

Crowdsourced Decision Support for Emergency Responders

Kathryn Laskey

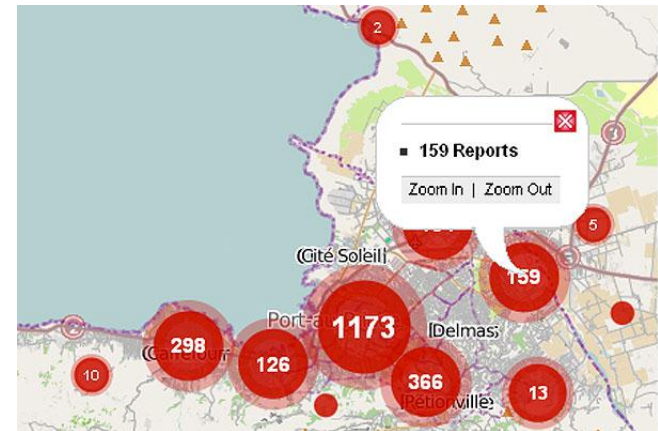
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with National Security Experimentation Laboratory, MITRE Corporation

Research supported by DoD and NSF

Crowdsourcing and Emergency Response

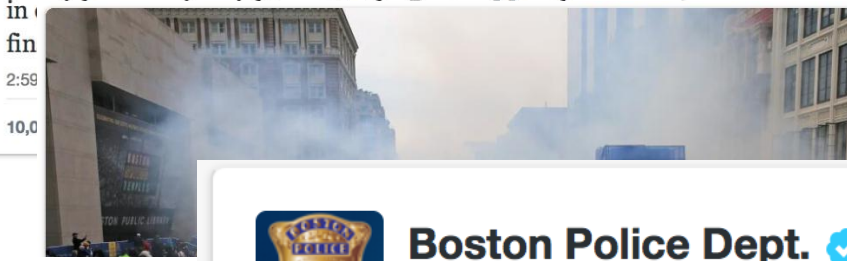
- Real-time citizen interaction is transforming crisis response
 - ▶ Haitian citizens collaborated with volunteers worldwide to map damage during 2010 earthquake
 - ▶ Social media figured prominently in government response to Hurricane Irene
 - ▶ “Social media follow Hurricane Sandy's destructive path” – USA Today
 - ▶ In Boston Marathon bombing, Boston PD used Twitter to monitor public reaction, engage public, correct rumors, assist in identifying/locating suspects
- Social media (e.g., Facebook, Twitter) provide natural avenue for citizen engagement with law enforcement / emergency management during a crisis



Boston Marathon

The Boston Globe
@BostonGlobe

BREAKING NEWS: Two powerful explosions detonated



The Boston Globe
@BostonGlobe

rt @mviser W
administration
necessary in t
3:52 PM - 15 Apr 20

98 RETWEETS 8 FAVO

@Boston
#breakingn

3:24 PM - 15 Ap

1,170 RETWEETS 77 FAVORITES

Follow



Boston Police Dept.
@bostonpolice

Follow

Boston Police looking for video of the finish line
#tweetfromthebeat via @CherylFiandaca



Boston Police Dept.
@bostonpolice

Follow

Suspect in custody. Officers sweeping the area. Stand by



Boston Police Dept.
@bostonpolice

Follow

CAPTURED!!! The hunt is over. The search is done. The terror is over. And justice has won. Suspect in custody.

8:58 PM - 19 Apr 2013

135,457 RETWEETS 45,944 FAVORITES

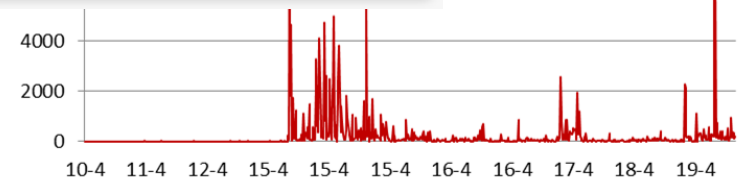
← ↻ ★

3,859 RETWEETS 81 FAVORITES

← ↻ ★

1,170 RETWEETS 77 FAVORITES

← ↻ ★



By @NewsReputation, MRI Universidad de Navarra

“The Boston Marathon bombings are certainly a tale of terror, but also a tale about the power and perils of social media.” – cbsnews.com

C2 and Citizen Engagement

- Nationwide Suspicious Activity Reporting (SAR) Initiative (NSI)
 - ▶ Oneway portal for posting and compiling anonymous reports of suspicious activity
 - ▶ Does not support the kind of real-time interaction that occurred in the Boston Marathon event
- Social media can support real-time collaboration
- Need to adapt command and control systems and processes to exploit technologies for communicating directly with citizens
 - ▶ Design and evaluate new systems and processes
 - ▶ Achieve benefits while mitigating problems
 - ▶ Train operators in new systems and processes

Policy Directives

- Presidential Policy Directive-8 (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..**”
- National Strategic Narrative calls for diverse and deployable Inter Agency, and a **well-informed and supportive citizenry.** *
- National Capital Region Homeland Security Strategic Plan calls for sharing information needed to make informed and timely decisions; take appropriate actions; and **communicate accurate, timely information with the public.**
- Department of Defense Quadrennial Defense Review, dated February 2010, identified **defending the homeland and support to civil authorities as one of 6 key missions** in which the Department must further rebalance policy, doctrine and capabilities

