Social Networks in Crisis Response: Trust is Vital

Tom Humplik, Sarah B. Smedley, Elizabeth A. Collins, Erin Sullivan
Christopher K. Ma

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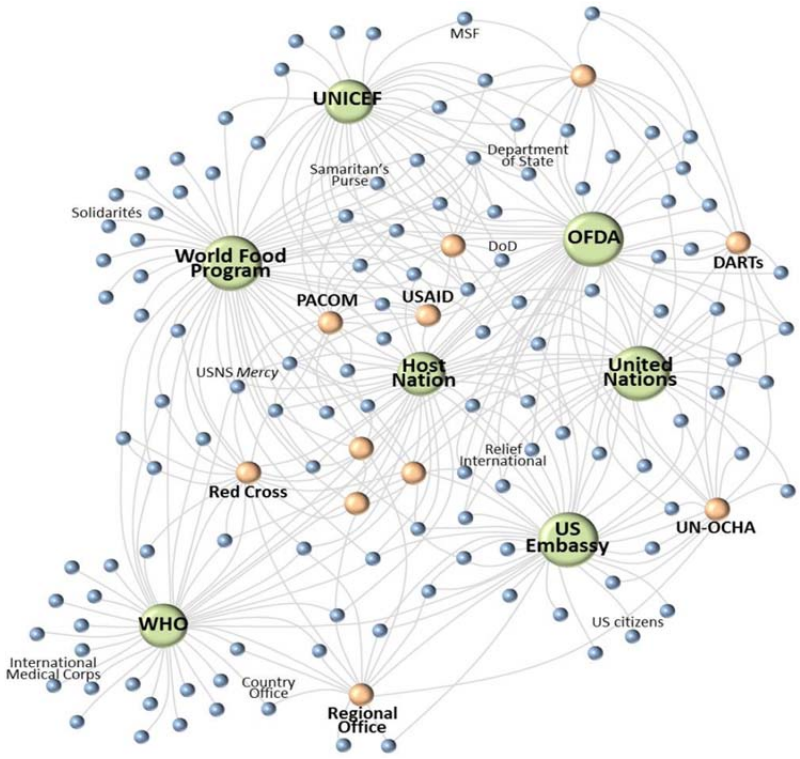

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E.D. McGrady, Director
Integration and Gaming
Advanced Technology& Systems Acquisition

Abstract

The Joint Logistics Enterprise (JLEnt) comprises a diverse group of entities that will work together in crisis response; they may have different motivations, organizational structures, and individual goals. Uniting and coordinating different groups toward a common objective can be challenging, and there are often—if not always—complexities due to politics and local perspectives. The Joint Staff J-4, Directorate for Logistics, created the Advancing Globally Integrated Logistics Effort (AGILE) as a multiyear campaign of wargames to help address the challenges of a JLEnt crisis response. One goal for this campaign is to understand how information is transferred and disseminated to participating JLEnt members in order to improve the effectiveness and value of the JLEnt during a crisis event. CNA examined the responses to six vastly different crisis events through the lens of social networking, looking for lessons learned, and focusing on social/organizational theories. The results of this study will inform stakeholders of possible best practices that can be refined and tested in future AGILE wargames.

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Executive Summary

The Joint Staff J-4, Directorate for Logistics, created the Advancing Globally Integrated Logistics Effort (AGILE) as a multiyear campaign of biennial wargames to help address the challenges of a global multinational/multi-organizational response to a crisis. Prior to Logistics War Game 2015 (LOGWAR-15) (which was the first wargame in the AGILE series), players shared what they believed were the most significant challenges facing the Joint Logistics Enterprise (JLEnt).[1] Most of the players in LOGWAR-15 were from the U.S. Department of Defense (DoD) and their inputs largely reflected their professional perspectives. We categorized their ideas, and found several main themes.

Bilateral communication and collaboration were among the most prevalent themes. Earlier works by the Joint Staff and the Joint Forces Command have said the JLEnt will not have a formal structure nor a rigid command architecture, but instead a behavior/communication model or "way of thinking" [1-2].

CNA was tasked with a quick response effort to examine communication flow in crisis events in order to improve the effectiveness of a future JLEnt. The results of this study will inform stakeholders of possible best practices that can be refined and tested in future AGILE wargames, and eventually affect how a JLEnt operates.

