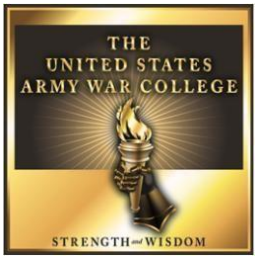
Strategy Research Project

Advancing Collection Capabilities Through Crowdsourced Intelligence

by

Lieutenant Colonel Dylan T. Randazzo
United States Army

Under the Direction of:
Colonel Brian R. Foster



United States Army War College
Class of 2018

REPORT DOCUMENTATION PAGE

Form Approved--OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	**2. REPORT TYPE**	**3. DATES COVERED** *(From - To)*
01-04-2018	STRATEGY RESEARCH PROJECT	

4. TITLE AND SUBTITLE
Advancing Collection Capabilities Through Crowdsourced Intelligence

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Lieutenant Colonel Dylan T. Randazzo
United States Army

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Colonel Brian R. Foster

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army War College, 122 Forbes Avenue, Carlisle, PA 17013

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT
Distribution A: Approved for Public Release. Distribution is Unlimited.
I understand this document will be included in a research database and available to the public. Author: ☒

13. SUPPLEMENTARY NOTES
Word Count: 8,753

14. ABSTRACT

The U.S. military must evolve beyond Open Source Intelligence's passive collection of publicly available information and Human Intelligence's reliance on limited interaction with small numbers of sources by embracing new opportunities afforded by crowdsourcing tools and methods. Crowdsourcing can augment and enhance intelligence collection methods by engaging larger swaths of people that have placement and access to information of intelligence value than permitted by traditional collection practices. Crowdsourced Intelligence (CSI) using common information and communications technology such as cellular telephones and the internet can overcome collection limitations related to lack of placement and access and risks associated with face-to-face interaction between the U.S. military and those abroad. This paper examines two case studies, one involving Ushahidi software and one explaining Pulse technology and methodology, to illustrate how crowdsourcing improved situational awareness and answered information requirements that enabled operations. Lastly, the author provides recommendations for advancing CSI within the U.S. military and explains how crowdsourcing can be applied to other national security problems.

15. SUBJECT TERMS
Crowdsourcing, Human Intelligence, Open Source Intelligence, Humanitarian Assistance, Counterinsurgency

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**			**19b. TELEPHONE NUMBER** *(w/ area code)*
UU	UU	UU	UU	43	

Advancing Collection Capabilities Through Crowdsourced Intelligence

(8,753 words)

Abstract

The U.S. military must evolve beyond Open Source Intelligence's passive collection of publicly available information and Human Intelligence's reliance on limited interaction with small numbers of sources by embracing new opportunities afforded by crowdsourcing tools and methods. Crowdsourcing can augment and enhance intelligence collection methods by engaging larger swaths of people that have placement and access to information of intelligence value than permitted by traditional collection practices. Crowdsourced Intelligence (CSI) using common information and communications technology such as cellular telephones and the internet can overcome collection limitations related to lack of placement and access and risks associated with face-to-face interaction between the U.S. military and those abroad. This paper examines two case studies, one involving Ushahidi software and one explaining Pulse technology and methodology, to illustrate how crowdsourcing improved situational awareness and answered information requirements that enabled operations. Lastly, the author provides recommendations for advancing CSI within the U.S. military and explains how crowdsourcing can be applied to other national security problems.

Advancing Collection Capabilities Through Crowdsourced Intelligence

> The Joint Force must improve its intelligence gathering capability with respect to human networks. . . [and] Fuse traditional and non-traditional collection, including open-source material, to provide timely, actionable intelligence.
>
> —Capstone Concept for Joint Operations 2030[1]

The U.S. military relies heavily on Human Intelligence (HUMINT) and Open Source Intelligence (OSINT) to gain insights into its areas of interest abroad, but these disciplines have inherent limitations. Traditional HUMINT, which primarily relies on collectors engaging small numbers of people, typically face-to-face, is often challenged in its ability to establish robust and responsive networks within contentious and expansive areas such as insurgent dominated cities of the Middle East or remote areas across Africa. Recent OSINT improvements have helped cover some of these gaps, but OSINT's approach that relies on hoping to find information of intelligence value that has been posted to the internet is too passive and reactive. Crowdsourcing using common information and communications technology can help overcome these challenges.

Crowdsourced Intelligence (CSI) can augment and enhance intelligence collection methods by quickly and actively engaging larger swaths of people that have placement and access to information of intelligence value than permitted by traditional collection practices. Unfortunately, general purpose military units are unfamiliar with CSI tools and methods and are unprepared to employ them. This paper examines two case studies, one involving Ushahidi software and techniques and one explaining Pulse technology and methodology, to illustrate how crowdsourcing using radio broadcasts, the internet, mobile phones, and various incentives answered information requirements. Crowdsourcing enabled organizations to identify human rights violations after elections

in Kenya, humanitarian relief requirements following earthquakes in Haiti and Chile, targeting information during the NATO air campaign in Libya, and various aspects of the operational environment in Africa and the Middle East. Lastly, this paper provides considerations and recommendations for furthering crowdsourcing within the Army to improve situational understanding, satisfy information requirements, and enable operations.

Defining Crowdsourcing and Its Importance to Intelligence Collection

The U.S. military does not appear to define crowdsourcing for intelligence purposes within doctrine or address how it can be used for intelligence collection purposes. The origins of the word "crowdsourcing" came from *Wired* magazine's Jeff Howe and Mark Robinson in 2006. Howe defined it as "the act of taking a job traditionally performed by a designated agent (usually an employee) and outsourcing it to an undefined, generally large group of people in the form of an open call."[2] The term "open call" refers to the broad invitation to the public, or anyone within certain parameters, such as an age group, or those present within a certain geographic area, to participate. Meriam-Webster's Dictionary defines crowdsourcing as "the practice of obtaining needed services, ideas, or content by soliciting contributions from a large group of people and especially from the online community rather than from traditional employees or suppliers."[3]

Although crowdsourcing for intelligence purposes has been discussed in several articles, the Intelligence Community (IC) tends to focus on various forms used for analytics and problem solving, rather than intelligence collection. The IC commonly uses the term to describe leveraging the "wisdom of crowds" or groups of subject matter experts to arrive at an informed consensus, identify novel ideas, answer questions, or

solve problems. These forms of crowdsourcing are categorized as creative crowdsourcing, collective knowledge, innovative crowdsourcing, peer production, and others.[4] Within this common context, one can find many examples such as the IC's Wikipedia-like "Intellipedia" websites; the Office of the Director of National Intelligence's (ODNI's) 2017 "CREATE" program seeking to "develop and test large-scale, structured collaboration methods to improve reasoning;" or the ODNI's "Innocentive" contest which offers a $500,000 prize to those who can provide "the best means of using artificial intelligence to transform the controversial intelligence analysis process."[5] Terms such as open access, open innovation, open source, and collective intelligence are also often associated with this type of activity or its effects.[6] This common application of crowdsourcing focused on improving analysis and problem solving has great merit, but this paper focuses on how crowdsourcing can be used to enhance intelligence collection operations.

Steven Stottlemyer's title of "Crowdsourced Intelligence" (CSI) describes the concept of engaging with a foreign geographic area's populace with the intent of them answering questions about their environment.[7] Nicholas Mumm described the concept as "Crowdsourced HUMINT," in which a unit can broadcast a call-to-action to the populace within an area of operations to encourage them to respond by text messaging. The unit would collect respondents' contact information and use it to initiate further two-way communications to pass information requests and responses, or inform one another without overtly exposing their relationship to potential adversaries who can threaten those cooperating with the unit. Mumm further explains how HUMINT

collectors could foster deeper relationships with those who demonstrate potential to be formal HUMINT sources.[8]

Mumm advocates the utility of this concept for counterinsurgency operations, but this form of collection can be useful in supporting a variety of operations in various environments. Crowdsourced intelligence can be particularly useful when there are limited friendly forces or capabilities available, or able, to engage with segments of the population of an area. During the Ebola crisis in Western Africa, the military could have employed CSI to reach populations in distant areas where the military did not have access to the population or in situations where the military did not want to risk exposure to the virus through close contact with people in infected areas. Crowdsourcing could have assisted units when establishing and maintaining a new base in places like Cameroon or Niger, where there are numerous intelligence gaps about the environment, heavy restrictions on movement, inadequate translator capabilities, and limited collection capabilities. Crowdsourcing may have helped in more contested areas such as Islamic State controlled Mosul, Iraq and Raqqa, Syria, where there was limited access to the population and numerous intelligence gaps.