Hypothesis

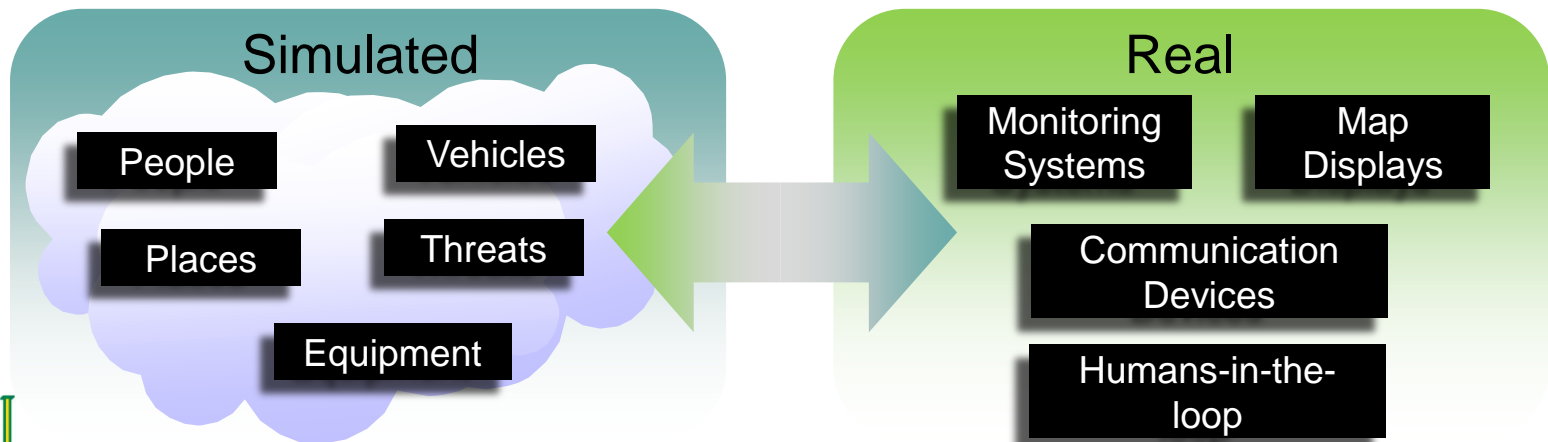


- Real-time interaction of citizens in planning and execution of a military/civilian contingency operation would improve its result
- Crowdsourcing technology is a viable method of including American citizens in the decision-making process
- Testing the hypothesis:
 - ▶ Implement prototype system to employ crowdsourcing for citizen participation
 - ▶ Simulate crisis in which civilian/military emergency managers use system to interact with a cross-section of the American public

SIMEX



- MITRE National Security Experimentation Laboratory (NSEL)
 - ▶ Conducts simulation 3-5 simulation experiments (SIMEXs) per year to examine C4ISR processes in support of ground, maritime, space and air operations
 - ▶ Use real operators, real C4ISR systems, simulated scenario and reports
 - ▶ 42 SIMEXs conducted since 2002
- SIMEXs support multiple sponsors to examine:
 - ▶ Tactics, techniques and procedures (TTPs)
 - ▶ Concept of operations (CONOPS)
 - ▶ Interoperability requirements



Testing the Hypothesis: A SIMEX examining Citizen Participation in Crisis Response

- Primary Goal: Examine impact of citizen involvement on tactical/operational decision-making and implementation.
- Objectives:
 - ▶ Refine and evolve CONOPS and TTPs for citizen participation in tactical/operational planning and implementation
 - ▶ Refine and evolve prototype DSS
 - ▶ Examine impact of DSS on tactical/operational decision-making & execution.
- Scenario: Defense Support of Civil Authorities
 - ▶ Radiological Dispersal Device detonates on George Mason University campus.
 - ▶ Notional NCR military/civilian emergency managers collaborate from Emergency Operations Center (emulated at the NSEL at MITRE McLean)
 - ▶ Student volunteers from George Mason University use DSS to collaborate in response decision making.



Citizens' Emergency Response Portal System (CERPS) Public Interaction

Simulated Sensory Environment (SSE)



Unfolding experiment events (view)

Reported events (view and post)



Citizens (GMU students)

News

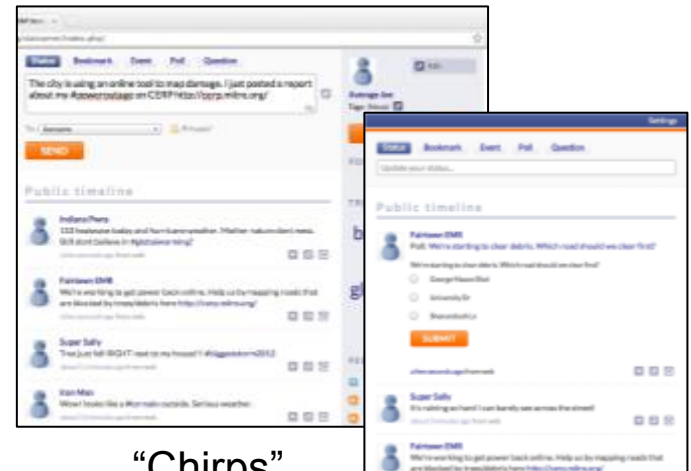
Discussion of events (view and post)

Simulated News Network

Citizens' Emergency Response Portal (CERP)



Chirp [open-source Twitter clone]

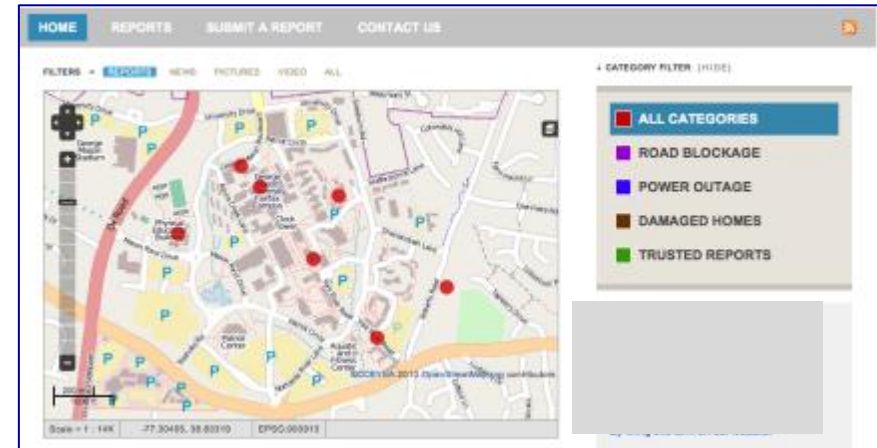


"Chirps"

Polling

Citizens' Emergency Response Portal (CERP)

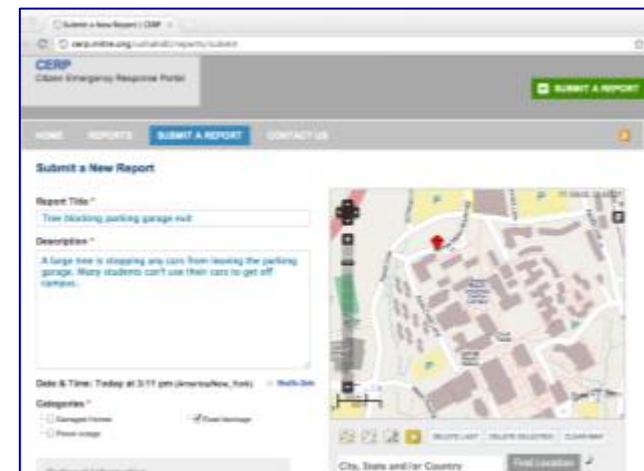
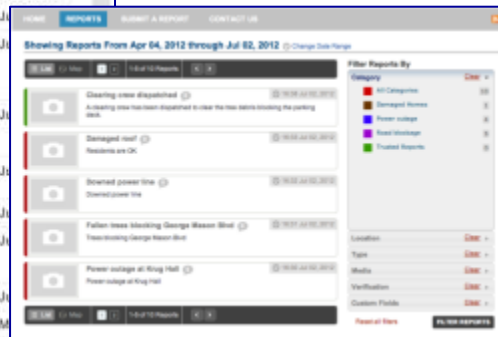
- Based upon Ushahidi platform
- Geographic display of incident reports and a means to review submitted reports
- Operators can post directly to CERP to provide official information
- Operators view reports posted by citizens



