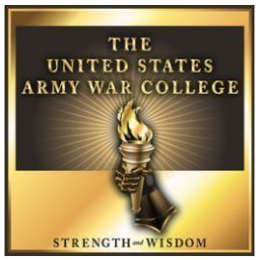
Strategy Research Project

Cloud Computing: The Way Ahead for Stability Operations

by

Commander Robert P. Johns
United States Navy



United States Army War College
Class of 2015

REPORT DOCUMENTATION PAGE

Form Approved--OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	**2. REPORT TYPE**	**3. DATES COVERED** *(From - To)*
01-04-2015	STRATEGY RESEARCH PROJECT	

4. TITLE AND SUBTITLE
Cloud Computing: The Way Ahead for Stability Operations

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Commander Robert P. Johns
United States Navy

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Dr. Raymond A. Millen
Peacekeeping and Stability Operations Institute

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.

13. SUPPLEMENTARY NOTES
Word Count: 7037

14. ABSTRACT

Even during a time of reduced budgets, the United States will continue to support worldwide stability efforts as part of its foreign policy and national security strategy. Accordingly, U.S. national interests are best served by partnering with other countries, international agencies, and non-governmental organizations to conduct stability operations effectively. Integral to any stability operation is information sharing to coordinate the efforts of all stakeholders involved. With a myriad of existing information systems and capabilities, the task of effectively sharing information among partners in a rapidly changing stability environment becomes imperative. The advent of “cloud computing” presents a unique opportunity to create information sharing among disparate groups at a relatively low cost. Conceptually, cloud computing offers an innovative means to assist in U.S. stability operations by optimizing and harmonizing the challenges of information sharing. This paper explores the basis for continued U.S. participation in stability operations, the salient challenges with information sharing during stability operations, the innovative solutions offered by cloud computing, and some of the challenges with respect to cloud computing.

15. SUBJECT TERMS
Information Sharing, Collaboration, Information Sharing Challenges, Coordination

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	

USAWC STRATEGY RESEARCH PROJECT

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Commander Robert P. Johns
United States Navy

Dr. Raymond A. Millen
Peacekeeping and Stability Operations Institute
Project Adviser

This manuscript is submitted in partial fulfillment of the requirements of the Master of Strategic Studies Degree. The U.S. Army War College is accredited by the Commission on Higher Education of the Middle States Association of Colleges and Schools, 3624 Market Street, Philadelphia, PA 19104, (215) 662-5606. The Commission on Higher Education is an institutional accrediting agency recognized by the U.S. Secretary of Education and the Council for Higher Education Accreditation.

U.S. Army War College
CARLISLE BARRACKS, PENNSYLVANIA 17013

Abstract

Title:	Cloud Computing: The Way Ahead for Stability Operations
Report Date:	01 April 2015
Page Count:	43
Word Count:	7037
Key Terms:	Information Sharing, Collaboration, Information Sharing Challenges, Coordination
Classification:	Unclassified

Even during a time of reduced budgets, the United States will continue to support worldwide stability efforts as part of its foreign policy and national security strategy. Accordingly, U.S. national interests are best served by partnering with other countries, international agencies, and non-governmental organizations to conduct stability operations effectively. Integral to any stability operation is information sharing to coordinate the efforts of all stakeholders involved. With a myriad of existing information systems and capabilities, the task of effectively sharing information among partners in a rapidly changing stability environment becomes imperative. The advent of “cloud computing” presents a unique opportunity to create information sharing among disparate groups at a relatively low cost. Conceptually, cloud computing offers an innovative means to assist in U.S. stability operations by optimizing and harmonizing the challenges of information sharing. This paper explores the basis for continued U.S. participation in stability operations, the salient challenges with information sharing during stability operations, the innovative solutions offered by cloud computing, and some of the challenges with respect to cloud computing.

Cloud Computing: The Way Ahead for Stability Operations

The United States is attempting to rebalance the national security focus from the Middle East to a global focus with increased attention toward the Asia-Pacific region. However, similar to the end of the Cold War and Operation Desert Storm, the Department of Defense (DoD) will undergo another force drawdown. Along with military personnel reductions, DoD's budget will decrease from $720 billion in 2011 to $581 billion in 2014, with an expected decline to $540 billion by 2020.[1] The 2011 Budget Control Act may lead to additional cuts as DoD meets its share of a mandated sequester cut of $50 billion annually from the U.S. Budget.[2] As such, senior political and military policy makers will face difficult decisions to shape the future U.S. military.