The concept of CSI is not entirely new for the military. One early form of CSI employed by deployed units is commonly referred to as the “Tips” line.[9] This technique uses the same concept as the effective 911 telephonic emergency service used in the U.S. With Tips lines, the military provides a phone number anyone can use to report violent extremist or criminal activity that requires security forces assistance. Tips line programs often offer monetary rewards in exchange for certain types of information provided depending on the results of the response and veracity of the information.

The U.S. Army's Every Soldier a Sensor (ES2) initiative and a related software application called TIGRNET (Tactical Ground Reporting System) were also early forms of crowdsourcing. The ES2 concept is that the Army expects every service member to always be observing and reporting information gained during the course of their normal duties which they think may be of intelligence value.[10] Similarly, TIGERNET was a web-based system that enabled units at the lowest level to share the results of their ES2 efforts so that it was discoverable through key word or geographic area searches by anyone with access to the system on the Secret Internet Protocol Router Network (SIPRNET).[11]

Both of these methods have been very effective in utilizing large groups of people to answer an analyst's questions, but they were limited to gaining information from other service members and did not leverage the input from the public in the units' area of interest. Although units' intelligence personnel often sensitize their formations to information or intelligence requirements, both ES2 and TIGRNET are primarily reliant on the participants' own initiative for reporting, rather than being in response to an open call for volunteers to answer specific information requirements.

More recent military efforts to use information from crowds for collection purposes include the military's OSINT activities, especially social media monitoring and analysis. This form of collection is generally passive in nature, in that the collector or analyst does not place an open call, or advertise a request for information, nor do they interact with those posting to social media. Instead, the collector or analyst uses web-based tools or key word searches to query existing social media sites or databases that contain social media information to gain insights from those who have posted. The fact

that the analyst does not post anything, or interact with those posting information, prevents the analyst from influencing the sort of information provided by those posting to social media. This passive method is believed to be less risky than any sort of active interaction with individuals or groups that could highlight the analyst or collector's identity and association with the U.S. government or an intelligence activity, and thus expose them and their network to potential targeting. Additionally, any active engagement is likely to incur additional planning, coordination, approval, and oversight in comparison to typical OSINT, which makes the activity less attractive due to the additional effort and time required.

The DoD can build on these early methods of crowdsourcing such as ES2 and Tips programs by capitalizing on information and communications technology and crowdsourcing methods. The following case studies provide examples of how different forms of crowdsourcing have been used to answer information requirements about the operational environment in support of different military, government, and non-government organizations' operations.

Ushahidi Crisis Mapping in Kenya, Haiti, Chile, and Libya

One well known information technology-enabled system that successfully used crowdsourcing to answer information requirements and improve situation awareness during numerous crises is known as Ushahidi. The system relies on the population to send reports via short message system (SMS) text, telephone, email, Twitter, or blog posts to the system's user who enters it into a web-based mapping program.[12] In some cases, those employing the system actively engage, or interact with those providing the information, while in other cases, there is no active dialogue with those providing the information.

Ushahadi was first used following the 2007 Kenyan elections.[13] Ushahidi provided the Kenyan public with a SMS short code that allowed them to text in information for free. The public used their mobile phones to text and email reports of post-election violence to a team that manually uploaded the data to the Ushahidi platform where anyone could view a Google-based “live map” of the incidents on their website.[14] This experience yielded over 45,000 respondents, numerous incident reports painting a “more complete picture of the violence than any one organization,” and many lessons on how the company could better vet the information provided by the public.[15]

In 2010, the founders of Ushahidi, members of the Fletcher School, and other volunteers used the Ushahidi software to create Ushahidi-Haiti (Figure 1) following Haiti’s devastating earthquake. This on-line map helped first responders, including members of the U.S. Southern Command’s U.S. Joint Task Force Haiti, to understand information such as who needed help, where they needed help, locations of various

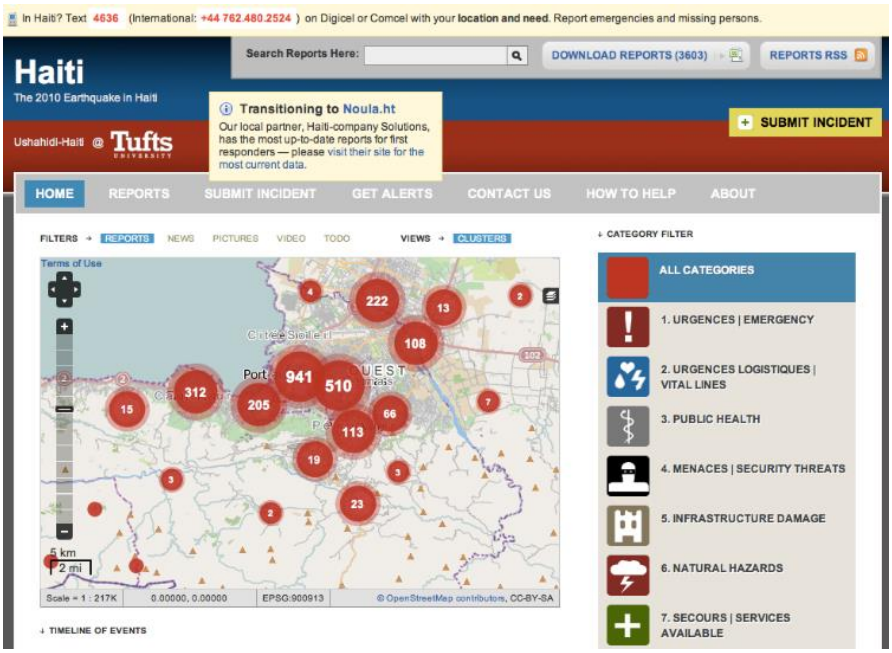


Figure 1. Ushahidi-Haiti Live Map[16]

resources, changes to routes, and the security situation in various areas. Common information needs such as detailed roadmaps and locations of critical assets and infrastructure were not available or readily accessible through an existing network.[17]

Figure 2. Ushahidi-Haiti Map showing reports of incidents along streets.[18]

Information gaps were exacerbated by the effects of the earthquake. For instance, the earthquake destroyed Haiti's National Center of Geospatial Information building making its significant data and imagery resources unavailable for immediate response. Also, the information flow from the United Nations (UN) Stabilization Mission in Haiti was disrupted by the collapse of their headquarters building.[19] Despite significant damage to Haiti, many cell phone towers were still operational, so the Ushahidi team relied heavily on cell phones to connect with the populace. The team created a short code that they provided to Haitians to SMS text message their location and most urgent needs to the Ushahidi-Haiti team. The team advertised the text number over radio broadcasts in Haiti.