Reports (from the map, listed in chronological order)

TITLE	LOCATION	DATE
Clearing crew dispatched	Parking Deck	Jul 2 2012
Damaged roof	Roberts Road	
Downed power line	York River Road and Presidents Park Drive	
Fallen trees blocking George Mason Blvd	George Mason Blvd and School St.	
Power outage at Krug Hall	GMU Campus Krug Hall	
Power outage at dormitory	Dorm 1	
Power outage at the Phys Ed Building	GMU Physical Education Building	
Mason Inn lost power	Mason Inn	
Ushahidi has arrived	MITRE-1	
Hello Ushahidi!	Nairobi	Apr 4 2012

[View More](#)



SSE: Participants' View of Scenario

Visualization:

- A live video stream of the 3D virtual environment
- A 2D map with notable locations
- A virtual camera to take pictures and share with others



Simulation of other senses:

Descriptions of auditory, tactile and olfactory sensations

Chirp

- Twitter-like application for providing brief messages and responding to opinion polls
- Citizens share observations and connect with others
 - Operators can join the discussion
- Operators can poll the citizens to obtain information

The screenshot displays the Chirp application interface. At the top, there are navigation tabs: Status, Bookmark, Event, Poll, and Question. A status update is shown with the text: "The city is using an online tool to map damage. I just posted a report about my #poweroutage on CERP <http://cerp.mitre.org/>". Below this, there is a "SEND" button. The main content area is titled "Public timeline" and shows several posts. One post from "Fairtown EMR" is highlighted, showing a poll: "We're starting to clear debris. Which road should we clear first?". The poll options are "George Mason Blvd", "University Dr", and "Sherandah Ln". The poll results show "George Mason Blvd" with 3 votes, "University Dr" with 1 vote, and "Sherandah Ln" with 0 votes. A red arrow points from the poll options to the poll results. The right sidebar contains user information for "Average Joe", a "SEND INVITE" button, and sections for "POPULAR NOTICES", "TRENDING TOPICS" (listing "biggeststorm2", "012", "globalwarming", "tornado"), and "FEEDS" (listing "Activity Streams" and "RSS 1.0").

CERPS SIMEX

- **Objective:**

- ▶ Examine impact of CERPS and citizen involvement on tactical / operational decision-making and execution

- **Participants:**

- ▶ Emergency management personnel: national (DoD, FBI, DHS, National Guard), state, county, city, and university
- ▶ GMU student volunteers to play role of citizens

- **Experiment:**

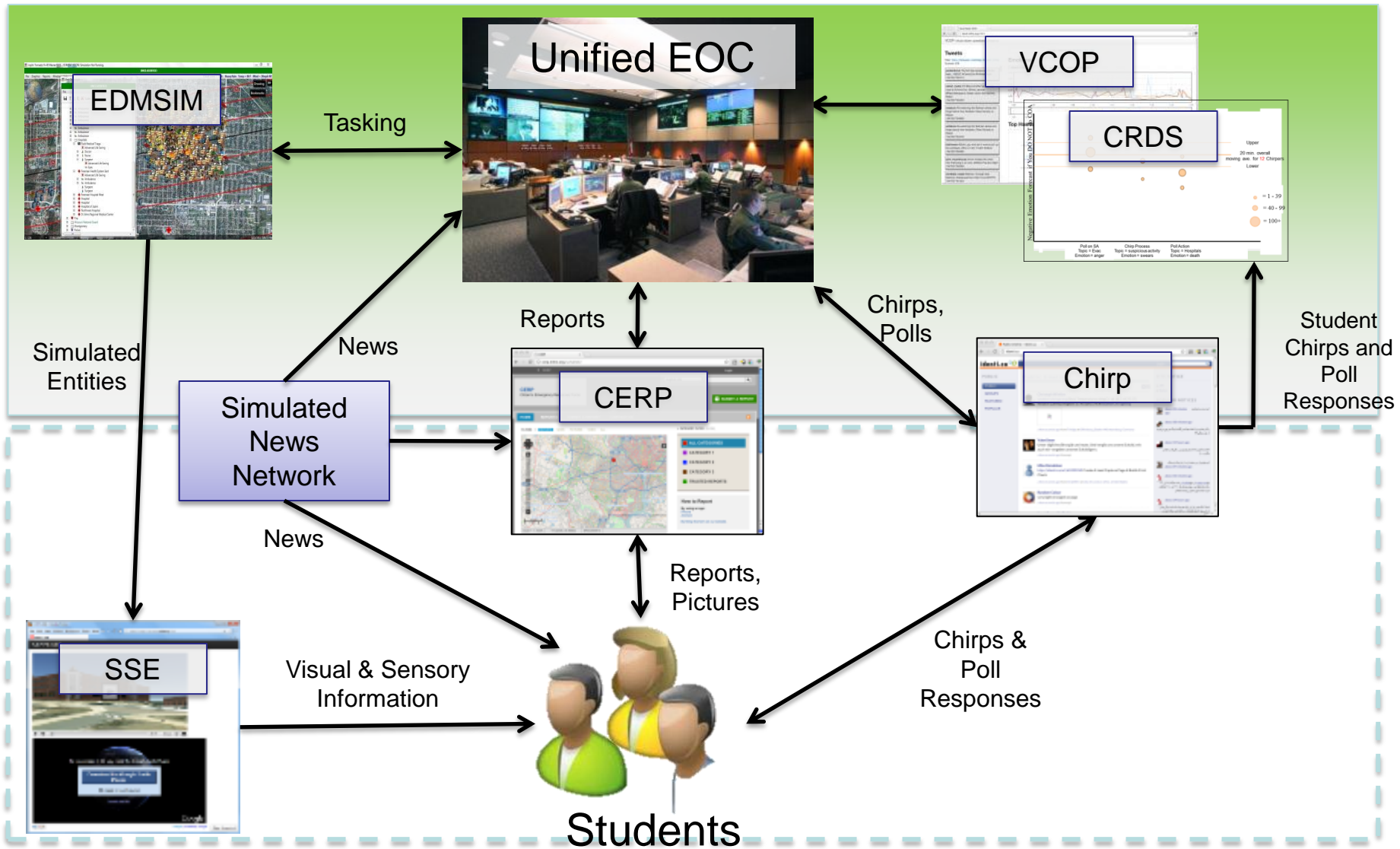
- ▶ Simulate crisis
- ▶ Execute crisis procedures
- ▶ Students interact with responders via CERPS

