situation awareness and decision support, which is how they currently respond. The use of social media returned in an afternoon run, with the same scenario events repeated.

4. Execution

Planning for the CERPS SIMEX began in April 2012. Execution of the CERPS SIMEX took place from 1-5 October 2012. The CERPS SIMEX execution took place between 0900 and 1600 daily. A daily briefing was held each morning and a daily hot wash each afternoon. A single scenario was executed each day with a one-hour pause for lunch. The scenario for the final day ended 30 minutes early at 1530 to allow for a longer discussion with the participants at the conclusion of the event.

5. Results

Results of the CERPS SIMEX are presented with respect to the objectives presented in Section 2.3.

5.1. Results for Primary Objective

MOE 1: Impacts from citizen involvement. Citizen involvement affected both the emergency managers and the public. For the decision makers, citizen involvement provided additional first-hand situation awareness, such as the locations of fires or pictures of suspicious packages. Reading Chirps and CERP reports helped emergency managers to decide when and how to provide information to the public. Polling helped emergency managers understand the needs of the public such as the need for more information about shelter locations.

Figure 6 shows the responses from the operators to the question of how citizen interaction impacted their role. The majority of participants indicated that citizen interaction had a positive or very positive impact on their performance.

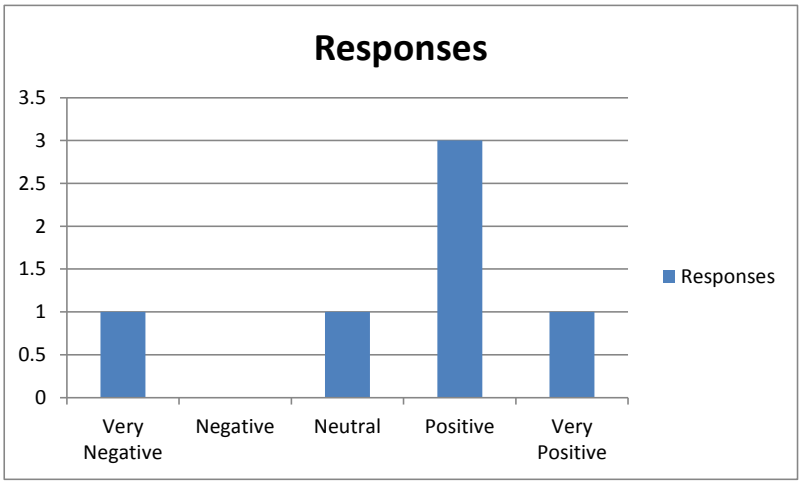

Figure 6. Impact of Social Media and Citizen Participation (from Ludwig, et al, 2012)

For the public, interaction with emergency managers kept them better informed about the ongoing emergency. It also helped them to feel that their needs were being taken into consideration by the emergency managers, and helped them to feel more involved in their own circumstances and less

like victims. Figure 7 shows the responses from the students to questions about the utility of messages from the EOC and whether they felt they were making a contribution. The majority of students answered that they strongly agree or agree to both questions.

MOE 2: Usage of CERPS components. Eye tracking equipment and analysis were used to collect information on the usage of each CERPS component. Results indicate that Chirp was the most frequently used tool, both in terms of number and duration of views. Chirp received many long and short duration views. Short duration views tended to indicate that the operator was checking for new posts, often after spending some time on another app or away from the computer. Longer view times are indicative of two behaviors: posting a message or conducting an in-depth review of all posts to see if any citizen posts required a response.

MOE 3: CERPS improvement to decisions. Observations and feedback from the emergency managers indicated that information coming from the public, such as pictures of events, helped emergency managers to make better decisions about their response to certain events. Likewise, results from polling indicated in some cases that information of greatest interest to the students differed from what was initially assumed by emergency managers.

Finding. Based on the usage levels of the social media tools and the emergency managers' assessments of the impact of citizen interaction, the primary objective is determined to have been achieved.