CNA selected six crisis responses, one in the contiguous United States (CONUS) and the other five outside CONUS (OCONUS), and all varied in size.

All the events were humanitarian aid/disaster relief (HADR) crisis response efforts:

- 2014 Ebola outbreak
- 2013 Cameroon refugee camp
- 2005 Hurricane Katrina

[1] The JLEnt refers to the collective group of service organizations, joint commands, defense agencies, foreign partners, nongovernmental organizations, and commercial partners that will respond to any given crisis event. Membership in the JLEnt is not fixed and will greatly depend on the particular crisis and the needs of the response. The JLEnt simply refers to the global logistics response community as a whole.

- 2014 search for Malaysia Airlines Flight 370 (MH370)
- 2012 South Sudan WASH crisis
- 2004 Indian Ocean tsunami.

The selected responses were studied using social networking and other organizational theories to analyze how different organizations communicate with each other during crisis events. Social networks are structures composed of individuals and/or organizations that are connected by one or more relationships. These social structures differ from organizational charts in that they describe how information flows formally and informally, rather than only through chains of command or lines of authority. While the six crisis responses do not cover every possible form of humanitarian response, CNA chose these responses in an attempt to find overall themes and best practices, as these responses varied substantially in size (casualties spanning three orders of magnitude), location (over 20 heavily impacted countries), involved agencies (DoD, United Nation (UN) agencies, the U.S. Department of State, international and local non-governmental organizations (NGOs), host nation embassies and governments, the World Health Organization (WHO), and many more), and U.S. involvement.

We examined each of the crisis responses as a case study. Using timeliness of response and response effectiveness as metrics of success, we sought to understand the advantages and disadvantages that existed in the various social networks.

For each case study, we sought to answer the following key analytical questions:

- What type of social network existed?
- How was the social network governed?
- How was information gained, stored, and used within groups to address crisis issues?

We pulled out common themes across events and analyzed the successes and failures in individual events to see whether specific environmental factors[2] contributed to those outcomes and how they could potentially be replicated or altered in different types of crisis response.

[2] While political and local factors inevitably influence crisis event outcomes, in this study we discuss such factors in the context of how they influenced the relevant social networks.

CNA found that:

- The ideal social network for the members of a JLEnt in a crisis response is a free-scale social network.
- Selecting the right type of governance for any given social network, given the levels of trust, number of JLEnt members, goal consensus, and need for network-level competencies, is a requirement for the network's success.
- Facilitators helped bridge gaps between nodes and enabled stronger lines of communication and trust. They also helped prevent hub[3] oversaturation.
- Lack of trust fractured social networks, diminished willingness to collaborate/integrate, and delayed or halted response times. Frequent, transparent, and accurate communications between nodes could mitigate these problems.
- Increasing the visibility of response actions may be an incentive for NGOs to put forth an earnest effort to collaborate with other JLEnt members.
- Training together can increase trust and familiarity among JLEnt members prior to JLEnt events.
- Traditional transactive memory system (TMS) theory can be successful in foreseeable crisis events. However, if certain characteristics of a crisis response (e.g., time, distance, or infrastructure) restrict the tools, personnel, or expertise needed, JLEnt members may need to have the flexibility to adopt an emergent response TMS approach. In this type of response, the JLEnt members need to have three key traits: knowledge flexibility, the ability to perform action-based (rather than expertise-based) responses, and coordination by operational-level nodes.

Although all of the vignettes in this study focused on HADR events, the lessons learned are applicable to the various types of responses the JLEnt encounters. If the JLEnt takes action on the findings of this report, it could have beneficial effects not only on how future JLEnts function in a HADR event, but in any JLEnt event.

With the conclusion of this study, CNA recommends the following be further pursued:

- In anticipation of future crisis events, the JLEnt should identify the relevant key players based on scenario type and geographical location and be

[3] Hubs are highly connected nodes in a free-scale network.

prepared to designate these organizations as operational and strategic hubs for other response participants to preferentially attach to.

- The J-4 should rigorously investigate the UN cluster system and the methodologies it uses to respond to crises. This would help the J-4 better understand how the humanitarian community operates within and integrates with the UN cluster system.