Despite reduced budgets, the United States will continue to support worldwide stability efforts as part of its foreign policy and national security strategy. America's new fiscal realities require national leaders to focus the elements of national power to meet U.S. strategic interests. Accordingly, U.S. national interests are best served by partnering with other countries, international organizations, and non-governmental organizations to conduct stability operations effectively. As noted in Joint Publication 3-07, stability operations include foreign humanitarian assistance, peace operations, nation assistance, and counterinsurgency, and may occur over the entire range of military operations.[3]

Although stability operations vary in type and size, information sharing is integral to coordinate the efforts of all stakeholders involved. Information systems and capabilities differ greatly between stakeholders, from fully capable to non-existent, so the task of effectively sharing information among partners in a rapidly changing stability environment becomes imperative. In 2007, as Chief of Naval Operations, ADM Mike

Mullen advocated creating a 1000 ship navy to allow countries to help another with disaster relief, or other challenges, such as piracy and smuggling that affect local and regional stability.[4] He also noted the varying technological levels of the world's navies, and suggested using the maritime Automatic Identification System as an inexpensive technological investment for all navies to assist with maritime security by providing a common picture of ships' location within a local, regional, or international area.[5] Cloud computing could provide a similar function for the United States and its partners during stability operations.

Cloud computing represents a shift in how the internet is used. Simply defined, cloud computing is using the internet, rather than local hardware, to access computer applications, data storage, servers and databases.[6] The advent of cloud computing presents a unique opportunity for information sharing among disparate groups at a relatively low cost. Conceptually, cloud computing offers an innovative means to assist in U.S. stability operations by optimizing and harmonizing information sharing. This paper explores the basis for continued U.S. participation in stability operations, the salient challenges with information sharing during stability operations, the innovative solutions cloud computing offers, and some of the challenges associated with cloud computing.

Continued U.S. Participation in Stability Operations

Even in austere fiscal circumstances, the United States will remain committed to preserving the international order. America will continue to engage in stability operations to promote and protect U.S. national interests. The National Security Strategy firmly establishes America's commitment to the international order by including it as one of four American national interests. The other three--security, prosperity, and values--also

mention support to international order and stability. The NSS discusses working with international partners and organizations to combat terrorism, preventing conflict, counter-proliferation, access to shared spaces, and fighting global pandemics.[7] The United States will also work with international organizations to promote universal values and lead efforts to address mass atrocities by providing protection and assistance.[8] Finally, the NSS recognizes that the United States needs work with the United Nations (UN), regional organizations, international financial institutions, specialized agencies, and other actors that are better placed or equipped to manage from peacekeeping to humanitarian relief to ensure their future viability.[9]

Other key national level guidance mirrors the NSS in calling for U.S. participation in stability operations and increased cooperation and collaboration with allies. The National Military Strategy (NMS) notes that American interests are deeply interconnected with the security and stability of the international system, which includes our partners, allies, and international organizations.[10] The State Department's 2012 Quadrennial Diplomacy and Development Review (QDDR) recognized, as part of U.S. foreign policy, America's need to involve its allies and emerging regional and global centers of influence to help share the burden of present and future challenges.[11] It also recognizes that the UN assists with multinational and multilateral burden sharing due its organizational legitimacy and involvement in a variety of issues.[12]

Most important for the purposes of this paper, NMS, as well as the 2012 Defense Strategic Guidance (DSG), illustrate the importance of information sharing. The NMS approaches the concept of information sharing by discussing improving the sharing and dissemination of information to better support decision makers.[13] The DSG's language

also creates an opportunity for the application of cloud computing in support of stability operations. The DSC mentions that the United States will “develop innovative, low-cost, and small footprint approaches” to meet national security objectives.[14]

DoD has incorporated this guidance into Joint Doctrine, including JP 3-07, *Stability Operations*, and JP 3-16, *Multinational Operations.* JP 3-07 notifies a Joint Force Commander (JFC) to expect a variety of actors to be present during a stability operation. These can include: U.S. government agencies, host nation organizations and agencies, allies, IGOs, NGOs, and private sector efforts.[15] To meet national objectives, the JFC is expected to pursue unified action to coordinate, or integrate, the efforts of the disparate groups to share the burden of stability operations.[16] JP 3-07 also discusses the importance of legitimacy in stability operations, and references JP-3-16 regarding multinational operations.

JP 3-16 further instructs the JFC to expect to conduct military operations as part of a multinational force, and coordinate between military and other entities.[17] JP 3-16 also addresses information sharing in its discussion of Rationalization, Standardization, and Interoperability (RSI). RSI, in terms of information sharing, provides guidance regarding communication at appropriate levels to protect information, assuring technical compatibility that includes communication equipment and data transmission streams, and using standardization to eventually achieve a commonality between multinational partners.[18]

As stability operations gather further importance in meeting U.S. national objectives, information sharing will be an integral enabler to success. Joint Doctrine addresses information sharing within RSI, and DoD policy instructs the Undersecretary

of Defense (USD) for Policy, the USD for Intelligence, and the DoD Chief Information Officer to coordinate in developing policies and systems to share classified and unclassified information among all stability operations participants, from U.S. military to NGOs.[19] Additionally, DoD policies instruct commanders to share information with relevant partners, and create a "responsibility to provide" mentality to readily share unclassified data as quickly as possible to an end user.[20] Although the U.S. strategic documents and doctrine provide reasons for America to participate in stability operations, there are information sharing challenges that could limit their effectiveness.