Since the emergency responders primarily spoke English, but the reporting population spoke Haitian Creole, the team used several translation methods. For instance, SMS Turk's ability to automatically translate text messages from Creole and French to English proved invaluable when quick responses were necessary.[20] The team also designed a microtasking platform that relied on volunteers on social media to translate the messages from Creole to English. Eventually, the team transitioned the translation effort to a more robust professional translation crowdsourced platform that utilized paid English-speaking workers in Haiti.[21]

The professionals and the volunteers collaborated in an online chat room where they worked together to decipher ambiguous translations, refine locations, and discuss changing conditions. The average time from translation to posting the location on the map and information being streamed to emergency responders on the ground was ten minutes.[22] The Ushahidi-Haiti team plotted over 2,500 reports within 25 days following the earthquake, of which about half came from text messages. Other geo-referenced data was pulled from various social media, news media, and situation reports to populate situational awareness products.[23]

Several organizations benefitted from the Ushahidi-Haiti responses. A separate group in Boston that was using emails, Facebook, and radio to geolocate crisis information began to incorporate the Ushahidi response data to refine locations and create actionable information. The U.S. Coast Guard and other first responders used the interactive map to enable their operations. The Federal Emergency Management Agency praised the Ushahidi live map as being the most comprehensive and up-to-date source of information for the humanitarian effort during the crisis.[24] Within two days of

the earthquake, the U.S. Marine Corps was using the Ushahidi information to respond to emergency requests.[25] A marine provided the following feedback to the Ushahidi-Haiti team describing the value of their crowdsourcing platform for his unit's operations: "I cannot overemphasize to you what the work of the Ushahidi/Haiti has provided. It is saving lives every day. I wish I had time to document to you every example, but there are too many and our operation is moving too fast."[26]

The U.S. Department of State acknowledged the value of Ushahidi-Haiti and stated that they ought to be recognized as a new player in the humanitarian information environment, but they also identified several potential problems related to information overload, reliability, and sustainability. SMS crowdsourcing could overwhelm responders with unverified reporting and requests for assistance. During the 25-day Haiti response, the Ushahidi team and their translators received over 80,000 text messages of which approximately 3,000 were used. Going forward, the UN is concerned that requests might be exaggerated or include misinformation that divert the staff's attention and resources from higher priorities. Also, the fact that the effort was reliant on volunteers and pro bono work places the system's sustainability and dependability at risk.[27]

The Ushahidi system demonstrated numerous opportunities and benefits for the IC. The platform was quickly employed and its facilitators required very little training to engage numerous Haitians. Despite the earthquake's significant degradation to communications, many Haitians, including those in austere locations, were still able to use SMS text to effectively communicate with the Ushahidi-Haiti team. In many cases, the system facilitated a two-way dialogue with the population. Different organizations,

including the U.S. Marine Corps, Coast Guard, and non-government organizations (NGOs) simultaneously used this unclassified information to answer intelligence requirements necessary to enable operations during the disaster response. Although the humanitarian nature of the event likely contributed to the low costs involved due to people volunteering their services, the effort was low-cost. The cheap mobile devices possessed by an estimated third of the Haitian population offered a pre-existing means of communication for respondents.[28] Additional incentives for the Haitian respondents were not necessary outside of the humanitarian relief they were already seeking for themselves, their loved ones, or others within Haiti. The system allowed the team and others to collaborate with one another to refine information and provide a common operational picture of the environment.

Less than two months following the Haiti earthquake, the Ushahidi team established Ushahidi-Chile to assist those effected by the 8.8 magnitude earthquake that devastated much of Chile. Building on lessons learned from Haiti, the team established the website in less than an hour and mapped over 100 reports within 48 hours of the earthquake. Together, with over 60 volunteers from Columbia University and Chilean expatriates, they used the platform to successfully display the locations of medical facilities, grocery stores, and water and food distribution sites to assist those in need and those providing relief.[29] They also posted incidents of looting, vandalism, and road closures.[30]

During the 2011 conflict between the Libyan regime and Libyan armed opposition forces, the UN prompted the creation of the Ushahidi Libya Crisis Map (LCM) based on the success of the previous models employed in Kenya, Haiti and Chile. The map

started as a way people could collaborate and share humanitarian information, such as NGO's deliveries of supplies to certain areas, locations and details of stranded migrants, and incident updates like "Explosion near Rajma." Those posting the information were primarily pulling it from online social media networks. With the announcement of a pending internationally-enforced No Fly Zone, Libyans began posting tactical military information to the crisis map.[31] Examples of reports included: "Government tanks posted at all entrances to Ajdabiyah between Zueitina and Ajdabiya," "Greek vessel arrives in Tripoli delivering weapons," "massive military presence," and "loyalist fighters."[32]

Figure 3. Ushahidi-Libya Live Map[33]

The LCM team encountered several challenges with their reports due to standardization and leadership gaps. For instance, volunteers did not have a format for certain data, so entries and some of their postings contained inconsistencies. Some of this was due to no centralized leadership being present at certain times. Going forward,

Ushahidi recognized the need for standard report formats and the presence of experts who could answer questions at all times.[34]

Another issue was that the volunteers tended to operate at a high "zoom level" that allowed them convey very detailed information on the ground about individual situations, but the larger organizations needed bigger picture analysis to drive multi-million dollar resourcing efforts. Hence, they intended to develop ways to aggregate the data to accommodate those working at different levels.[35]

The Ushahidi staff dealt with three ethical questions related to protecting participants during the LCM deployment. First, the staff wanted to ensure those reporting could not be identified by the information in the LCM. Second, they wanted to ensure the reports' locations could not be pinpointed, so they anonymized their location by centering it in the city. Third, they wanted to ensure they minimized the chance of doing anyone harm. To minimize risk, but still maintain detailed data, the UN decided to run two separate websites. One was a private site with all original data which was only accessible by approved agencies. The second one was a public site containing no identifiable information, plus postings were delayed by 24 hours. Although some critics argued both sites were unnecessary, Ushahidi stated the two-site method worked.[36]

Another development resulting from the LCM was that other people started to combine the LCM data with their own data to develop more disciplined maps. These mappers made their information available to North Atlantic Treaty Organization (NATO) and others.[37] Stottlemyre explained how NATO tweeted stories about these social network users who were trying to assist NATO, which likely fueled additional contributions and helped validate the type of information that was valuable to NATO's

efforts. It appeared that specific Twitter users managed the information collection efforts. They posted information requirements for Libyans to report and refined the information through dialogue with the respondents which the manager then posted to a Google map.[38]

In addition to the Kenya, Haiti, Chili, and Libya case studies, Ushahidi has been used in other areas for other purposes such as mapping deforestation in Madagascar and crime in Atlanta.[39] Other 2016-2017 examples include reports and locations associated with on-the-job training locations in India, information to assist relief efforts for Somalia's drought victims, incidents supporting the Palestinian anti-apartheid movement in Palestine, and 2016 election monitoring in the Philippines.[40]

IST Research "Pulse" Support in Central Africa, Jordan, Iraq, and Afghanistan

A company called IST Research uses "Pulse," a combination of technology and methodology that passively and actively collects data from people in targeted areas. Pulse passively collects publicly available information, such as social media user names, hashtags, and keywords from the World Wide Web using social media application interfaces and web crawlers. Pulse's active engagement includes direct interaction with the population using SMS text, social media, or telephonic engagement to solicit responses. Pulse uses common media sources like radio, TV, social and print media to advertise and solicit the local populace's participation in the surveys.[41] IST incentivizes responses in various ways such as offering prizes and compensating respondents with cell phone minutes. People respond to the surveys via SMS, web surveys, interactive voice response, social media, and in-person interactions. Pulse aggregates and analyzes the data collected to help describe the information

environment and inform decisions of its supported organizations such as the 4th Military Information Support Group and Special Operations Command Africa (SOCAF).[42]

From 2014-2017, SOCAF contracted IST Research to use its Pulse platform to collect information from indigenous communities within the four central African countries of South Sudan, Central African Republic (CAR), Democratic Republic of Congo, and Uganda in support of OPERATION OBSERVANT COMPASS (OOC). Even though this was an "advise and assist mission to better enable African militaries of the region to counter the Lord's Resistance Army (LRA)," SOCAF needed information from the population to optimize their efforts.[43] SOCAF's limited capabilities and small presence spread out across this expansive area challenged their ability to engage with large numbers of the populace. SOCAF's intended use of the Pulse platform was to help gauge local perceptions toward counter-LRA operations and the U.S. military presence.[44]

IST Research employed their standard campaign model to collect data within the region using Pulse. They conducted site surveys to identify mobile carriers and relevant media outlets across the four countries. IST bought air time with the commonly used radio stations in each location. They purchased and maintained prepaid SIM cards and air time for each of their networks. IST established their Pulse gateway phones and plans for support, maintenance, and internet connectivity. The gateway smartphones acted as the regional interface between the messages from the population and the Pulse server where the information was aggregated. They established an agreement with a local NGO to act as an attribution partner. IST designed non-mission specific information campaigns to initiate and maintain engagement with the populace until