5.2. Results for General Objectives

General objective (*a*), to observe interactions between state, local and federal responders, was achieved. General objective (*b*), to evaluate the use of federal level resources for the radiological disaster, was partially achieved. The scenario used during this experiment was not well suited for triggering a federal-level incident response, due to the limited duration of each scenario. Some federal resources were used, and the mechanisms for requesting other federal resources were discussed. General objective (*c*), to enhance awareness for a RDD scenario, was achieved. The RDD scenario prompted the participants to review their RDD response procedures and to familiarize themselves with the resources available from the participating agencies. The consensus of a post-experiment discussion among the EOC participants was that their awareness for handling RDD scenarios had been enhanced. General objective (*d*), to avoid the "Orson Welles Effect" by controlling the public message, was achieved. Numerous steps were taken in the design of the experiment to ensure that the experiment did not cause panic among the general public. Technical measures included requiring the use of a virtual private network to control access to the CERPS applications, and the use of Chirp instead of Twitter to reduce the chances of Tweets being sent outside of the experimental channel. Non-technical measures included

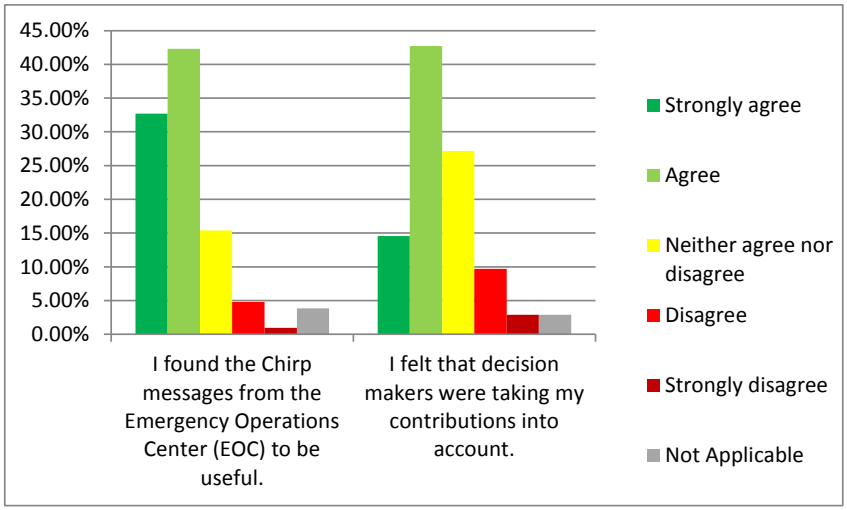

Figure 7. Impact to Public from Interaction (from Ludwig, et al, 2012)

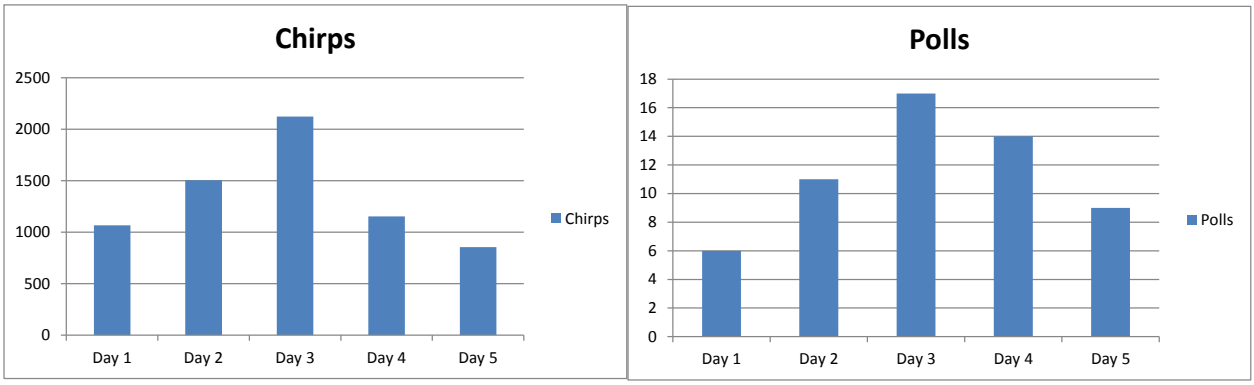

Figure 8. Chirp and Poll Usage (from Ludwig, et al, 2012)

explaining the experiment in advance to news media and inviting them to observe the experiment. Local jurisdictions and the Secret Service were informed of the experiment and scenario. Public Information Officers (PIO) from the participating organizations monitored traditional and social media during the execution of the experiment to detect and respond to any unintended mentions of the experiment or scenario.