- The J-4 should quantify the DoD response efforts in past HADR events (e.g., the percentage of airlift provided or the DoD's response time compared to other agencies' response times) to provide insight into how the world-wide humanitarian community utilizes (or improperly utilizes) the DoD's unique capabilities.

- The J-4 should investigate technologies that military and non-military JLEnt organizations could potentially use to communicate during a crisis response.

- The J-4 should more fully map out the social network among responders on one recent crisis event (e.g., the 2015 Nepal earthquake). This type of analysis would provide a far more detailed understanding of social networks during crisis and test the conclusions that we developed in this work.

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Acronyms

ACEEN	Association Camerounaise pour l'Education Environmentale
AGILE	Advancing Globally Integrated Logistics Effort
AFRO	Regional Office for Africa
ALDEPA	Action Locale pour une Développement participatif et Autogéré
ARC	American Red Cross
C2	Command and Control
CAPT	Naval Captain
CAT	Crisis Action Team
CCC	Combined Coordination Center
CMOC	Civil-Military Operations Center
CNA	Centre de Nutrition Ambulatoire
CONUS	Contiguous United States
CSF	Combined Support Force
CSG	Carrier Strike Group
DART	Disaster Assistance Response Team
DG	Director General
DoD	Department of Defense
FEMA	Federal Emergency Management Agency
FRC	French Red Cross
HADR	Humanitarian Assistance/Disaster Relief
HCT	Humanitarian Country Team
IASC	Inter-Agency Standing Council
ICAO	International Civil Aviation Organization
ICRC	International Committee of the Red Cross
IO	International Organization
IT	Information Technology
JFMCC	Joint Force Maritime Component Commander
JFO	Joint Field Office
JLEnt	Joint Logistics Enterprise
JOC	Joint Operations Center
JTF	Joint Task Force
LOGWAR-15	Logistics War Game 2015
METOC	Meteorological and Oceanographic
MH370	Malaysia Airlines Flight 370
MOT	Malaysia Ministry of Transportation

MSF	Doctors Without Borders / Médecins Sans Frontière
NGO	Non-Governmental Organization
NORTHCOM	U.S. Northern Command
NRP	National Response Plan
OCHA	Office for the Coordination of Humanitarian Affairs
OCONUS	Outside the Contiguous United States
OFDA	Office of U.S. Foreign Disaster Assistance
PACOM	U.S. Pacific Command
PHEIC	Public Health Emergency of International Concern
PVO	Private Voluntary Organizations
RADM	Rear Admiral
RC	Resident Coordinator
SAILD	Services d'Appui aux Initiatives Locales de Développement
SAR	Search and Rescue
SECDEF	U.S. Secretary of Defense
SECSTATE	U.S. Secretary of State
TMS	Transactive Memory System
UN	United Nations
UNCERF	United Nations Central Emergency Response Fund
UNCT	UN Country Team
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations Children's Emergency Fund
USAID	United States Agency for International Development
USN	United States Navy
WASH	Water, Sanitation, and Hygiene
WCO	World Health Organization country offices
WFP	World Food Program
WHO	World Health Organization

Background

The AGILE initiative is a series of progressive wargames focused on understanding and improving the JLEnt[4] concept. The first in the series of wargames was LOGWAR-15, which aimed to assess the value that the JLEnt approach could bring to operations [3]. This wargame was conducted in July 2015 and was based on a scenario in which the political collapse of a fictitious, large-scale government in the South Pacific set off a chain of events that required coalition partners to provide assistance.

In the lead up to LOGWAR-15, players[5] expressed what they believed were long-term sustainment challenges facing the JLEnt. They raised a range of topics, including optimizing lift requirements through a health priority vetting process, moving and storing sensitive/contaminated (medical) materiel, and allocating money to cross Title 10 and Title 22 funding lines (see Appendix A).

Common topic areas began to emerge: collaboration, doctrine, visibility, and standardization (see Appendix B). The JLEnt challenges ranged from strategic to tactical in nature, and some straddled two or more of these categories. Few of the player comments were new, and most highlighted issues that previous literature [1, 4-7] had touched on. Although inputs were primarily from DoD participants, they echoed sentiments heard from various non-DoD organizations.