SOCAF had specific information requirements for them to incorporate into the messages. IST deployed their platform in October 2014 and initiated Pulse surveys in December 2014.[45]

From December 2014 to December 2015, IST's campaign showed positive results across seven target cities within each of the four countries using various incentives. They received 25,608 messages with 11,331 phone numbers within one year.[46] Pulse captured and sorted the responses and collected each participant's phone number that could be used for future engagements. Incentives included combinations of soccer balls, hand crank radios, and airtime cards.[47]

In May 2017, IST Research conducted a Pulse survey campaign focused on the people in Gulu, Uganda, and Haut-Mbomou, CAR. The survey was intended to gauge sentiment regarding the U.S. military's announced withdrawal from the region as SOCAF prepared to end OOC. This campaign provided SOCAF, the U.S., and its partner nations with insights into public opinion in these mostly rural areas that had been heavily affected by the presence of U.S. security forces.[48]

The May campaign's engagement methods concentrated on the predominant technology and communication methods used in the areas of interest. An estimated 19% of Ugandans used internet, 52.3% used mobile phones, 3.8% possessed a computing device, and 70.4% listened to radio. Within CAR, 4.5% of people used internet, 38% had mobile phone subscriptions, and 81% listened to radio. Therefore, IST conducted most of their initial outreach through radio broadcasts during prime times and several spot messages during off-hours throughout each day of the 5-day period. They used popular local radio stations covering a 100 km range to advertise the survey

and provided a SMS text number for respondents to use. Radio messages informed listeners that those who completed the surveys would receive a small mobile airtime reward. Although the majority of participants responded to the radio broadcasts, IST also engaged respondents from previous surveys to maximize participation.[49]

Once the respondents texted their number, they were sent a message inviting them to participate in web-based survey or an enumerator-led survey for respondents without internet access. If the respondent chose the web-based survey, they were sent a link to the website which was accessible by a mobile device and available in several languages common to the area. If they elected to speak to an enumerator, they were contacted by one of IST's partners capable of conducting the interview in several different languages.[50]

IST also advertised over Facebook in a similar fashion to the radio broadcasts by including a description of the survey and a link to where people could conduct the survey. Social media netted more responses in Uganda where internet penetration was higher (19% internet penetration and 2,104 responses), in comparison to CAR, which had lower internet penetration and a very low internet response rate (4.5% penetration and 65 responses).[51]

Within the targeted areas of Gulu, Uganda and Mbomou, CAR, IST was able to engage with a fairly broad portion of each city's population. They received responses from 4,254 people, including 3,257 completed surveys.[52] Enumerator-led surveys yielded 454 responses in Uganda and 634 in CAR.[53] Responses provided insights into each city's opinions regarding effectiveness of counter-LRA operations, attitudes towards U.S. presence, and impacts of U.S. withdrawal.[54]

Pulse technology and methodology quickly connected SOCAF with the population and provided insights into public sentiment to help inform analysis of the human domain. IST used a small number of people to establish a large number of respondents within an area where the U.S. military had limited access to the population. Using the respondents' contact information and biographical data from previous surveys, a unit, or service provider, such as IST Research, could directly engage previous participants to answer questions about their environment in response to emerging intelligence requirements. Although the Pulse campaigns in support of OOC were primarily used to support information operations, the same model can be used to inform a wide degree of Joint Intelligence Preparation of the Environment (JIPOE) requirements where intelligence and collection gaps exist.

In 2017, IST Research used Pulse to engage people within Jordan to determine their worldviews, perceptions toward the government and their country's situation, and their susceptibility to radicalization. Due to Jordan's high rates of internet penetration (73% use the internet), mobile subscription (133%), social media use (69%), and literacy rates (95.4%), IST solely used digital means to advertise and engage with the population. IST started their research by performing passive social media collection from January 1 to June 23, 2017, to assist preliminary analysis and preparations for active engagement via their online surveys.[55]

They conducted their surveys in two phases. During the first five-day survey, IST had a relatively low response and completion rate. The survey informed participants that they would be entered into a contest that would randomly award 100 respondents that completed the survey with 10 Jordanian Dinars (JD) in airtime. Of the 1,808 Jordanians

who responded, only 339 completed the survey (19%). IST surmised the low completion rate was likely due to general participant uncertainty and skepticism about the survey. Following completion of the initial survey, IST announced the selection of the 100 winners of the contest on IST's Facebook page. The winners validated the credibility of the survey contest by posting that they received the 10 JD in airtime.[56]

The participation rate during the second survey phase conducted from June 12-14, 2017, improved drastically. The survey advertisement was the same, but IST adjusted the incentive to a pay-per-completion scheme that offered respondents 2 JD ($2.82 USD) in airtime for completing the survey. IST attributed the improvement to their incentive modification and the trust they had gained following the first survey. Between the two surveys, Pulse netted 10,521 responses, of which 3,871 participants provided their phone numbers to be contacted for future surveys.[57]

IST used recognized social psychological scales to craft survey questions to help measure respondent worldviews and gain insights into Jordan's sociological landscape.[58] The survey helped gauge perceptions of government and security, beliefs regarding justice, right wing authoritarianism, distribution of aggression, submission, and conventionalism, and general opinions of whether Jordan is headed in the right direction.[59] IST's analysis showed how the survey results served as an indicator of Jordanians' low susceptibility to radicalism and religious opposition to their king and government.[60] The surveys did not indicate any underlying extremist or oppositional attitudes or elements.[61]

From March 30 to April 19, 2017, IST Research's web-based survey in the more tumultuous country of Iraq netted 8,993 participants in 21 days, with 3,147 respondents

completing the survey in its entirety. The survey was only advertised on Facebook due to time and budget constraints. In addition to demographics by province, the survey provided insights into which provinces reported higher states of aggression, opinions on the acceptability of aggression, and other indicators of attitude and opinion trends for each area.[62]

The Pulse survey campaign conducted in Afghanistan from January to February 2017 differed slightly from the Iraq and Jordan surveys. The campaign started with a 2-week baseline period in which IST conducted a thorough passive social media collection campaign to better understand the information environment and help craft the direct engagement survey. They then used both enumerator-led and web-based surveys to conduct a 4-week long survey focused on gauging Afghan sentiment regarding security, governance, and general concerns.[63] Incentives for people completing the survey included pay-per-completion with cellular data, a chance to win cellular data, and a final set that did not offer a tangible incentive. For the portion of the survey that included free responses, IST used both automated and manual methods of sorting the answers based on key terms.[64]

The Pulse campaigns in Afghanistan were successful in connecting the researchers with the population, providing insights into people across Afghanistan, and demonstrating the benefits of conducting an active survey approach to collection. IST received 4,255 completed surveys with respondents from all 34 provinces of Afghanistan.[65] Trends showed many Afghans expressed fears that Pakistan was fueling instability by using opposition groups to internally destabilize Afghanistan, and that respondents thought individuals often participated in extremist groups due to economic

issues such as unemployment and poverty.[66] The free response questions resulted in explicit information indicating primary concerns related to lack of security, poverty, unemployment, grievances over foreign intervention, and ineffective governance.[67] Similar to the Jordan survey, IST also concluded that the direct engagement campaign using surveys was more effective in defining Afghan issues and perceptions related to different regions and demographic groups in comparison to IST's passive social media collection effort; however, the combination of both passive collection and active engagement yielded the best results.[68]

The Pulse Afghanistan experience provides several other useful insights for intelligence operations. The pay-per-completion incentive scheme was most successful, followed closely by chance-to-win, and then the no-tangible, or altruistic, incentive survey. Automated processes using key term frequency can help sort responses as a way to triage information for analysts.[69] In aggregate, survey results may provide skewed viewpoints from overrepresented respondent groups such as educated Pashtu speaking urbanites, rather than the beliefs and attitudes of less represented groups such as rural and female populations. Fortunately, assuming participants provided relatively accurate demographic information, analysts can quickly sort responses by different demographics to identify overgeneralizations and provide more representative assessments.