5.3. Results for Social Media Objectives

Social media objective (*a*), to observe integration and sharing of social media information among first responders, decision-makers and leadership, was achieved. Figure 8 shows the number of Chirps and Polls each day. The totals for Day 4 are lower due to a technical outage during one run. The totals for Day 5 are lower due to having only a single run with social media on that day. While there was a learning curve associated with use of the new tools, most operators were using CERP and Chirp after the first day and VCOP and CRDS by the third day. Trust in the citizen information was a concern, but operators learned to trust some citizens and identify some deceptive accounts. The main use of social media occurred after the main response activities for the emergency managers were completed. Messaging was most intense around times when an emergency management decision, such as identifying the locations for shelters or evacuation routes, had just been made.

Social media objective (*b*), to determine how to layer crowdsourcing on top of current operations, was partially achieved. No activities became unnecessary as a result of using social media. Social media provided beneficial information, but also caused additional workload for the emergency managers, particularly those in PIO roles. Time had to be devoted to monitoring social media, verifying messages, tracking threads, and crafting messages to provide or solicit information. This was especially the case for 911-like messages that required immediate attention.

Social media objective (*c*), observe how operators fuse social media indicators, was achieved. The social media tools were used quite effectively. Emergency managers used Chirp, VCOP, and Tweet Explorer to understand Chirps about their organization. They looked for multiple messages on the same topic to gain confidence, and encouraged the use of specific hashtags to make finding these correlating messages easier. Using hashtags to gain traction was a challenge, and there were often multiple similar hashtags for a single subject. Messages with pictures or from trusted Chirpers were also used. Emergency managers frequently correlated CERP and Chirp messages with those from the Simulated News Network (SNN). On occasion, they would interact directly with SNN to learn more, or to provide official information. Many emergency managers used social media indicators (emotion, sentiment, influence) and investigated when they saw anomalies. However, the scale of the

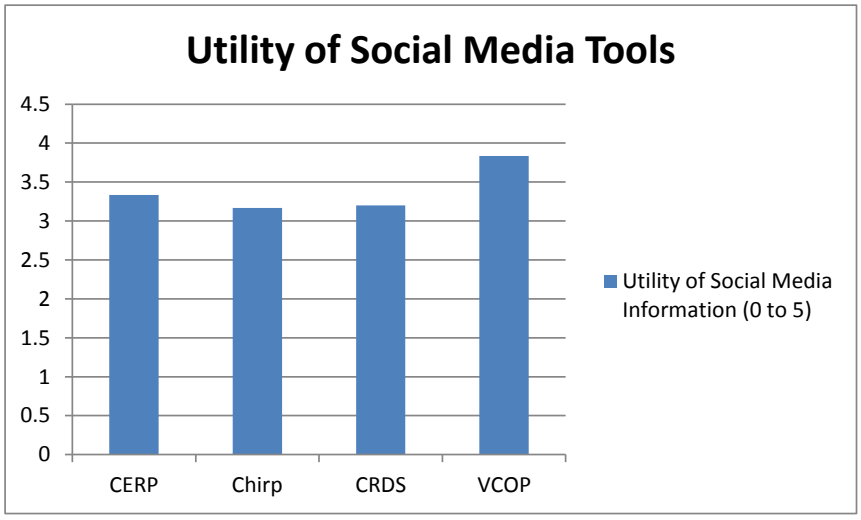

Figure9. Self-Assessed Utility of Social Media Tools (from Ludwig, et al, 2012)

experiment was such that the operators could read nearly every Chirp directed to them. This would not be the case in an emergency scenario involving thousands to millions of citizens.

Social media objective (*d*), assess the utility of social media information (Chirp and polls) for local/regional emergency operations and the military staff assessment process, was achieved. As shown in Figure 9, emergency managers' self-assessed utility of the social media tools was fairly high. Assessments from data collectors also shows high utility and comfort levels, as shown in Figure 10. Results also show that the majority of operators had some trust in the information coming from social media. This indicates their level of confidence in their ability to differentiate between legitimate and deceptive social media messaging.