Information Challenges to Stability Operations

Improvements in information and communications technology (ICT) allow the U.S. military, other U.S. agencies, IGOs, NGOs, and other organizations to access and transfer information easily, but significant challenges to information sharing during stability operations remain. One challenge is technological limitations caused by differing levels of technology that each stakeholder brings to stability operations. Another limitation is the creation of information silos (explained below) between organizations that limit effective information sharing. One last challenge is the information overload caused by the exponential growth and access to information via ICTs.

Differing levels of technology limit information sharing among organizations conducting stability operations. One of the benefits in U.S. military participation in stability operations is the superior level of command and control, via high ICT levels, it can bring to any operation. Unfortunately, high ICT costs limit the ability for countries and organizations to obtain technology similar to U.S. military levels, which can pose a technological barrier to information sharing.

Although the biggest difference is usually found outside the U.S. government, the disparity of information technology budgets among U.S. agencies also contributes to information sharing challenges. According to the USG's ITdashboard website, DoD spent $31.3 billion in information technology (IT) expenditures for FY2014.[21] DoD's expenditure is larger than the next seven agencies combined, and is 19.5 times larger than the combined State Department/USAID IT expenditure of $1.6 billion.[22] This gross difference creates a significant ICT[23] gap among DoD and State and USAID, which are its primary partners in stability operations.

The differences are even greater between DoD and Intergovernmental Organizations, such as the United Nations (UN). The UN manages two budgets, a $5.2 billion regular budget and $7.06 billion peacekeeping budget.[24] The DoD IT budget is almost twice the size of the combined UN regular and peacekeeping budgets. To further highlight the disparity, the UN Office for the Coordination for Humanitarian Affairs (UNOCHA), another key or possible partner in stability operations, spent just $12.8 million on communications and information management in 2013.[25] The United Nations noted that lack of IT investment was an impediment to information sharing.[26]

NGO IT expenditures vary, but are significantly smaller than DoD and the United Nations. However, most NGOs share the following similarities. First, the NGO's mission takes priority over everything, including ICT infrastructure. On average, NGO's spend about two percent of their budgets on overhead, which includes IT.[27] The overall priority is based on satisfying donors, not efficiency of operations.[28] Next, this cost-management strategy (or lack thereof) forces the NGOs to develop unique mitigation strategies. Due to budget limitations, NGOs use commercial off-the-shelf (COTS)

technology to help minimize costs.[29] This also steers NGOs to purchase IT software and hardware that are specific to their needs. Consequently, no two NGOs will have the same ICT infrastructure.[30] Although NGOs face ICT challenges, these pale in comparison to the underdeveloped countries where they normally operate.

Underdeveloped nations have fiscal constraints that limit their IT expenditures. Namely, the countries' need for basic infrastructure overrides the development of IT infrastructure. Although technology is becoming easier and cheaper to purchase, it still needs a basic services infrastructure to operate. The ability for a nation to absorb and benefit from new technology is based on the availability of basic infrastructure, like an electrical grid or other stable sources of power for the IT systems.[31] Additionally, the high start-up costs of IT infrastructure may prevent countries from investing in them due to other more immediate needs, such as roads or hospitals.

Although the U.S. military has placed a high premium on ICT, other agencies, organizations, and countries lack the financial resources to purchase comparable systems. Organizations develop specialized systems to answer the specific information needs of a particular organization. The resulting variety of ICT systems may or may not be able to effectively communicate with each other and share information effectively. This situation contributes to the next challenge, information silos or stovepipes.

While there is an abundance of information and ICT systems available to countries and organizations during stability operations, technological limitations due to funding can contribute to a condition known as information silos. An information silo is a term that refers to a place where information, priorities, and control move vertically.[32] While information silos can be online, it also can refer to information that is stored

locally on hard drives and shared via email between certain partners. In stability operations, it may mean information and analysis are segregated which increases the difficulty in building a composite information picture.[33]

The ICT hodgepodge creates barriers that are hard to overcome. ICT systems that were purchased by a specific organization to fulfill a specific need lead to fragmented information. In the 2010 Pakistan floods, a key issue was a lack of standardized information gathered through varied processes from different organizations.[34] This lack of standardization creates data that cannot be easily shared among groups to be processed effectively into information. For example, after the 2010 Haitian earthquake, Ushahidi, an open-source crowd-mapping tool, was unable to integrate into the relief efforts fully since its data sets did not match those used by the UN and some NGOs.[35] Additionally, some NGOs are unwilling to share information due to competition over donor funding, or simply the perception that they did not need to share for their operations to be effective.[36]

The U.S.-specific information systems also creates silos during stability operations. In Afghanistan, among other operations, NGOs, IGOs, and even certain allies and partners have noted that unclassified information provided to the United States quickly moves to restricted networks for sharing among U.S. organizations (either in-country or within America), but rarely reemerges from said networks to support operations.[37] Although information silos limit the type of information that is shared, advancements in information technology contribute to another problem in stability operations, information overload.