IST's Middle East and Africa Pulse campaigns provided lessons regarding the combination of OSINT collection and surveys. Open-source intelligence can help survey designers develop questions and target specific audiences. Surveys can help corroborate, expand upon, or explain the results of OSINT findings. IST concluded that

their “online data collection determined that social media content alone is insufficient for understanding public opinion in some environments; however, the survey responses were effective in ascertaining worldviews and gathering local perceptions concerning topics such as security and governance.”[70]

Pulse can be used to augment and enable HUMINT. Intelligence personnel could use it to spot and assess leads for development. Organizations could engage specific segments of the population such as those with certain religious affiliations, ethnicities, education levels, or employment status. Survey responses can be used to tip and que other assets for more focused collection. Surveys can incorporate questions to help corroborate or validate information derived from other sources. The system can be employed in a relatively short amount of time with minimal pre-existing relationships to help establish a network; whereas traditional HUMINT typically requires far more time to establish relationships, especially at scale. Organizations can use Pulse to communicate with those within an area of interest to gain valuable insights about developing situations and operational environment conditions. Pulse can reduce the time, resources, and risks that may be incurred by U.S. personnel or other assets that would otherwise have to travel and gain access to an area and subject matter. This advantage could be particularly useful immediately following an event such as a protest or attack, especially where certain respondents have already been conditioned to requests for information and have demonstrated higher levels of agreeableness, aptitude, and validity. Additionally, intelligence personnel or law enforcement partners can employ other validation methods for those who’ve provided phone numbers.

Pulse data can be used to inform JIPOE requirements related to the physical and cognitive dimensions of the information environment such as the newspapers and radio stations used by different demographics, or perceptions and attitudes of different groups. Pulse can help identify key personalities, influencers, and groups operating in an area. It can be used to inform the Special Forces community's Operational Preparation of the Environment requirements such as providing information to assist with area familiarization, "atmospherics" of the populace, or the location of certain businesses and infrastructure that are not readily identifiable through internet searches.

Pulse has enabled successful information collection on numerous occasions within both permissive and non-permissive environments including Jordan, Iraq, Afghanistan, and Central Africa. Although the system has only been used by a commercial company in support of the DoD, the tools and methods do not require extensive funding, equipment, or manning. If the DoD determines that it cannot standup its own similar organic capability, the DoD can continue to leverage the services of IST and similar providers to enable intelligence collection.

Challenges, Solutions, and Other Considerations

The following section examines some common questions and concerns associated with CSI and developing CSI as a discipline. Topics such as incentives, information overload, doctrine, ethical and legal concerns, organization, manning, training, and materiel must be addressed to progress CSI's use by the military.

Incentives

The global growth in cellular telephone and mobile money users provide the DoD with one common method of paying for people's information, time, and services. Mobile phone subscriptions reached over 900 million in Africa and 3.7 billion in Asia the first

quarter of 2015.[71] The use of mobile money has exploded in places like Africa where over 40% of adults in seven Sub-Saharan African countries now use mobile money.[72] In Afghanistan, M-Pesa, one of several mobile money service providers, has over 1.2 million subscribers.[73] Peer-to-peer mobile money transfers allow people to transfer small amounts of money quickly and securely from one person to another. Pre-paid mobile airtime minutes are another common and older form of currency used across much of the world. Mobile minutes can be transferred between phones, exchanged for cash with dealers, and used to barter for goods and services.[74]

The Ushahidi and Pulse case studies provide examples of how local radio broadcasts, website postings, and mobile phones were used to advertise incentives and connect with the population. In some cases, such as Ushahidi-Haiti, the population saw an opportunity to connect with a service provider that could potentially meet their basic needs in time of crisis when no other relief or positive means of communication was available. Others were motivated for altruistic reasons because they saw Ushahidi-Haiti as a way to help others. In the case of Ushahidi-Libya, some may have been motivated to share information about Gaddafi's military forces in order to help topple the regime. In the case of IST Research's Pulse campaigns, the population tended to be more responsive to tangible incentives such as electronically transferred mobile airtime and mobile money. When airtime could not be used, other incentives such as soccer balls and radios were awarded to contest winners.

Information Overload

As the case studies demonstrated, CSI has the potential to capture thousands of responses which are of little use unless the information can be processed and analyzed in a timely manner. Information overload could also pose a problem in certain crisis

response situations where the population becomes reliant on the CSI campaign for emergency relief, but the U.S. cannot process the information fast enough to take appropriate action. Units may be able to process large numbers of responses by federating the task to others like an aligned intelligence reserve unit. Also, various software, such as SwiftRiver, can help aggregate, categorize, and summarize crowdsourced data to expedite validation and processing.[75] Crowdsourcing practitioners will need to account for these risks when designing their campaign plan. Although having too much information can present validation and processing challenges, having ample information is generally preferred over insufficient information.

Doctrine

One impediment to advancing CSI is that intelligence professionals may disagree about how it relates to other intelligence disciplines. Steven Stottlemyre's 2015 article asks whether CSI is "HUMINT, OSINT, or Something New?"[76] Since the IC has been using OSINT to glean data from large groups of people posting to social media, some may think crowdsourcing is a form of OSINT. Others may argue that we are merely using humans to collect information from other humans and therefore, CSI is a form of HUMINT. Yet, others may believe CSI warrants its own discipline since they don't believe it fits into any existing discipline.

Stottlemyre argues that CSI is distinctly different than OSINT and HUMINT.[77] He submits that because OSINT is collected second-hand from publicly available information, and that the OSINT is not originally provided to support intelligence requirements, that CSI cannot be considered OSINT.[78] He explains that CSI cannot be considered HUMINT because HUMINT "collectors must secretly elicit information that satisfies intelligence questions issued to the collector."[79] Stottlemyre reasons that CSI

cannot be considered OSINT or HUMINT because crowdsourcing requires open requests for crowd assistance, which he believes is not inherent to either discipline.[80]

Stottlemyre's argument for distinguishing CSI from OSINT is sound, but his interpretation of HUMINT is unnecessarily restrictive. At its core, CSI is a form of basic HUMINT- humans engaging other humans to collect information of intelligence value. Joint Doctrine defines HUMINT as "a category of intelligence derived from information collected and provided by human sources."[81] Crowdsourced Intelligence would be most akin to the HUMINT subcategory of debriefing, which joint doctrine describes as

> the process of questioning cooperative human sources to satisfy intelligence requirements...Debriefing may be conducted at all echelons and in all Operational Environments (OEs). Through debriefing, face-to-face meetings, conversations, and elicitation, information may be obtained from a variety of human sources, such as…volunteers, who freely offer information of value to US forces on their own initiative.[82]

Crowdsourced Intelligence could fall under the definition of clandestine or overt HUMINT collection depending on the degree of secrecy or misrepresentation being applied by the collectors or administrators of the activity. If the questions were communicated in a manner that misrepresents the administrator or collector's affiliation as not being associated with an intelligence organization or an intelligence purpose, then the CSI may be considered a form of clandestine collection. If the administrator falsifies his affiliation with intelligence, or falsifies the purpose of the activity to deliberately mislead participants into believing there is no intelligence affiliation, then it could be considered a form of clandestine HUMINT. If the administrator does not mislead participants through false representation or false purposes, then the activity could be considered a form of overt HUMINT.

Ethical and Legal Concerns

Many of the same ethical concerns pertaining to other forms of intelligence collection also apply to CSI, such as safety. Due to the potentially large number of public participants involved, there is a risk that some could be affected in some way. For instance, a sophisticated actor, such as a government intelligence service or technically savvy violent extremist group could gain access to participants' personally identifiable information, such as internet protocol addresses, names, and phone numbers, and use the information to target them in some way. When a suspected criminal's identity is made public, such as on a website where the results of the crowd's information is posted, the public or security forces may wrongfully target someone, such as what occurred when both authorities and the public targeted innocent suspects following the Boston Marathon bombing.[83]

The fact that participants are interacting over a mobile device or the internet, and that they are one of many participants, provides a level of anonymity that reduces risks to participants. Crowdsourced Intelligence provides a relatively safe environment in comparison to other traditional forms of HUMINT involving meeting sources face-to-face where they can be observed and singled out. Crowdsourcing administrators can employ other measures to harden and protect communication systems, databases, and information. Administrators can also enact other anonymizing measures to reduce the risk of exposing participants or those providing information. In the Ushahidi-Libya case, the team maintained two separate databases and maps, one with more detailed information that was only available to certain people, and one with more ambiguous information that was shared more widely. They also refrained from directly communicating with those operating within Libya to maintain a level of separation and

ensure the team did not do or say anything to drive the participant to do something risky.