5.4 Results for Federal Agency Objectives

Federal Agency objective (*a*), assessing NCEL experimentation methodology, was achieved through documenting the SIMEX process and inviting Federal Agencies to send observers to the SIMEX. Federal Agency objective (*b*), supporting a simulation cell in the EOC, was not achieved because the RDD plume simulation was used only in advance but not during the execution phase of the experiment. Federal Agency objective (*c*), examining the value of human simulation to represent the general public, was achieved. The demographics of the GMU student participants were broadly comparable to the general public, with the exception that the students tended to be younger than the

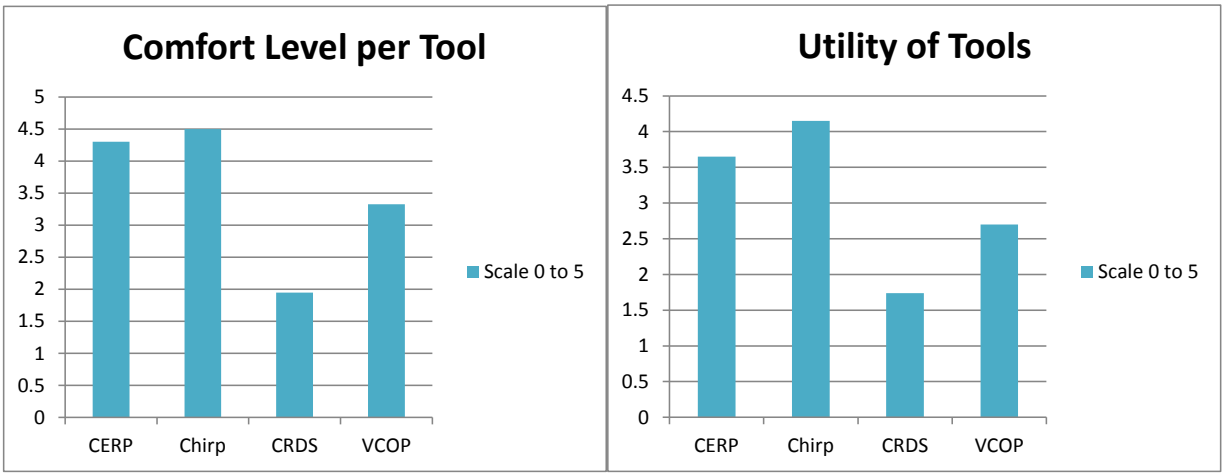

Figure 10. Comfort and Utility of Social Media Tools as Assessed by Data Collectors (from Ludwig, et al, 2012)

general public. EOC responders indicated that their interactions with the students felt authentic and provided a valuable dimension to the experiment. All emergency managers rated the student responses between neutral and very realistic. Federal Agency objective (*d*), examining the logistics of mass human simulation in National Emergency Management exercises, was achieved. This aspect of the experiment required consideration in the design of the technical architecture and additional effort for the technical team, due to the need to develop a synthetic environment for student use and a virtual private network infrastructure isolated from the open Internet. Interaction was limited to laptops. Support for mobile devices would increase realism and improve student access, but required too much additional effort to be implemented for this SIMEX.

5.5 Results for Law Enforcement Agency Objectives

Objective (*a*), to determine the type of information received from citizen input and how it relates to investigation, was achieved. Information provided by the students through Chirp and CERP were mainly categorized as reports of suspicious activity. This included suspicious persons, packages, and events. The information was mainly text-based, but sometimes also included images of the suspicious item. These inputs were used as additional information to guide law enforcement investigations, and sometimes resulted in agents reaching out to individual students to follow up in more detail. The information received from citizen input was typically treated by the law enforcement agency in the same way that anonymous tips would be treated.

Objective (*b*), *to* observe public reaction to law enforcement engagement in scenario and determine how to utilize this reaction, was achieved. Reaction to law enforcement involvement was determined based on reviews of student Chirp postings. Typically, the student reaction to law enforcement involvement was positive, especially when law enforcement personnel or vehicles were observed responding to emergency situations on campus or participating in the investigations after explosions. However, there were a few instances of negative reactions to law enforcement involvement that occurred when the students mistook armed law enforcement agents for terrorists. These cases of mistaken identity took place at times of intense scenario activity. Some of the mistaken identity cases may have been the result of poor viewing angles or limited graphical resolution obscuring the law enforcement markings on the simulated agents' uniforms.

5.5 Results for George Mason University Objectives

Objective (*a*), to empower students to be engaged in the experiment and become active SIMEX participants, was achieved. Levels of student participation were high during the experiment. Daily student participation averaged over 80 students. Total Chirps for the week totaled approximately 6700. Hundreds of Chirps were either "Liked", re-Chirped, or replied to in each run.