- **Evaluation:**

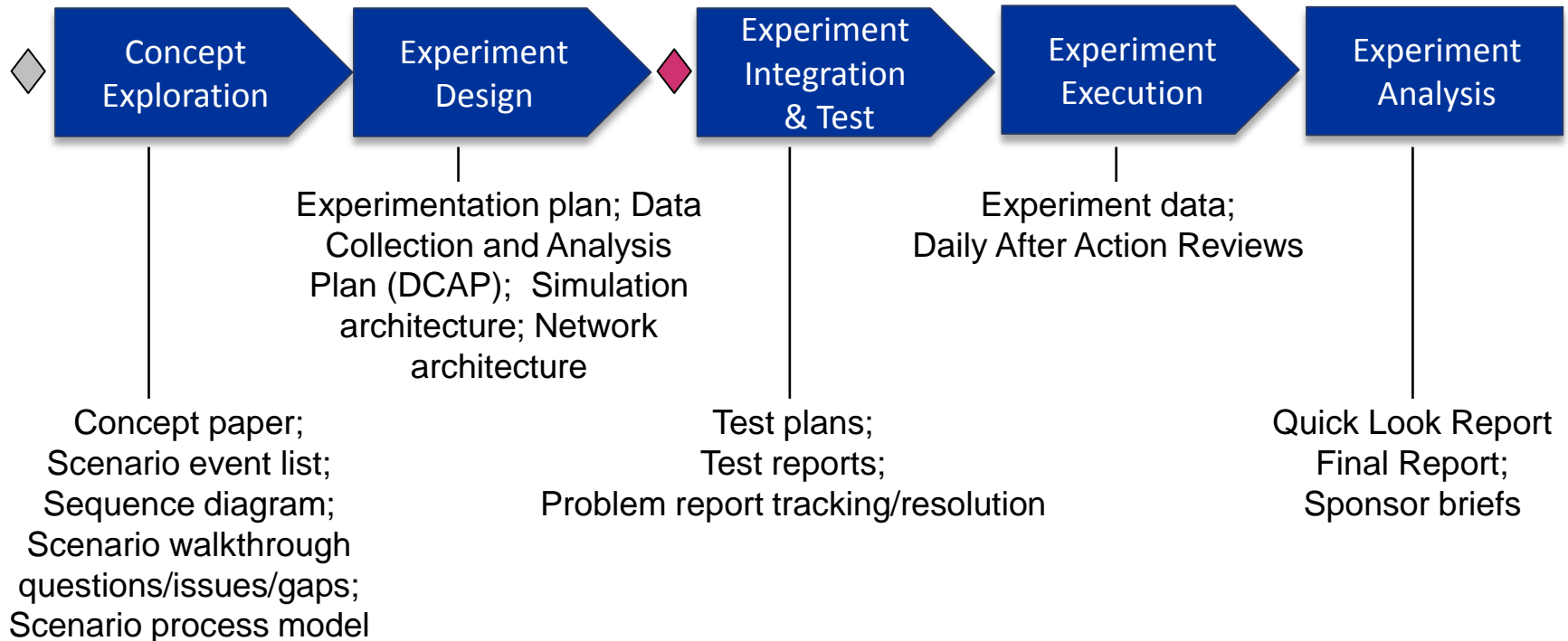
- ▶ Examine results on metrics of interest



CERPS SIMEX Operational View



SIMEX Process



- ◆ - Initial Planning Conference (IPC)
- ◆ - Final Planning Conference (FPC)

GMU Tasks

- Advise on CONOPS
- Coordinate IRB approval
- Recruit student participants
- Support training
- Coordinate strategic communications plan with MITRE community relations (avoid “war of worlds effect”)
- Participate in EOC



Student Participation

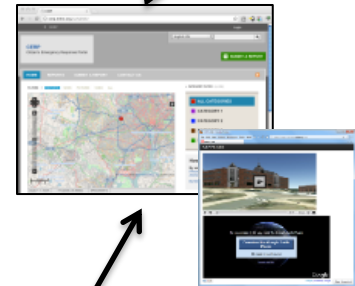
- Participants
 - ▶ Goal: 200 student participants
 - ▶ Actual: 199 recruited, 125 trained, 114 participated
 - ▶ Paid \$95 in Mason money plus iPad for top performer
- Activities:
 - ▶ Training session (2 hrs)
 - ▶ Test runs (2 hrs)
 - ▶ Experimental sessions (at least 5 hrs)
 - A different virtual emergency each day for 5 days
 - Respond to virtual environment through CERPS
 - Minimum of 5 hours
 - ▶ Feedback session (no more than 30 min)

Government Stakeholders

- NORTHCOM
- Joint Staff
- Fairfax County
- Virginia Commonwealth
- DHS/FEMA
- National Guard Bureau
- FBI
- Israeli Home Front Command*

Timeline

- Summer 2012:
 - ▶ Develop concept of operations, scenario, data collection and analysis plans
 - ▶ Obtain IRB approval
 - ▶ Develop publicity plan
- September 2012:
 - ▶ Recruit and train participants
- October 2012:
 - ▶ Conduct SIMEX (Oct 1-5)
 - ▶ Produce quick-look briefing
- November 2012:
 - ▶ Release report to public