Those conducting the collection or acting on the information may be subjected to increased risks to targeting. The collectors are dealing with many more people, most of whom they do not know. They are operating on unclassified systems that increase the risk of them being monitored and identified. The relative ease and anonymity of the communication could allow someone to inadvertently, or intentionally, lead the response force into a deliberate attack, such as an ambush or explosive device.

In addition to information being used to harm someone, adversaries or seedy entrepreneurs may find ways to manipulate information. Examples can range from a third party nation manipulating information to make a situation look unfavorable to the host nation or the organizations involved with an effort. Opportunists can manipulate information in a way to divert aid to their benefit over an intended recipient or those more deserving of the aid. In cases where force might be applied in response to reporting, an adversary may attempt to misdirect military efforts or instigate further damage, harm, or unrest to discredit the response force, or disadvantage a rival.

As with any information provided by a source, the unit must do its best to protect the source, validate information, and recognize that threat actors could be baiting them into a dangerous situation. The unit can ensure only trusted people or organizations have access to the participants' information to reduce the chance that an unintended audience can use the information for malicious purposes. When information requires further vetting, the unit may be able to use the participant's cell phone number to help corroborate or strengthen confidence in the information by speaking to the individual

during a follow-up engagement or validating aspects of the information through other technical means of corroborating their story and associations. The collector can also engage other participants or independent local sources within the area to corroborate the information. Collectors can also use another variant of crowdsourcing, known as "bounded crowdsourcing," which starts with a smaller network of trusted respondents who then broaden the network by adding others whom they know or can vouch for; therefore reducing the chances of malicious actors misinforming collectors.[84] Additionally, commercial firms are designing methods and applications to improve crowdsourced data quality by studying factors such as time, experience, and agreement with others, and how to improve the collection interface design.[85] Others have designed algorithms that identify the valuable responses even when they are in the minority, increasing accuracy rates of answers from 52% to 87%.[86]

Another risk is that certain demographic groups may be advantaged over others. For instance, certain CSI initiatives may glean more information from those who live in urban areas where access to the internet and education is more likely. Conversely, an illiterate segment of the population or those in more rural areas without internet or mobile phone access may lack exposure to internet-based CSI campaigns. Also, CSI campaigns that do not offer certain language options may risk excluding certain populations.

Both Ushahidi and IST Research showed different ways to tailor crowdsourcing to be more inclusive. For instance, Ushahidi implemented a voice-messaging system to accommodate illiterate respondents.[87] IST used enumerators who spoke the language of the callers to incorporate their responses, plus both cases cited other manual and

automated translation solutions available. Additionally, different technical sorting and analytical methods can help identify where biases and gaps may exist within data.

Some may raise concerns over the potential to violate another country's sovereignty or an individual's privacy. One way to overcome this concern is to work with the consent of the host nation country. In many cases, such as humanitarian efforts, the U.S. is being asked to assist and CSI is just another way to optimize support. Regarding privacy concerns, all the participants are volunteers and CSI administrators can take extra precautions to protect, control, and discard sensitive or personally identifiable information.

The key to reducing risks is taking the time to outline hazards and develop mitigation measures as the military strives to do with any activity. Many risks and mitigation measures will be similar to those associated with other forms of HUMINT, OSINT, and Signals Intelligence (SIGINT). Additionally, the military may be able to benefit from various organizations' related code of ethics, such as those in the humanitarian field.[88] Although the literature from the case studies identified some of these risks, there was no mention of any incidents that occurred despite the multitude of robust crowdsourcing operations.

Many of the same legal constraints and considerations pertaining to HUMINT, OSINT, and SIGINT are likely to apply to CSI, especially if intelligence personnel are involved. Fortunately, the military is likely to benefit from other government and humanitarian organizations that have addressed legal issues for similar activities.[89] Legal precedents for surveys, Tips lines, and rewards programs are also likely to expedite legal review.

Organizations, Manning, and Training

The Army's Intelligence and Security Command (INSCOM) is one logical organization that should be considered for implementing this capability. The INSCOM's Theater Intelligence Brigades (TIBs) supporting each geographic command could use CSI to accomplish their "set-the-theater" requirements or support nearly any line of operation within each brigade's area of intelligence responsibility. The TIBs could perform CSI or manage and oversee it while a service provider conducts the activity on their behalf.

Following the TIB model, each brigade has a number of personnel which could be reoriented towards CSI just as some may be focused on being more proficient at interrogations, source operations, debriefings, or document and media exploitation. The HUMINT personnel within the collection battalion or the aligned reserve battalion could assume this function. In many cases, CSI would be a combat multiplier for the TIB in areas where it would be challenged to deploy its personnel or develop a responsive source network that could satisfy the Combatant Commander or Service Component Commander's intelligence requirements. CSI could enable the unit to accomplish much more than a small team could do on its own. CSI training could follow a similar model to the OSINT training methodology, while building off of what various organizations like Tufts University and Ushahidi have already devised.[90]

Materiel

The crowdsourcing activities discussed in the case studies required very little materiel. In many cases, the software is available through open source and can be adapted for a unit's needs, including integrating the data into existing intelligence databases and systems.[91] In the case of IST's Pulse capability, they were able to use a

handful of smartphones in the target area to serve as the gateway devices between the population and those conducting the collection. Text responses were relayed through the smartphone to a server where IST processed the information over an unclassified commercial network.[92]

Other CSI and Crowdsourcing Opportunities

Crowdsourcing presents numerous opportunities for intelligence operations beyond the CSI concepts already presented. Expanding on Nicholas Mumm's concept, and incorporating the methods used within the Ushahidi and Pulse case studies, units can create an interactive neighborhood watch-like community of interest that helps the community rapidly share security concerns with U.S. or coalition forces during counterinsurgency or counterterrorism operations. Either through a publicly accessible website, or specific group of people previously identified through CSI network development, units can post pictures and descriptions of threat actors, vehicles, or warnings that sensitize the community to threat-related information requirements which the populace can report if observed. Once the U.S. military becomes proficient at building these communities of interest, they can help other nations' security forces employ similar models that work for them.

The military can use CSI-derived networks of people to enable other successful forms of crowdsourcing. For instance, the *Cities at Night* project posts pictures of cities at night taken from space to a website where volunteers can help match the photographs to the actual city.[93] Using this model, a unit could post pictures from jihadist videos or social media to a website, or text it to a specific previously identified population, to help identify the location and personnel involved. Units can use the CSI network to outsource other intelligence-related work, such as video recording buildings

along streets in certain areas so the images can be used to help plan operations when necessary. A unit can use a CSI-derived network of people to identify prospective hires within communities who possess certain skills such as those proficient in both English and an obscure local dialect that is needed for translations. Using a model such as Amazon's Mechanical Turk, a unit can outsource translations of articles from local newspapers or transcribe what was said in a video into text, all while building a network of volunteers who may be willing to help with other tasks.

Recommendations

The Army or DoD should consider the following recommendations in order to develop a CSI capability:

1. The U.S. Army Intelligence Center of Excellence should establish a pilot program to develop CSI tactics, techniques, and procedures through experimentation within a semi-permissible real-world operational environment, such as Cameroon or Niger. Consider utilizing organizations such as an INSCOM TIB with support from organizations such as the Asymmetric Warfare Group, Peacekeeping and Stability Operations Institute, Combatting Terrorism Technical Support Office, Defense Advanced Research Projects Agency, Rapid Equipping Force, and the Joint Improvised-Threat Defeat Organization.

2. Establish a tiger team that can work with commercial companies to support TIBs with crowdsourcing and help address doctrine, organization, training, materiel, leadership and education, personnel, and facilities requirements. Identify opportunities for the tiger team to observe or participate in CSI-like activities with organizations who are performing them.