Objective (*b*), to protect the privacy and safety of students, was achieved. MITRE and GMU took numerous steps to protect the privacy and safety of students. Foremost among these was submitting the CERPS experiment to the GMU Institutional Review Board (IRB) process for approval. In addition, students participated in the experiment using Chirp user names rather than their actual names. Only the GMU experiment lead had access to the mapping between student names and user names. To protect the safety of the students, all events were simulated and took place in a virtual environment, removing any possibility of physical harm. Additionally, during the sign-up and training sessions, the students were informed of the types of simulated events they would be viewing and reacting to on their computers and given the opportunity to withdraw from the experiment. Student surveys indicated that over 95% of the student participants felt their privacy and safety were adequately protected.

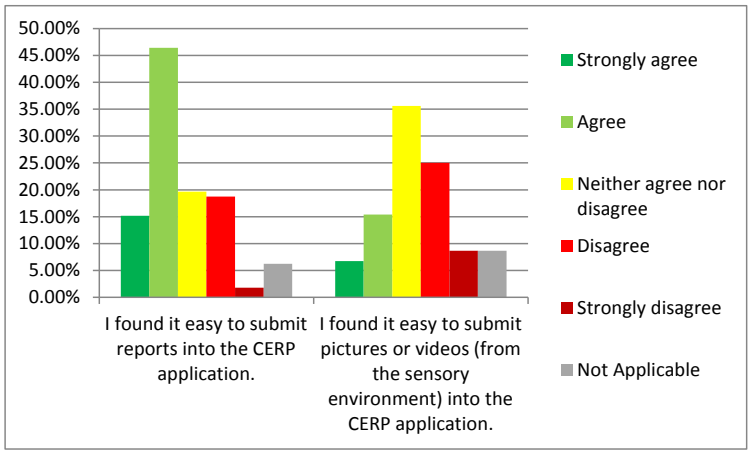

Figure 11. Student Ratings of Ease of Use of CERPS (from Ludwig, et al, 2012)

Objective (c), to obtain student feedback on value of CERPS from their perspective, was achieved. Figure 11 shows the students' assessment of ease of use of CERPS. Generally, students found CERPS to be easy to use, however they found uploading pictures or videos to CERPS to be more difficult. In comments, students indicated their desire to have a smartphone access to CERPS in addition to the laptop access that was provided. Figure 12 shows student responses to the question dealing with usefulness of CERPS. The majority of students felt that CERPS kept them informed about the simulated emergency. Additionally, the majority also found the interactions with the emergency managers to be informative and felt that their contributions and opinions were being taken into consideration by the emergency managers. Figure 13 shows student ratings of the quality of the simulated environment. The students found the scenarios and virtual environment to be adequate for the purposes of the experiment. However, a significant number of the students found the quality of the imagery and graphics they viewed to be insufficiently realistic.

5.6. Policy Findings

For the purposes of the experiment, it was assumed that future policy would permit and enable the types of public interaction being explored. Discussions with emergency managers during the planning and execution of the CERPS SIMEX revealed that there are numerous policy challenges that will need to be resolved for such a capability to become operational. Part of the reason for this is that existing policies were developed prior to the advent of social media technology and have not been updated with it in mind. Some of the main policy concerns are outlined below.

Expectations. Emergency managers expressed concerns over the expectations that would be set if they began responding to Chirps, especially ones seeking emergency assistance. The concern was that