At one time, the greatest challenge to stability operations was the lack of information regarding the environment. However, ICT advancements contribute to the opposite problem, information overload. For example, due to advancements in mobile technology, people afflicted by the 2010 Haiti earthquake were able to use social media and mobile communications to request help.[38] Japanese civilians tweeted 2000 tweets per second after the 2011 Japanese earthquake, and Americans posted over 20 million tweets and photos after Hurricane Sandy.[39] Combined with information coming from U.S. agencies, UN, host nation, IGOs, NGOs, and Private Volunteer Organizations (PVOs), sharing the right information becomes problematic in part due to limited personnel who may not have the time, expertise or capabilities to evaluate information to make better decisions about allocating efforts and resources.

In stability operations, individuals focus on remedying the situation, particularly in humanitarian assistance and disaster relief. Since most NGOs and IGOs either have no or very few dedicated IT individuals in the field, information sharing becomes a secondary (or more likely tertiary) task. During the Haitian Earthquake, many organizations, such as Médecins Sans Frontières and the British Red Cross, did not collect and share data because of their focus on immediate disaster relief efforts.[40]

ICT improvements also allow units in the field better communications with respective home organizations and senior officials. Unfortunately, the respective demands for information by the home organizations limit information processing and sharing. Prompted by a twenty-four news cycle, senior UN and NGO staff constantly demanded basic metrics and operational data over higher humanitarian priorities after the Haiti earthquake. The UN staff in Haiti, overburdened by the situation, were quickly

overcome by the repeated situational awareness requests from offices outside the country.[41]

As ICT infrastructure is restored within the afflicted nation, additional information is introduced as affected individuals use social media to express their plight. Social media (texts, Tweets, Instagram, Facebook posts, etc.) is rapidly becoming a source of information during stability operations. However, the volume of social media platforms presents a concern for information management as the deluge of information can quickly overwhelm responding organizations in the affected area. It is estimated that Haitians sent hundreds of thousands of texts to convey information to relief workers, the volume and velocity quickly began to overwhelm them.[42]

Information overload makes it difficult for relief workers to find the right information to share that will best support the goals of the stability effort. Although there will be no single solution to address all the needs of all the actors within a stability operation, cloud computing presents an opportunity to share information with the right consumer when they need it.

Using Cloud Computing to Address Information Sharing

As the use of cloud computing grows in the public and private sectors, the technology is also an innovative option to improve information sharing during stability operations. As previously mentioned, cloud computing uses the internet, instead of local hardware, to access computer applications, data storage, servers and databases.[43] It is an adaptive, holistic ICT system that can be accessed globally, using any computing device from a desktop computer to tablet to mobile phone. As an illustration, Google and its services exemplify a cloud computing service provider. Cloud computing presents innovative solutions to address information sharing during stability operations

in the areas of ICT budget savings, universal usage, information availability, and variety of applications.

ICT Budget Savings

One of the dramatic benefits from cloud computing is the relatively large reduction in IT infrastructure costs. A recent survey found in 2013 that the average cost reduction from cloud computing was 23 percent of business IT infrastructure costs, which businesses were able to reinvest into their corporations.[44] If DoD could reduce its IT budget by 23 percent, the resulting savings of $7.2 billion could fund the entire UN Peacekeeping Budget for 2014.[45] Since a great deal of the IT infrastructure would reside at the cloud provider rather than the organization, this system could greatly reduce IT overhead costs, allowing organizations to spend less on IT personnel and more on direct operations.[46]

Cloud computing also works on an economy of scale, in which organizations can pay for what they use instead buying systems and capabilities they may not need.[47] For instance, if an organization decided to invest in Google Apps for Work, they could pay $5 per user per month, or $50 per user per year, but their data storage would be limited to 30GB per user.[48] Alternatively, they could pay $10 per user per month, or $120 per user per year, for unlimited data storage, an electronic vault for archiving information, and other functionalities not found on the $5 service.[49] Google also provides options to add and remove users depending on what plan is selected.[50]

Finally, since cloud computing is software versus hardware based, costs are reduced for IT maintenance and upgrades. Upgrades are made at the server with little to no impact to the users.[51] For example, if an organization of 100 people were to convert their operation from a traditional IT infrastructure to Google and Google

Chromebooks, their IT costs could go from $621,300 to $107,200 over three years.[52] Google also provides verified non-profit organizations with free, or highly discounted, services which create additional benefits to move to cloud computing for NGOs.