CERPS SIMEX Command and Control

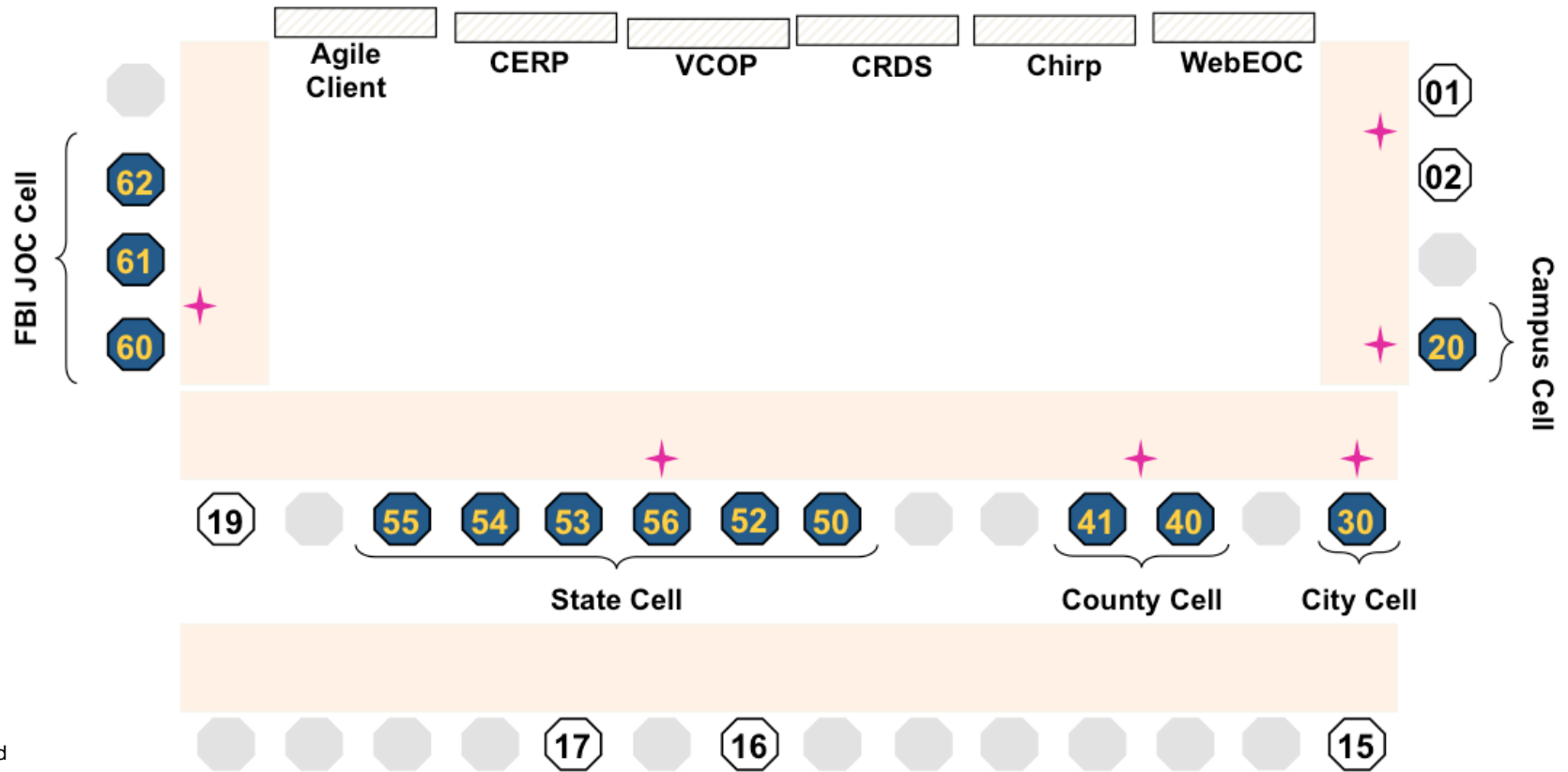
- Variety of cells within a unified Emergency Operations Center (EOC)
- County EOC Commander is in charge of overall management
- Incident Commander (County Fire Chief) controls on-scene response from Incident Command Post (ICP)
- EOC/Responder command and control, perceived situational awareness and notional response operations are emulated/simulated at NSEL
- Public represented by GMU Student Volunteers operating from Campus



Scenario

- Initial Conditions
 - ▶ Boy Scout Jamboree (National Special Security Event) taking place in area
 - EOC stood up, Federal, NG CERP-T, CST in place; NG units on standby in Fairfax county for crowd control, checkpoints, security, etc.
 - ▶ Rally at the Johnson Center to protest controversial author Simon Pierce, PhD. who is speaking to a packed room at the GMU Johnson Center @ 1800
 - ▶ Fairfax County and GMU websites hacked by Anti-Pierce Group and replaced with messages threatening violence
 - ▶ Sold out concert taking place at Patriot Center
- Emergency Events
 - ▶ Confrontations between protestors and rally attendees
 - ▶ Anti-Pierce Group detonates vehicle bomb containing radiological device on campus
 - ▶ Anti-Pierce Group detonates explosive backpacks in crowds at Johnson Center
 - ▶ Additional secondary detonations and threats of additional attacks take place throughout the run
- All runs were variants of this basic scenario with times, locations, and magnitudes modified

SIMEX: Emergency Operations Center



- 01 EXCON
- 02 Data Collection Lead
- 03 Scenario Lead
- 04 SIM Control
- 05 Integration Lead
- 06 Development Lead
- 07 Decision Support Lead
- 08 Tech Support
- 09 SSE Lead
- 10 Incident Commander / Campus Police
- 11 News Media
- 12 DCO

- 13 CERP Administrator
- 15 City EDMSIM
- 16 JTF EDMSIM
- 17 NGB EDMSIM
- 19 FBI EDMSIM

- 20 Campus Cell Commander / EDMSIM
- 30 City Cell Commander / PR
- 40 County EOC Commander / EDMSIM
- 41 County PR
- 42 WebEOC Controller

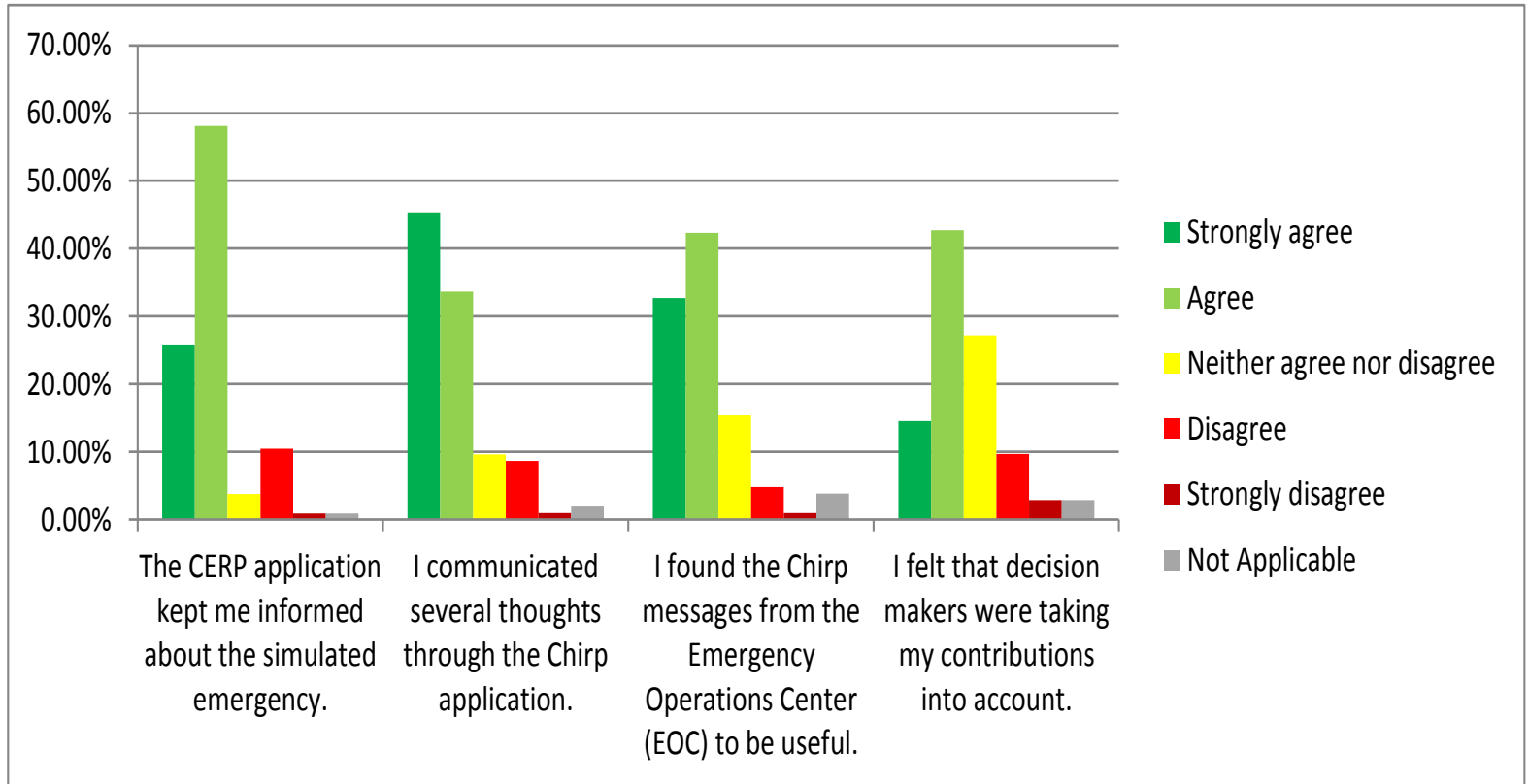
- 50 State Cell Commander / PR / EDMSIM
- 52 JTF-NCR LNO
- 53 State NG SEPLO
- 54 FEMA FCO
- 55 FEMA External Affairs
- 56 JTF-CS LNO
- 60 FBI SAC
- 61 FBI PR
- 62 FBI CTOC Coordinator