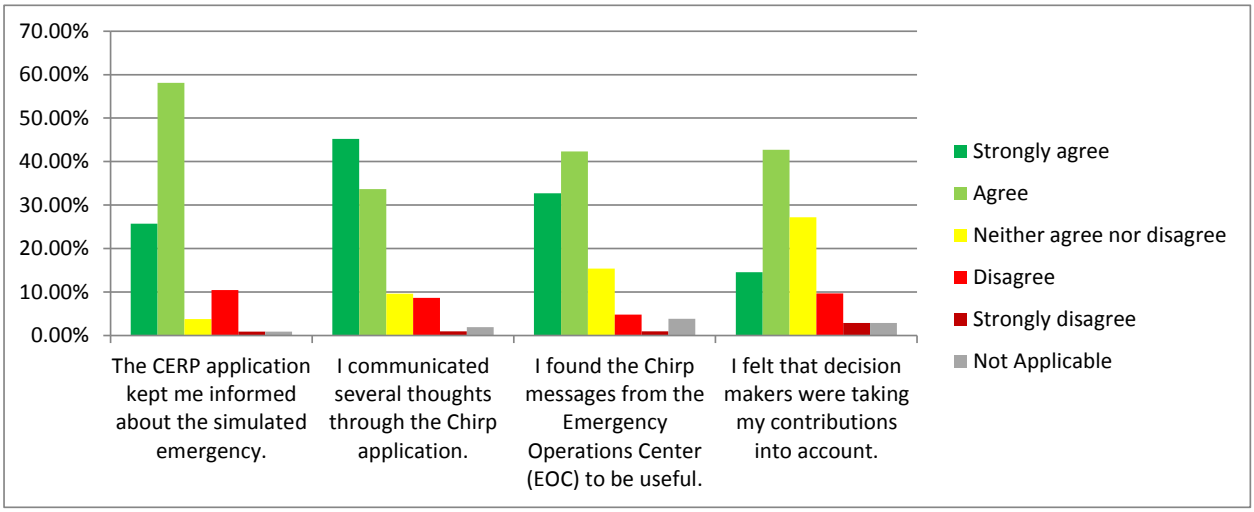

Figure 12. Student Ratings of Usefulness of CERPS (from Ludwig, et al, 2012)

once they started to do that, the public would then assume that they would always monitor and respond to calls for help made through social media. Feedback from students substantiated this concern as several of them pointed out their expectation that once emergency managers began using social media that they would then always be available through social media. In spite of these concerns, it was mentioned that social media monitoring may have a role to play in any future 911 system.

Liability. Emergency managers expressed concerns about liability issues arising from their interaction with the public. The biggest concern surrounds giving advice, instruction, or asking assistance of a member of the public that ultimately results in their injury. This concern may result in controls or limits on which personnel are allowed to interact with the public, including rules or procedures for these interactions. Clarifying this issue would make helping the public easier.

Privacy. Emergency managers also expressed concerns about privacy issues resulting from their interactions with the public. Guidance will be needed on how they can handle things such as personal information and location. Subscribing to or following members of the public on social media may also raise privacy concerns. While it is important to develop appropriate policies, the policies dealing with privacy matters will likely be different for those engaged in emergency response versus those engaged in law enforcement and investigative activities.

5.7. Other Feedback

During and after the execution of the CERPS SIMEX, EOC operators and students provided numerous additional insights about the subject matter. Some key observations are given below.

- Emergency management agencies should have arrangements with counterparts outside their local area who are able to take over social media duties in the event of an outage at the local EOC
- Bad actors can monitor social media and attempt to take advantage through the use of deceptive accounts or false reporting
- Emergency managers and PIOs of the agencies involved in an emergency should coordinate pre-planned messages and responses to provide a consistent message to the public and to help combat the spread of rumors