For IGOs, NGOs and other organizations that have much smaller budgets, the move to the cloud can provide a modern IT infrastructure at an optimal cost that is updated and relatively easy to access globally. There are three different cloud computing infrastructure levels from which can choose. Every level offers a different amount of control to the user. The most familiar level is also the highest level of cloud computing: Software as a Service (SaaS). SaaS is "the capability provided to the consumer . . . to use the provider's applications running on a cloud infrastructure.[53]" In other words, the user selects from applications provided by the service via an internet browser. Examples of SaaS applications include Google for Governments, Gmail, Google Drive, Dropbox, and Microsoft Office 365.[54]

The next level offers the user more flexibility: Platform as a Service (PaaS). PaaS is "the capability provided to the consumer . . . to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages, libraries, services, and tools supported by the provider.[55]" PaaS provides more flexibility by allowing the user to develop applications while the cloud provider arranges and supports the rest of the cloud infrastructure.[56] Users can build applications to meet their needs. Examples of PaaS applications include Amazon's Elastic Beanstalk[57] and Salesforce Force.com.[58]

The last level offers the most flexibility: Infrastructure as a Service (IaaS). IaaS is "the capability provided to the consumer . . . to provision processing, storage, networks,

and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications.[59]" IaaS provides the most flexibility of the three options since the service provider creates the cloud infrastructure, and the user creates, maintains and updates his/her own platform and software.[60] IaaS offers the user a level of control over security and access. Amazon's Elastic Compute Cloud (EC2)[61] is an example of this system.[62]

Additionally, DoD is moving toward the Joint Information Environment, a cloud computing enterprise, in part to reduce DoD IT overhead costs. DoD's current IT infrastructure is a collection of disparate IT capabilities that create a barely compatible information environment that can limit information sharing. *It is also cost-prohibitive to operate and maintain*.[63] In late December 2014, DoD published a new cloud computing policy that will further enable commercial organizations to house military data and applications, and allow the Services to obtain cloud services for themselves.[64] The U.S. Navy's Space and Naval Warfare Systems Command began moving its IT systems to the cloud in late 2013/ early 2014, and noticed a significant savings in its IT storage costs from $.09 per gigabyte to $.033 per gigabyte.[65] As a key enabler for stability operations command and control, the U.S. military's move to cloud computing for cost savings further encourages the use of cloud computing for information sharing.

Universal Usage

Although cloud computing allows near limitless access to information based on an internet connection, it also presents a universal usage that accommodates users regardless of their device or particular operating system. This allows information to be shared and manipulated across a variety of platforms and operating systems. Universal usage also addresses a key challenge in information sharing, the disparate systems

that various U.S. agencies, UN, IGOs, NGOs, and PVOs currently use during stability operations. Furthermore, buy-in from participants would likely be easier since it does not rely on a specific computer or system. Google Drive and Docs Editor can work on Windows Systems from XP to Windows 8, Mac Systems from Lion to Mavericks, and via the web for LINUX users or using the mobile app.[66] This functionality allows individuals to access online storage (Google Drive) and create and edit various text documents, spreadsheets and presentations (Google Docs Editor).

Google Drive and Docs editors as well as other Google apps also work on mobile technology including iPhones, Windows Phones, Blackberries, and Android phones. This functionality can take advantage of the growing mobile communications market, especially in underdeveloped countries. Cellular technology has exploded in the past twenty years as ICT improvements allow users to do more with their handheld devices. Individuals can call, text, listen to music, send photos and videos, and explore the Internet using their mobile devices. One of Google's selling points is that its cloud system allows people to access work from any device with a web browser from home, waiting for a flight or sitting in a car.[67] As the use of mobile technology increases within underdeveloped countries, so does the ability to use mobile devices to access the cloud to share information during stability operations.

Cellular technology continues to grow rapidly in the Third World. It has allowed nations to leapfrog costly wired communication structures to provide a fairly reliable and extensive wireless communications system to their citizens.[68] In 2012, mobile phone use grew to nearly five billion subscribers in developing nations, and three-quarters of the planet has access to cellular networks.[69] One example that illustrates the power of

mobile technology in the Third World is how 68 percent of all Ugandans regularly use their cell phone to conduct monetary transactions, compared to Russia at 24 percent.[70]

The rapid growth in mobile technology changed the nature of humanitarian assistance and disaster relief. In 2012, the Philippine government used mobile communications and social media to prepare citizens for Typhoon Pablo. It provided mobile-accessible websites to direct people to shelters, created a Twitter hashtag for the storm to specify tweets for aid, and used the tweets to help with early assessment efforts with the United Nations.[71]

Individuals from IGOs, NGOs, host nation, coalition partners, and other groups will likely use mobile phones during stability operations. Approximately 86 percent of all NGO workers surveyed stated that they use mobile technology to accomplish their mission, namely for SMS texting and collecting data, photos, and videos.[72] Mobile technology allows relief workers input and share information regarding an afflicted population during a stability operation by accessing the cloud from their mobile devices. This ability to access information from virtually anywhere by anyone makes cloud computing an excellent option for information sharing during stability operations.

Information Availability

The centralization of data provided by cloud computing provides excellent information sharing opportunities. Data centralization allows in-country and home personnel access to the same data. Google Apps allows effortless collaboration across teams, agencies and locations in real time since all players can access the latest version of any file via the cloud.[73] This level of access could greatly reduce the amount of questions from higher headquarters since they will be able to access data

themselves, allowing deployed personnel to focus operations. Additionally, the cloud innately allows reach-back support.