- VoIP
- White Cell
- Operators

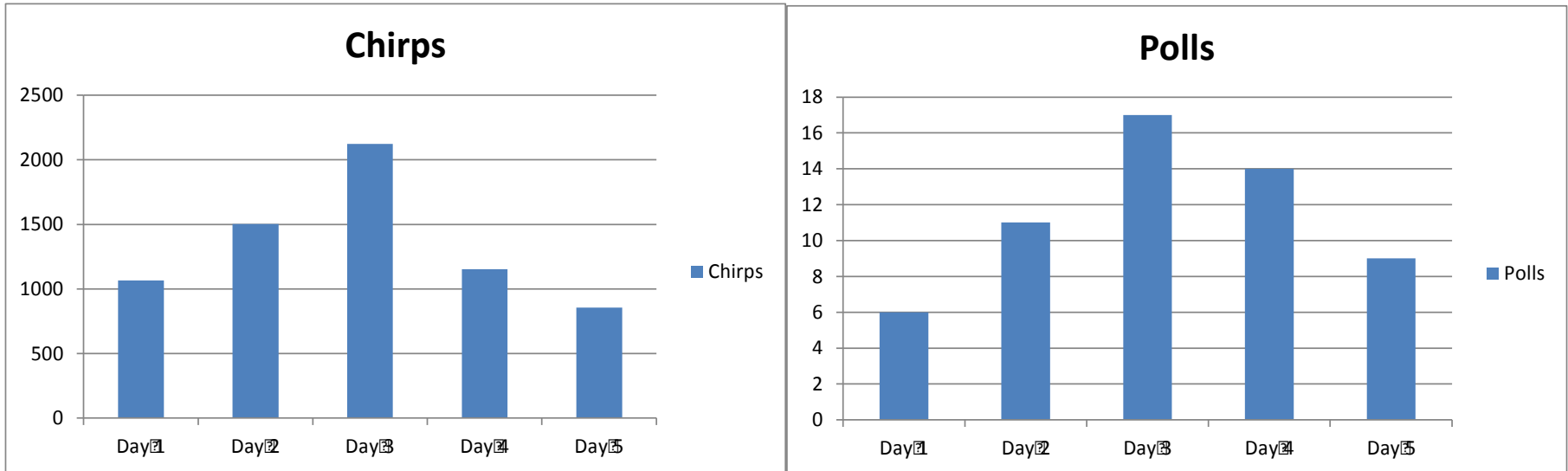
Media Attention

- Experiment Crowdsources Public in Emergency Response Decision-Making
 - <http://www.hstoday.us/industry-news/general/single-article/experiment-crowdsources-public-in-emergency-response-decision-making/9e632d951b75fa299ac746a4ce2d55df.html>
- This is just a test: Emergency responders tap the Twitterverse
 - <http://www.nextgov.com/emerging-tech/2012/10/just-test-emergency-responders-tap-twitterverse/58622/?oref=ng-HPtopstory>
- Mason Students Observe and Report During Mock Attack in Fairfax
 - <http://about.gmu.edu/mason-students-observe-and-report-during-mock-attack-in-fairfax/>
- Safety Tweet: Northern Virginia Magazine by Jenna Makowski January 14, 2013
 - <http://www.northernvirginiamag.com/buzz-bin/2013/01/15/safety-tweet/>

Student Perceptions



Chirp and Poll Usage



- Usage steadily increased through Day 3
- Unplanned outage on Day 4
- Unplanned interruption on Day 5