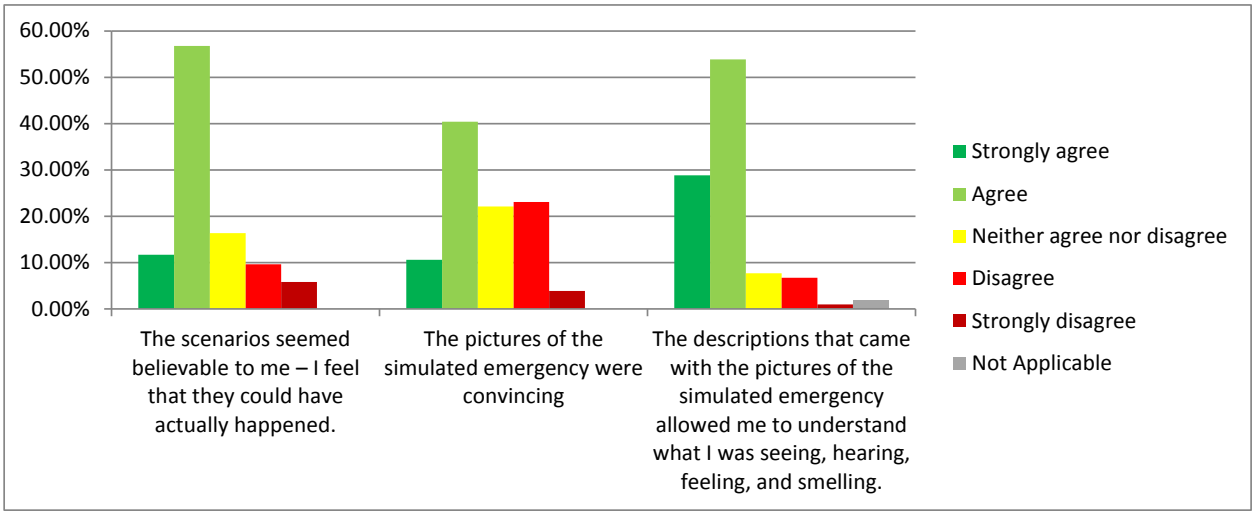

Figure 13. Quality of the Virtual Environment

- Creating hashtags and getting them to gain traction during an emergency can be challenging. PIOs should consider establishing and publicizing hashtags in advance, if possible.
- Current staffing levels or responsibilities may need to be adjusted to accommodate the interactive use of social media
- Future EOC staffs may need to include experts in social sciences to assist PIOs in understanding information from social media analysis tools and to craft the best messages.

6. Conclusions and Recommendations

The CERPS SIMEX demonstrated that citizen interaction with emergency managers can provide positive impacts. This included providing additional 911-type information about incidents, and providing information about the needs of the public. Sentiment analysis of social media traffic helped emergency managers understand the mood of the public and allowed them managers to adjust their communications strategies to better respond to the needs of the public.

The CERPS SIMEX also highlighted some of the challenges that engaging in public interaction through social media will bring. This includes the vetting of information for accuracy, the possible influence of bad actors, and the potential for emergency managers to be distracted by vocal social media users to the detriment of the overall emergency response.

Based on the execution, results, and feedback of the CERPS SIMEX, the following recommendations are made for consideration in any future CERPS experiments.

1. *Increase the number and diversity of people making up the simulated public.* A greater number of participants would result in even higher levels of social media traffic, providing a greater challenge for emergency managers and social media analysis tools. A greater diversity of people includes a wider range of ages, but also educational backgrounds and personal experience.
2. *Include CERT members in the simulated public.* Using trained CERT members may help with the challenge of populating crowd-sourced disaster maps such as CERP. Because CERT members are known and have training, they may be able to act as trusted agents, populating CERP with information that may not require further verification before being acted upon by emergency managers.
3. *Include a Facebook-like application as part of the social media toolset.* Experience from emergency managers during Hurricane Sandy suggests that Facebook may be a more heavily used application than Twitter in disaster situations.
4. *Add the ability to move around the virtual environment.* Giving the simulated public even a limited ability to move freely would help them become more immersed in the scenario. It would also enable them to comply or not comply with instructions from emergency personnel. This dynamism would result in a more realistic experience for both the public and the emergency managers.
5. *Include a representation of a 911-call center.* Many of the Chirps contained messages that would be analogous to 911 calls. Including a representation of a future 911 call center would enable the exploration of concepts for handling these types of messages. Additionally, traditional 911 calls about incidents will continue and not be replaced by social media. Having a better representation of simulated 911 calls would enhance realism.

6. *Consider a large regional disaster for future scenarios*. A large, regional natural disaster such as a hurricane or blizzard would allow emergency managers to work through the entire preparedness, response, and recovery process. This would allow the impacts of citizen interaction to be examined for each phase.
7. *Improve integration between WebEOC and CERP*. For emergency managers, using CERP typically meant manually copying information from WebEOC (a web-enabled state/local crisis-information management system providing secure real-time information sharing) and pasting it into CERP. This redundancy reduced the usage of CERP, and thus the amount of information coming from the EOC to the public. Integration of data between WebEOC and CERP would reduce the workload for emergency managers and potentially get more information out to the public.
8. *Include social media tools in use in EOCs or developed by industry*. PIOs are using some social media tools such as TweetGrid and Twitterfall today. Including tools currently in use by PIOs would enhance operational realism. In addition, any future tools under development on behalf of the government for use in EOC environments should be considered for inclusion.
9. *Consider modifying the length of the SIMEX*. Federal, State and Local operators suggested that a week-long experiment could be too demanding on emergency managers' schedules. Options discussed included reducing the length of the experiment or establishing a rotation of operators while maintaining the current SIMEX length.

In summary, the CERPS SIMEX provided a valuable demonstration of the value of citizen interaction during a crisis, highlighted policy issues that must be addressed as social media become integrated into crisis response command and control, and identified areas for further work to enable effective use of crowdsourcing for emergency response.

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