As budgets decrease, numerous organizations are exploring the concept of reach-back support to bridge the gap of reduced deployed personnel. Reach-back is a process where deployed forces can request assistance from remote expert sources of information.[74] The U.S. military used the reach-back concept to provide support during Operations Enduring and Iraqi Freedom with varying degrees of success.

The internet uses crowdsourcing as a way to provide extra assistance, particularly during crisis situations. The cloud allows volunteers and other concerned individuals global access to the same data. This type of assistance is important as organizations involved in stability operations are overcoming basic connectivity issues to a deluge of information from affected populations and people willing to assist.[75] The 2010 Haiti earthquake offered the first instance of crowdsourcing during a disaster. Volunteers and Technical Communities (V&TCs) from around the world provided valuable support with data analysis to help disaster relief efforts.[76] Ushahidi[77], Frontline SMS[78], Crowdflower[79], and other companies worked with the U.S. State Department to create a text-message hotline to support Haitian relief efforts.[80] Using the hotline and other social media sources and humanitarian situation reports, these V&TCs provided fast situational awareness products, including imagery-based maps used by the U.S. Coast Guard, the 22nd U.S. Marine Expeditionary Unit, and other first responders in relief operations.[81]

Using the cloud as an information sharing device, crowdsourcing becomes more effective since the information is not locked away in silos as in previous stability

operations. One of the largest challenges Haiti relief workers faced was the lack of basic data regarding humanitarian information (demographics, roads, health facilities, previous humanitarian projects, etc.) that was unavailable although the United Nations operated in the country for decades.[82] This information silo caused groups to reinvent the data as they began operations, causing delays in assistance. The challenge was compounded as affected Haitians began using social media to request assistance.[83]

UNOCHA is attempting to combat this issue using cloud computing. UNOCHA established Humanitarianresponse.info[84], an online community that provides a repository of common and functional operational datasets of basic humanitarian information needed during a disaster as well as access to variety of online tools.[85] Additionally, UNOCHA created the *Digital Humanitarians Network* to link humanitarian organizations to V&TCs using cloud computing and collaborative tools to link those organizations for expertise, social media monitoring, and big data analysis.[86] For this type of collaboration and information sharing to be effective, cloud computing will be needed to freely share data and allow multiple actors in various locations access to said data simultaneously.

Applications

Although cloud computing can be a partial solution to information sharing during stability operations, an understanding of the types of applications that are available on the cloud requires further study. Using Google, the applications in the areas of visualization, data processing and communications will be examined for their potential use in stability operations.

Google uses Google Maps and Google Earth as their geographic visualization tools. Google Maps can provide maps of various locations that contain some basic

information of the operational environment including roads, rail and subway systems, hospitals, schools, and large sports complexes. Additionally, users can create customizable information flies that can be added as layers on Google Maps.[87] Users involved with stability operations can show information such as: ethnic and tribal areas, damaged transportation routes, temporary IDP or refugee camps, or status of services in an area. Users can also use Google Maps to share and consolidate data from other mapping software and from spreadsheets stored in Google Sheets. Custom maps can be easily shared or exported in a KML file.[88]

Google Earth can provide global imagery and display information from Google Maps. Additionally, Google Earth Pro, recently made free to all users, can aid in stability efforts by allowing users to create three dimensional views and fly-through of cities and areas, import large amounts of Geographic Information System (GIS) data, and easily measure distances and areas.[89] The visualization tools allow users to work from different systems as well as account for areas where Google Maps is not fully developed. Along with map information, Google's Picasa and YouTube can share photos and videos, respectively, and can be imbedded into Google Maps and Earth.

As part of its cloud computing architecture, Google also offers data processing applications similar to Microsoft Office. Google Docs offers the word processing functionalities of Microsoft Word within the cloud. It can import and convert Word and PDF files and export documents in those formats, plus .txt, .odt, .html, and .rtf formats.[90] Docs also allows for real-time collaborative editing and chat with an unlimited revision history.[91] Google Sheets is similar to Microsoft Excel and Google Slides is similar to Microsoft PowerPoint, and contain similar functionalities as Google Docs.

Additionally, Google also offers Google Forms and Google Sites. Google Forms can create custom surveys and questionnaires whose data can be analyzed with Google Sheets. It can also ensure that certain data sets, such as email addresses, dates, and names, are formatted correctly.[92] A quickly generated form that provides standardized data into the cloud would be helpful in sharing information that can be easily accessed and used by local and distant agencies during a stability operation.

Google Sites can create a website to collaborate internally within an organization or across the web depending on the access set by the organization.[93] Information can be shared relatively easy via a web page, but certain aspects can be controlled to protect individuals, groups or ethnicities during a stability operation.