3. Address crowdsourcing within DoD and Army intelligence doctrine such as Army Field Manual 2-0: Intelligence.

4. Conduct familiarization training of new crowdsourcing information and communication technology and processes in advance of crises to prepare units to employ CSI or exploit CSI results from a commercial provider.[94]

5. Engage with the private sector and academia to keep abreast of crowdsourcing technology and methodology advancements.[95]

Conclusion

The U.S. military needs to quickly capitalize on evolving information and communication technology and innovative crowdsourcing methods to broaden and improve its intelligence collection operations, or risk lagging behind its adaptive adversaries and competitors within the information domain. The case studies, concepts, and examples presented within this paper demonstrate CSI's potential to rapidly connect with large groups of foreign nationals in an area of interest, incentivize them to answer questions about themselves and the environment, and present opportunities to create a responsive human network. This network could answer follow-up questions or more tailored requests based off their specific demographics and demonstrated aptitude and willingness to participate. Active CSI, especially when coupled with more passive OSINT collection, can significantly augment and enhance other collection methods. Crowdsourced Intelligence networks have the potential of facilitating dialogue with individuals or communities of interest that can inform leadership decisions and accomplish tasks through additional crowdsourcing methods. Crowdsourced Intelligence can provide the military with an unprecedented low-cost, low-risk, high-payoff method of quickly gaining valuable insights into an operational environment and the human domain that is not inherent to current collection capabilities.

Endnotes

[1] U.S. Joint Chiefs of Staff, *Capstone Concept for Joint Operations 2030*, Draft Pre-Decisional (Washington, DC: U.S. Joint Chiefs of Staff, June 28, 2016).

[2] Jeff Howe, "Crowdsourcing, A Definition," *Crowdsourcing, Why the Power of the Crowd is Driving the Future of Business*, blog entry posted June 2, 2006, http://crowdsourcing.typepad.com/cs/2006/06/crowdsourcing_a.html (accessed December 3, 2017).

[3] *Merriam-Webster Home Page*, https://www.merriam-webster.com/dictionary/crowdsourcing (accessed December 3, 2017).

[4] James Dohety, "Crowdsourcing vs Crowdfunding: What's the Difference?" *Scifabric* blog posted on January 27, 2016, https://scifabric.com/blog/2016/01/27/crowdsourcing-vs-crowdfunding.html (accessed January 14, 2018).

[5] Office of the Director of National Intelligence*, Analytic Outreach*, Intelligence Community Directive Number 205 (Washington, DC: U.S. Office of the Director of National Intelligence, August 28, 2013), 1, https://fas.org/irp/dni/icd/icd-205.pdf (accessed December 3, 2017); No Author, "IARPA Launches "CREATE" Program To Improve Reasoning Through Crowdsourcing," February 9, 2017, linked from the *Office of the Director of National Intelligence Home Page* at "Press Releases 2017," https://www.dni.gov/index.php/newsroom/press-releases/item/1735-iarpa-launches-create-program-to-improve-reasoning-through-crowdsourcing (accessed December 3, 2017); Innocentive, "ODNI Crowdsourcing Artificial Intelligence Analysis," May 22, 2017, linked from the *Innocentive Home Page,* https://www.innocentive.com/odni-crowdsourcing-artificial-intelligence-analysis/ (accessed December 3, 2017).

[6] Jesse Roy Wilson, "Goldcorp Crowdsourcing, An Industry Best Practice for the Intelligence Community?" *Joint Force Quarterly Online*, no. 69 (2nd Quarter 2013): 21, http://ndupress.ndu.edu/Portals/68/Documents/jfq/jfq-69/JFQ-69_20-24_Wilson.pdf (accessed December 3, 2017).

[7] Steven Stottlemyre, "HUMINT, OSINT, or Something New? Defining Crowdsourced Intelligence," *International Journal of Intelligence and Counterintelligence* 28, no. 3: 579.

[8] Nicholas Mumm, "Crowdsourcing: A New Perspective on Human Intelligence Collection in a Counterinsurgency," *Small Wars Journal Online* (January 3, 2012): http://smallwarsjournal.com/node/12036 (accessed December 3, 2017).

[9] Center for Army Lessons Learned, *Commander's Guide to Money as a Weapon*: *Tactics, Techniques, and Procedures*, CALL Handbook 09-27 (Fort Leavenworth, KS: US Army Combined Arms Center, April 2009), 28, http://usacac.army.mil/sites/default/files/publications/09-27.pdf (accessed February 6, 2018).

[10] Department of the Army, *The Warrior Ethos and Soldier Combat Skills*, Field Manual 3-21.75 (Washington, DC: Headquarters, Department of the Army, January 28, 2008), 9-1, https://fas.org/irp/DoDdir/army/fm3-21-75.pdf (accessed February 7, 2018).

[11] Maryann Lawlor, "Web 2.0, Military Style," *Signal Magazine Online*, March 2008, https://www.afcea.org/content/web-20-military-style (accessed February 7, 2018).

[12] *Ushahidi Home Page*, https://www.ushahidi.com/features (accessed February 7, 2018).

[13] Anand Giridharadas, "Africa's Gift to Silicon Valley," *The New York Times Online*, March 13, 2010, http://www.nytimes.com/2010/03/14/weekinreview/14giridharadas.html (accessed February 7, 2018).

[14] Patrick Meier and Rob Munro, "The Unprecedented Role of SMS in Disaster Response: Learning from Haiti," *SAIS Review of International Affairs* 30, no. 2 (Summer-Fall 2010): 91.

[15] Angela Oduor Lungati, “Going Mobile: Information Sharing and the Changing Face of Digital Data Collection,” blog entry posted July 31, 2013, https://www.ushahidi.com/blog/2013/07/31/going-mobile-information-sharing-and-the-changing-face-of-digital-data-collection (accessed December 20, 2017). Simon Jeffery, “Ushahidi: Crowdmapping Collective that Exposed Kenyan Elections Violence,” blog entry posted April 7, 2011, https://www.theguardian.com/news/blog/2011/apr/07/ushahidi-crowdmap-kenya-violence-hague (accessed February 7, 2018).

[16] Ushahidi Staff, “Crisis Map Haiti: Some Final Reflections,” blog entry posted April 14, 2010, https://www.ushahidi.com/blog/2010/04/14/crisis-mapping-haiti-some-final-reflections (accessed February 7, 2018).

[17] Matthew Zook et al., “Volunteered Geographic Information and Crowdsourcing Disaster Relief: A Case Study of the Haitian Earthquake,” *World Medical and Health Policy Online* 2, no. 2 (2010): 14, http://www.un-spider.org/sites/default/files/Volunteered%20Geographic%20Information.pdf (accessed February 7, 2018).

[18] Ushahidi Staff, “Crisis Map Haiti, Some Final Reflections,” blog entry posted April 14, 2012, https://www.ushahidi.com/blog/2010/04/14/crisis-mapping-haiti-some-final-reflections (accessed February 7, 2018).

[19] Dennis King, *Haiti Earthquake: Breaking New Ground in the Humanitarian Information Landscape*, White Paper (Washington, DC: US Department of State Humanitarian Information Unit, July 2010), 3 and 5, https://reliefweb.int/sites/reliefweb.int/files/resources/4FCA4AC874331CFE85257768005AF32F-Full_Report.pdf (accessed February 7, 2018).

[20] Janine Erasmus, “Kenya On Top of Chile Data,” March 3, 2010, linked from the *Brand South Africa Home Page* “welcome to Africa,” https://www.brandsouthafrica.com/investments-immigration/africanews/ushahidi-040310 (accessed January 20, 2013).

[21] Meier and Munro, “The Unprecedented Role of SMS in Disaster Response: Learning from Haiti,” 93.

[22] Ibid.

[23] Ushahidi Staff, “Haiti, Taking Stock of How We Are Doing,” blog entry posted February 6, 2012, https://www.ushahidi.com/blog/2010/02/06/haiti-taking-stock-of-how-we-are-doing (accessed January 20, 2013).

[24] Meier and Munro, “The Unprecedented Role of SMS in Disaster Response: Learning from Haiti,” 95.

[25] Ibid., 93.