Student Ratings: Usefulness and Quality

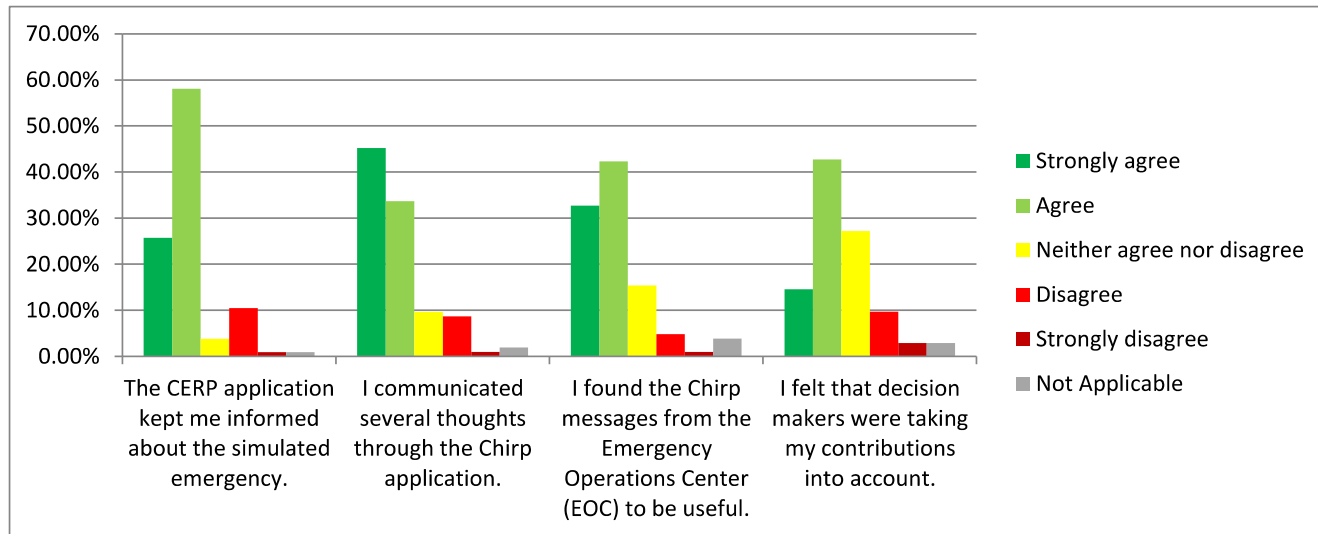


Figure 12. Student Ratings of Usefulness of CERPS

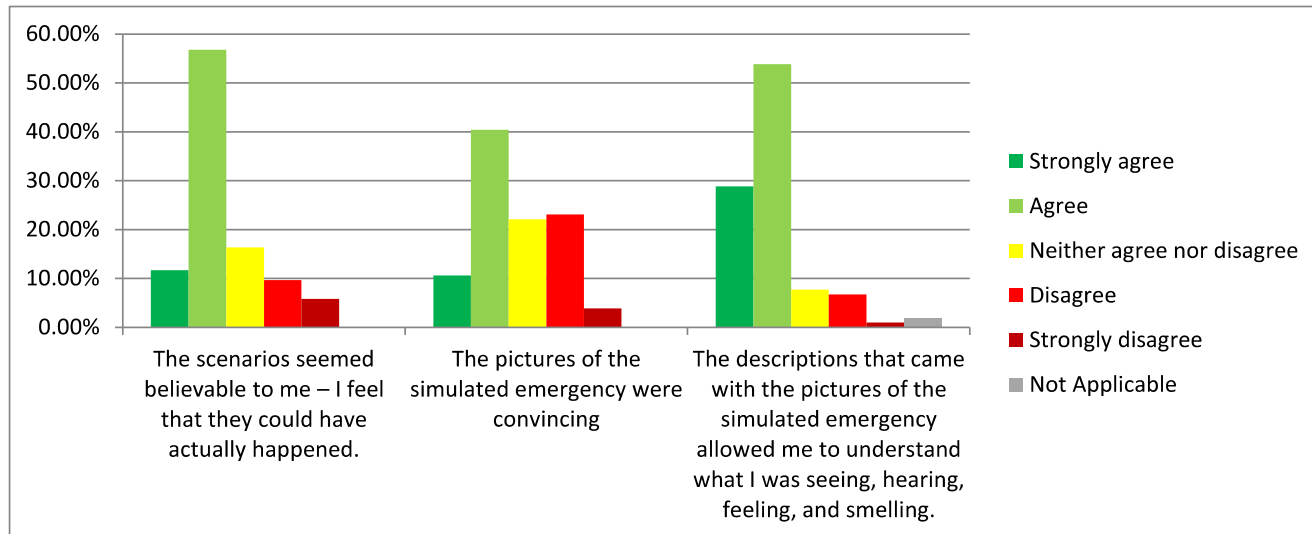
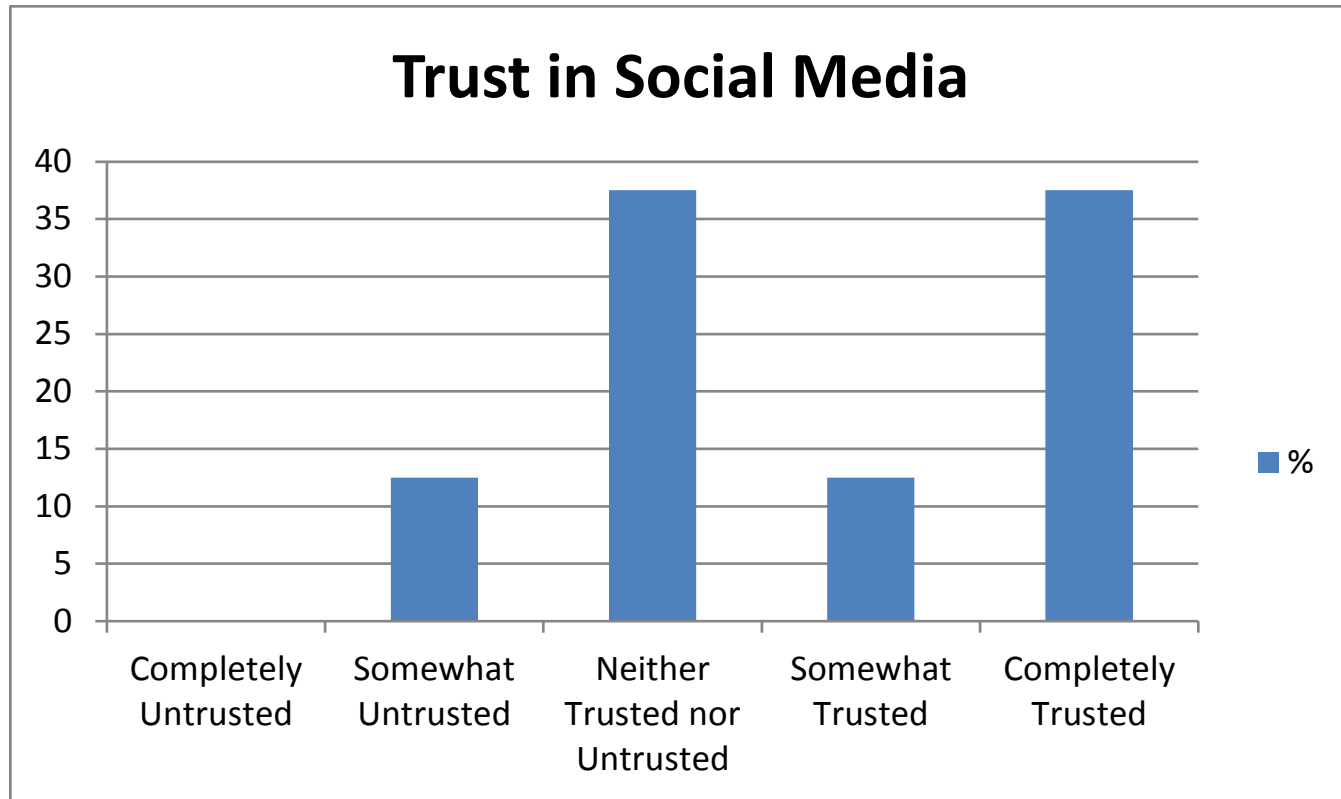