Google also provides ways for organizations to communicate via the cloud that can assist in stability operations. Google Hangouts would be helpful during stability operations. Hangouts can be used to send and receive SMS and MMS messages if it is linked to an Android phone.[94] Organizations can purchase and use low-cost Android phones to use Hangouts with SMS/MMS. This functionality is similar to the FrontlineSMS program, which also allows an individual to send and receive SMS messages either using a mobile account or via an online gateway such as Clickatell or IntelliSMS.[95]

Hangouts can also be used to create multiparty chats between Google users as well as a video and voice chat capability up to ten users.[96] Google also provides a VTC capability with Chromebox for Meetings, starting at $1000 per unit. The VTC can accommodate 15 participants and can connect with other Google applications.[97]

Hangouts and Chromebox for Meetings can provide organizations with a VTC capability that is scalable to costs.

Although communications are necessary, communications in the right language are vital. Stability operations will involve various people speaking various languages. Google Translate can help bridge the gap to begin operations until translators arrive. Translate can access 90 languages and can receive inputs via text, voice, writing, or picture.[98] It can operate on computers, tablets, and mobile devices- even offline with an Android Phone.[99] Translate can automatically translate websites and documents as well.[100] Language barriers can seriously impede information sharing, and cloud computing provides a way to overcome them.

The uses of Google for stability operations are not limited to the areas addressed in this paper because it is ever evolving to meet its customers' needs. More importantly, Google's applications can be used on any desktop, laptop, or mobile device with any operating system. That universal usage combined with the ability to be used either via Wi-Fi or cellular signal provides numerous options for information sharing in stability operations. However, several concerns may limit information sharing via the cloud.

Potential Concerns with Using Cloud Computing for Information Sharing

Although cloud computing presents an excellent solution for information sharing, three major issues may present challenges with using cloud computing in stability operations: security, trust, and connectivity. Each of these issues has the potential to derail efforts to move to cloud computing for information sharing during stability operations.

Data security is the biggest challenge facing cloud computing. Reports of data breaches are a regular occurrence, and might cause some participants to hesitate their

migration to the cloud. Over 2014, major retailers and organizations, such as Target, Amazon, Washington State Courts, and Maricopa Community College, reported data breaches that compromised personal information including: full names, credit card data, email addresses, and Social Security numbers.[101]

Serious security breaches with high profile organizations could lead IGOs, NGOs and other organization to resist moving to cloud computing. Humanitarian organizations are increasingly concerned about cyber-attacks from hostile governments, armed non-state groups like al Qaida, or malicious hackers to gain access to sensitive personal information to use against aid recipients.[102] Additionally, social media, which resides on the cloud, can be misused to attack individuals. For example, Mexican civilians who were publicly posting drug cartel activity near the U.S.-Mexican border were murdered in 2011. Their bodies were found with the web site addresses of where they were posting their information.[103]

Similarly, there are concerns about the potential misuse of data if shared via the cloud. Due to the fine line between intelligence and information, NGOs and other groups may be hesitant to share information with the U.S. military over concerns that it could be used for intelligence to support military operations.[104]

However, there are mitigation strategies to alleviate security concerns. First, cloud organizations provide a layer of security for their services. Google uses an optimized custom secured operating system and file structure. Additionally, it encrypts content that moves between the users and Google servers, between Google data centers, and from Google servers to other companies' servers with 2048-bit key, the leading encryption in security.[105] This upgrade to 2048-bit encryption was due to

concerns over reported U.S. government surveillance over internet activity leaked by Edward Snowden.[106] Next, there are services that encrypt data on a personal computer before it is stored in the cloud. Companies, such as SpiderOak and Personal.com, encrypts the data before it is uploaded to the cloud. Only the user will know what information is being encrypted, but it will limit information sharing.[107]

Also, it is important to note that previous cloud breaches were not accomplished by breaking the encryption, but due to brute force attacks that repeatedly attempted to guess passwords on particular accounts[108] or other methods that comprised previous IT infrastructures like phishing or key logger programs. As a testament to its security, the Central Intelligence Agency went to cloud computing in August 2014. Although its cloud is protected by the Intelligence Community firewall, it uses Amazon's cloud technology to provide services to the 17 U.S. Intelligence agencies.[109] Due to the various levels of classified information, the CIA cloud will segregate information to ensure only authorized users receive certain information, preventing security breaches or misuse of data.

The next significant challenge to cloud computing is the issue of trust. Trust breaks down into two subcategories: source of the data and cloud ownership. One of cloud computing's strengths is the ability for users to access data globally. However, this ability also means other organizations can access and manipulate the data, which can cause misgivings about the data's fidelity. The volunteer and technical communities provided invaluable assistance during the 2010 Haiti Earthquake, but were initially met with some resistance by the relief organizations. Ushahidi, for example, met with some resistance since its base of operations was in Boston, Massachusetts. It was not until its

data was continually verified as accurate, and some Ushahidi staff went to Haiti, that relief workers accepted the organization's information.[110]

Additionally, there are concerns from various humanitarian organizations that V&TCs do not fully understand some important humanitarian principles such as neutrality and impartiality, and due to their distance from a crisis, their level of commitment.[111] The V&TC crowdsourcing efforts can also miss the local knowledge that is necessary for successful operations, such as tribal dynamics, local politics, and local customs.[112] Finally, most organizations are hesitant to try or trust the V&TCs in crisis situations. Staffs and organizations tend to trust the tools and processes that are most familiar to them, and will not try new things during a crisis.[113]