[26] Patrick Meier, “How Crisis Maps Saved Lives in Haiti,” *National Geographic Changing Planet,* blog entry posted July 22, 2012, https://blog.nationalgeographic.org/2012/07/02/how-crisis-mapping-saved-lives-in-haiti/ (accessed December 17, 2017).

[27] King*, Haiti Earthquake: Breaking New Ground in the Humanitarian Information Landscape,* 4-5. This endnote encompasses the paragraph.

[28] Zook et al., "Volunteered Geographic Information and Crowdsourcing Disaster Relief," 23.

[29] Jessica Ramirez, "'Ushahidi' Technology Saves Lives," *Newsweek Online*, March 3, 2010, http://www.newsweek.com/ushahidi-technology-saves-lives-haiti-and-chile-210262 (accessed December 17, 2017).

[30] Erasmus, "Kenya On Top of Chile Data."

[31] Steve Stottlemyre and Sonia Stottlemyre, *Crisis Mapping Intelligence Information during the Libyan Civil War: An Exploratory Case Study* (Washington, DC: US Department of State and Georgetown Public Policy Institute, n.d.), 4, http://ipp.oii.ox.ac.uk/sites/ipp/files/documents/Crisis%20Mapping%20Intelligence.pdf (accessed December 17, 2017).

[32] Stottlemyre, "HUMINT, OSINT, or Something New?" 4.

[33] Ushahidi Staff, "Crisis Map Haiti, Some Final Reflections."

[34] Andrej Verity, "The [unexpected] Impact of the Libyan Crisis Map and the Standby Volunteer Task Force," *Standby Volunteer Task Force*, blog entry posted December 19, 2011, http://www.standbytaskforce.org/2011/12/19/sbtf-libya-impact/ (accessed December 17, 2017).

[35] Ibid. This endnote encompasses the paragraph.

[36] Ibid. This endnote encompasses the paragraph.

[37] Stottlemyre, "HUMINT, OSINT, or Something New?" 4.

[38] Ibid., 7.

[39] Jose Verticat, "Open Source Mapping as Liberation Technology," *Journal of International Affairs* 64, no. 1 (Fall/Winter 2010): 196.

[40] Ushahidi, "Examples of Deployments," linked from the *Ushahidi Home Page* at "Support," https://www.ushahidi.com/support/examples-of-deployments (accessed January 20, 2018).

[41] IST Research "Gulu, Uganda and Haut Mbomou, Central African Republic, Surveying Attitudes Towards US Military Withdrawal and LRA," June 2017.

[42] IST Research, "Pulse Support to Operation Observant Compass Update as of Dec 2015," briefing slides, Crystal City, DC: IST Research, December 2015.

[43] United States Africa Command, "What We Do," http://www.africom.mil/what-we-do, (accessed January 20, 2018).

[44] IST Research, "Attitudes towards U.S. Military Withdrawal and LRA," summary report, Summer 2017, 1.

[45] IST Research, “Pulse Support to Operation Observant Compass Update as of Dec 2015,” briefing slides, Crustal City, DC: IST Research, December 2015.

[46] Ibid.

[47] Ibid.

[48] IST Research “Gulu, Uganda and Haut Mbomou, Central African Republic, Surveying Attitudes Towards US Military Withdrawal and LRA,” June 2017, 1. This endnote encompasses the paragraph.

[49] Ibid., 3.

[50] Ibid., 3-4.

[51] Ibid.

[52] IST Research, “Attitudes towards U.S. Military Withdrawal and LRA,” summary report, Summer 2017, 2.

[53] IST Research “Gulu, Uganda and Haut Mbomou, Central African Republic, Surveying Attitudes Towards US Military Withdrawal and LRA,” June 2017, 4.

[54] Ibid., 16.

[55] IST Research, “Jordanian Analytic Report, Understanding Susceptibility to Radicalization,” August 2017, 6. This endnote encompasses the paragraph.

[56] Ibid., 6-7.

[57] Ibid., 7.

[58] Ibid., 18.

[59] Ibid., 18-24.

[60] Ibid, 25.

[61] Ibid., 34.

[62] IST Research, “Understanding Susceptibility to Radicalization in Iraq,” summary report.

[63] IST Research, “Afghanistan Analytic Report – Part II, Population Engagement in Afghanistan Using Pulse,” March 2017, 2.

[64] Ibid., 7.

[65] Ibid., 13.

[66] Ibid., 35.

[67] Ibid., 11.

[68] Ibid., 2.

[69] Ibid., 7.

[70] IST Research, "Jordanian Analytic Report, Understanding Susceptibility to Radicalization," 34.

[71] Daniel Runde, "M-Pesa and the Rise of Global Mobile Money Market," *Forbes Magazine Online*, August 12, 2015, https://www.forbes.com/sites/danielrunde/2015/08/12/m-pesa-and-the-rise-of-the-global-mobile-money-market/#5f9f38515aec (accessed January 21, 2018).

[72] GSMA, *2016 State of Mobile Money in Sub-Saharan Africa* (London: GSMA, 2016), https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2017/07/2016-The-State-of-Mobile-Money-in-Sub-Saharan-Africa.pdf (accessed January 21, 2018).

[73] Runde, "M-Pesa and the Rise of Global Mobile Money Market."

[74] The Economist, "The Other Type of Mobile Money: Airtime is Money," *The Economist Online*, January 19, 2013, https://www.economist.com/news/finance-and-economics/21569744-use-pre-paid-mobile-phone-minutes-currency-airtime-money (accessed January 21, 2018).

[75] Seth Hall, "SwiftRiver in Plain English," *Ushahidi,* blog entry posted June 14, 2010, https://www.ushahidi.com/blog/2010/06/14/swiftriver-in-plain-english (accessed March 7, 2018).

[76] Stottlemyre, "HUMINT, OSINT, or Something New? Defining Crowdsourced Intelligence."

[77] Ibid., 585.

[78] Ibid.

[79] Ibid.

[80] Ibid.

[81] U.S. Joint Chiefs of Staff, *Joint Intelligence*, Joint Publication 2-0 (Washington, DC: U.S. Joint Chiefs of Staff, October 23, 2013), B-4, http://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp2_0.pdf (accessed January 21, 2018).

[82] Ibid., 119.

[83] Nick Lally, "Crowdsourced Surveillance and Networked Data," *Security and Dialogue* 48, no. 1 (February 2917): 66-67.

[84] Patrick Meier, "New Information Technologies and Their Impact on the Humanitarian Sector," *International Review of the Red Cross* 93, no. 884 (December 2011): 1260.

[85] Piotr Organisciak, "Design Problems in Crowdsourcing: Improving the Quality of Crowd-Based Data Collection," (PhD diss., University of Illinois, 2015), 19.

[86] Yavuz Yilmaz, "Targeted Crowdsourcing Using Participant Interest," (PhD diss., State University of New York at Buffalo, May 2015), XV.

[87] Lungati, “Going Mobile: Information Sharing and the Changing Face of Digital Data Collection.”

[88] Meier and Munro, “The Unprecedented Role of SMS in Disaster Response: Learning from Haiti,” 101.

[89] Meier, “New Information Technologies and Their Impact on the Humanitarian Sector.”

[90] Ushahidi Staff, “Taking the Lead: Ushahidi-Haiti @ Tufts,” blog entry posted February 19, 2010, https://www.ushahidi.com/blog/2010/02/19/taking-the-lead-ushahidi-haiti-tufts (accessed February 7, 2018).

Ushahidi Staff, “Crisis Map Haiti: Some Final Reflections,” blog entry posted April 14, 2010, https://www.ushahidi.com/blog/2010/04/14/crisis-mapping-haiti-some-final-reflections (accessed February 7, 2018).

[91] Meier and Munro, “The Unprecedented Role of SMS in Disaster Response: Learning from Haiti,” 100.

[92] Ryan Patterson, discussion with the Author, Arlington, Virginia, summer 2014.

[93] *Cities at Night Home Page*, http://citiesatnight.org/ (accessed January 22, 2018).

[94] King*, Haiti Earthquake: Breaking New Ground in the Humanitarian Information Landscape,* 6.

[95] Ibid.