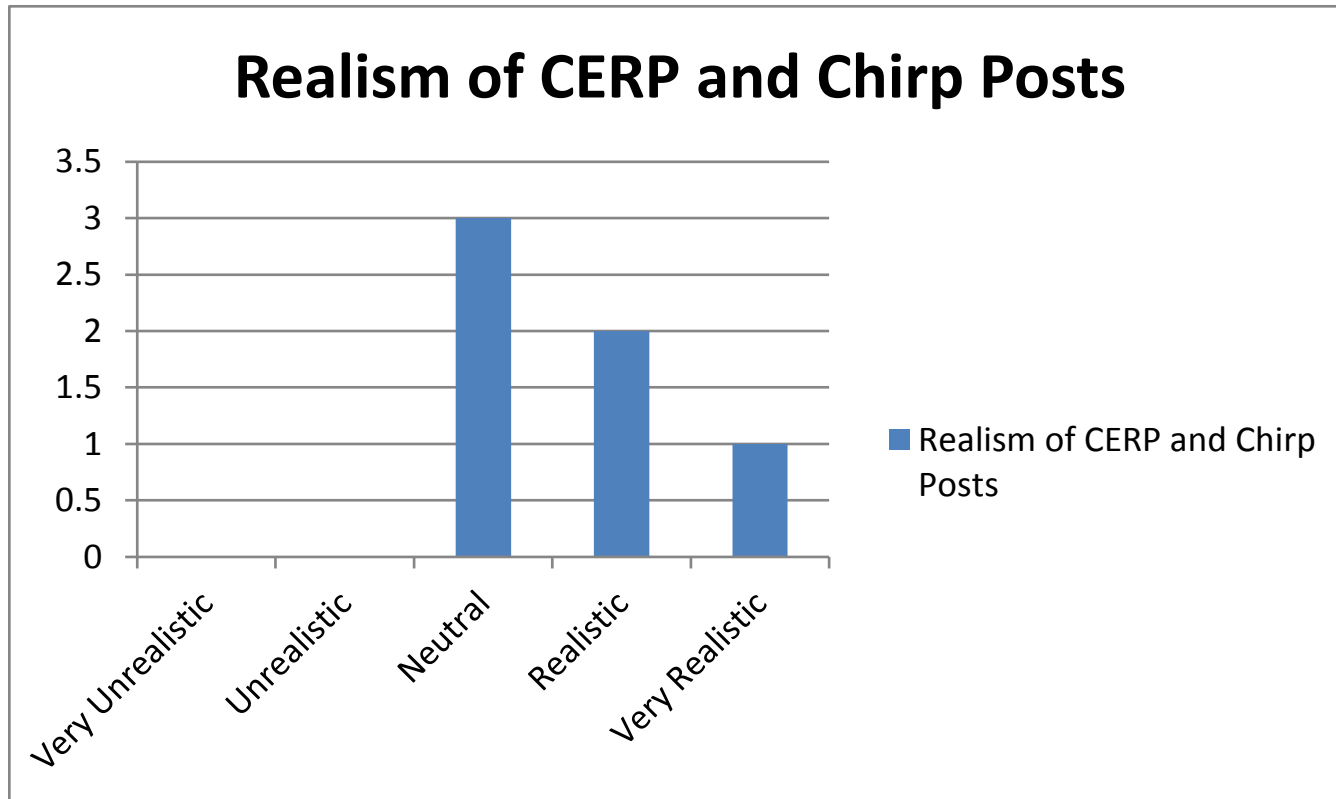
Figure 13. Quality of the Virtual Environment

Operator Trust



- Operators showed trust in social media
- Influence of simulated “bad actors” was limited and short term
- Trust would have been improved with geospatial information (disabled for privacy reasons)

Realism



- Operators reported interactions with public felt authentic and added valuable dimension to experiment
- Operators reported missing public interaction during unplanned run without interaction

Conclusions

- Demonstrated potential for positive impacts from citizen interaction with emergency managers
 - ▶ Augment 911-type information about incidents
 - ▶ Sentiment analysis of social media traffic
 - Helped emergency managers understand mood of public
 - Allowed managers to adjust communications strategies to better respond to needs of public
- Highlighted challenges of public interaction through social media
 - ▶ Vet information for accuracy
 - ▶ Account for possible influence of bad actors
 - ▶ Mitigate potential for emergency managers to be distracted by vocal social media users

Research Issues

- Effective integration of citizen input into C2 processes
- Integrating public participation into logistics
 - Provide timely assistance where it is most needed
- Human factors – citizens and operators
- Identifying trusted sources / filtering bad information
- Information security
- Providing information to operators while protecting personally identifiable information
- Mining large volumes of social media for actionable information

Policy Issues

- Expectations – If we start responding to Chirp, does that establish a public expectation that we will always respond to Chirp (especially for 911-type Chirps)?
- Liability – What happens if you ask public to do something (like evacuate using a certain route) and they get hurt as a result?
- Privacy – How must personal info, geolocations, etc., be handled?
- Two way communications with public, following/liking – Who will be allowed to do this and under what circumstances?
- Law Enforcement – Emergency management has fewer constraints on interactions than law enforcement
- Consent – Does the public need to consent before we respond using social media?
- Involvement – Who is the public? Who can be involved?

Current policies were not designed with social media in mind and will need to be evolved to enable CERPS-like capabilities

Proposed Follow-On SIMEX

- Maintain theme
- Include additional stakeholders
- Follow similar planning and execution schedule
- Incorporate alternative tools as appropriate from government and industry
- Expand to include GMU campus and surrounding region (“College Town USA”)
 - ▶ Larger population sample
 - ▶ Students, staff and faculty
 - ▶ Other participants from community
- Expand / revise EOC staffing



Take Aways

- The cloud and social media bring major new opportunities for decision support in crisis situations
- We are just beginning to understand how to exploit these opportunities
- CERPS SIMEX was an important first step in adapting C2 processes and tools to new
- Additional work is needed to improve our understanding of issues and solutions
 - ▶ Follow on SIMEXs
 - ▶ Research on technology, tools, processes
 - ▶ Policy analysis and development



Thank You!

GMU

- Stu Wharton (participant coordinator)
- Dave Farris (emergency management)
- Paul Liberty and Jim Greif (public relations)
- George Ginkovsky (university police)

MITRE

- Jim Dear (Project Lead, NSEL)
- Jackson Ludwig
- Jennifer Mathieu
- Alaina McCormack
- Tobin Bergen-Hill
- Karina Wright
- ... and many others

and all the SIMEX participants