Trust issues can also occur with who operates the system. The United States Department of Defense developed the All Partners Access Network (APAN) to serve as its premier unclassified information sharing and collaboration network.[114] Although the network was successful with collaboration and sharing environments like Afghan Information Sharing (Ronna), Humanitarian Assistance in Haiti (in 2010), and the Ebola Response Network, there are still organizations that will not use or collaborate with APAN because it is a U.S. DoD network. Highlighting this opinion in a 2006 *European Affairs* editorial, Nicolas De Torrenté, Executive Director of MSF-USA (Doctors without Borders), wrote it was impossible for the military and humanitarian organizations to collaborate without compromising the other missions. De Torrente further expressed that the two groups should not even try.[115]

The issues of trust and security may be rendered moot if there is no connectivity to the internet to support the information sharing cloud for stability operations. Cloud

computing's main premise is based on an assumption that users will have the necessary communications infrastructure to access the internet. Unfortunately, most stability operations occur in locations where the local infrastructure is either degraded or destroyed. However, as the 2010 Haiti Earthquake and 2012 Typhoon Pablo illustrated, mobile infrastructure can be very robust in crisis situations. Within a few days, mobile phone communications were restored in Haiti, before the 4636 emergency SMS number was operational.[116]

ICT advancements also allow IGOs and NGOs to use satellite phones and Very Small Aperture Terminals (VSATs) by smaller organizations. Many field workers are using VSAT technology to have internet communications in less developed areas of the world.[117] Alternatively, the massive capabilities of U.S. military communications could create a temporary wireless network to support stability operations until other communications infrastructures become available.

In 2009, a group of Massachusetts Institute of Technology students created a public use wireless network in Jalalabad, Afghanistan with easily fabricated point to point antennas and commercially available data routers.[118] Although the Jalalabad network was open for all to use, a similar U.S. wireless network in a stability operation could provide simple internet privacy encryption to allow allies, coalition partners, IGOs, NGOs and other organizations access to the network for information sharing.

Although there are challenges to using the cloud for information sharing during stability operations, the mitigation strategies should be able to allay some misgivings to convert to the cloud. Cloud encryption is pretty fairly robust, and can be partitioned to protect personal information while still allowing enough data to be shared to contribute

to stability operations. Using Google or another civilian cloud provider would provide a level of trust by using a proven, familiar technology. Additionally, it would lessen the stigma of a U.S. governmental system that may limit organizations from participating in the cloud. Finally, communications infrastructure is sufficient to provide access to the internet for the cloud to work. Mobile communication systems are fairly robust, VSAT technology is fairly available, and the U.S. military could potentially deploy a temporary network with existing technology.

Conclusion

As the United States continues to participate in stability operations during a time of fiscal austerity, cloud computing provides an excellent solution to information sharing during stability operations. Since the majority of the IT costs are borne by the cloud provider instead of the user, the Department of Defense and its U.S. government partners could save significant funds that could be used for other operations and activities, including additional personnel. For the United Nations and other inter- and non- governmental organizations, cloud computing will allow those organizations to maximize their limited ICT budgets, and in some cases, free or highly discounted cloud services provided by Google.

Additionally, cloud computing's universal usage allows groups involved in stability operations to readily share information. Since the cloud's structure allows any device and operating system to access information, ICT differences are quickly overcome. A simple internet connection is needed to access the cloud, and allows any nation or organization with the proper access to participate in collaborating on information pertinent to stability operations. The type of computer or operating system is not a limitation, and mobile devices can also access to the cloud to use functions like Google

Docs and Google Maps. This functionality uses the growth of cellular technology in the Third World to provide IGOs, NGOs, host nation personnel, and other groups that will likely use mobile phones during stability operations access to information.

Cloud computing also expands the groups that can collaborate and coordinate during a stability operation. Those groups can be local, regional, or international, such as Combatant Commands, the United Nations, V&TCs, PVOs, or other concerned personnel. As working relationships develop among these groups, information sharing should increase as trust builds.

Trust is an important factor for information sharing. Without trust, information sharing will be extremely limited, regardless of available technology. Using a commercial cloud interface rather than a completely U.S.-operated cloud would likely increase the willingness of some countries, IGOs, NGOs and other groups to collaborate with the United States. Additionally, a cloud computing partnership provided by a reputable organization like Google or Amazon would likely increase trust in the system, increasing the amount of users, and thus, increasing information sharing.

Ultimately though, cloud computing is not a panacea that will solve all information sharing issues during stability operations. The employment of cloud computing during stability operations must be as carefully developed as the stability operation's actual strategy. Security concerns, user interfaces, and organizational accesses are only some challenges that need to be addressed before a disaster or other crisis occurs. Like security assistance or medical visits, cloud computing development should be considered as part of Phase 0 operations in a Theater Campaign Plan.

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