Each of the categories appeared to be interrelated with at least one other category. For instance, issues regarding visibility were influenced by the level of collaboration, and vice versa. Standardization could be assisted by the implementation of a universal doctrine. Players felt that incongruent parts/supplies/resources or lack of common terminology limited incentive for collaboration. Underlying issues of communication, trust, and training spanned all categories.

[4] As defined by the Joint Chiefs, the JLEnt is a collection of service organizations, joint commands, defense agencies, interagency and foreign partners, NGOs, and commercial suppliers, carriers, and service providers that together would provide logistics support for joint, interagency, and multinational operations. In an idealized case, the JLEnt response would have unity across all participating organizations to integrate and synchronize a global logistics response to the crisis.

[5] Players represented: DoD, non-DoD U.S. governmental agencies, multinational partners, NGOs, inter-governmental organizations, and the private sector. Most were DoD personnel.

To inform the next wargame, scheduled for 2017, the J-4 requested an analysis of one key issue stemming from the results of LOGWAR-15 and inputs from the players. The J-4 chose to investigate the role of social networking in crisis responses and what common threads exist in this area, across the landscape of various HADR events. Lessons learned and analysis from this report can shape the design and analytical questions of AGILE-17[6] and should have broader applicability for globally integrated logistics at large.

[6] Several months after LOGWAR-15, the J-4 officially changed the name of the LOGWAR campaign series to AGILE. AGILE-17 is the next wargame in the series and the direct successor to LOGWAR-15.

Introduction

The ad hoc nature of current responses to global crises can lead to decreased effectiveness and significant inefficiencies. The JLEnt could mitigate these issues by creating a framework for engaging and leveraging crisis response organizations. Rather than a rigid metastructure, the JLEnt is a series of pathways for formal and informal information to be collected, organized, and shared with all of the participating members in a JLEnt event.

This report will examine the responses to six different crisis events through the lens of social networking. Crises ranged from: national to international; isolated to multinational; and naturally occurring to acts of terror. By studying a diverse set of crises, universal themes that inhibit or preclude success may emerge, and these themes can inform the characteristics of a JLEnt framework.

In this paper, first we tell the stories—we provide short vignettes on each of the six crisis events to offer context and to substantiate the social network analysis. Then, later in the paper, for each vignette, we discuss and analyze:

- The type of social network;
- The type of governance of the social network;
- Transactive Memory System (TMS) theory.

Social network theory is the study of the interactions of a network of nodes within a system, whether it is the brain and its synapses, the Internet, molecules connected by biochemical reactions, or the U.S. power grid. In the context of the JLEnt, the social network describes how organizations and/or individuals formally and informally communicate. By categorizing the type of social network in place, and understanding the advantages or limitations of a particular network, improved avenues of communication can be formed to overcome obstacles seen in previous JLEnt responses.

When a group of people comes together, the success of the group can depend on how it is governed. **The application of different types of network governance** can amplify or hinder the success of the network participants. The governance type should be based on several key factors, such as number of participants and level of trust among network entities. By correlating governance style to failures or successes

of a network, the Joint Staff J-4 can make predictions that will inform future JLEnt events.

TMS theory is a sociological theory that examines how information is collected, stored, and distributed among groups. If organizations are the nodes of a social network, then TMS theory examines the links between those nodes.

By examining past crisis events and applying these three components (in bold in the three paragraphs above) to correlate failures and successes of social networks in those events, the Joint Staff J-4 can use the lessons learned to tailor future JLEnt responses to events and better position the JLEnt for success.

Data Collection and Methodology

CNA's sources for this report include after-action reports, situational reports, meeting reports, in-person interviews, news articles, and research studies. Due to the analysis timeline for this report and the varying availability of data on the six events, coverage and detail of each event and each social network differs within this study. Because access to sources of information was inconsistent across events, the level of analysis correlates to the resources available. The social networks described in this report are not all-inclusive.

Crisis response data is subjective and its availability varies, depending on the crisis. However, CNA's goal was to analyze crisis responses through a social networking lens and, in order to identify themes, the crises chosen ranged in scale, location, and timeline. The vast differences in the crises meant varying availability of data; therefore, in many cases, we had to make assumptions and inferences based on the data collected.

All the events were HADR crisis response efforts:

- 2014 Ebola outbreak
- 2013 Cameroon refugee camp
- 2005 Hurricane Katrina
- 2014 search for Malaysia Airlines Flight 370 (MH370)
- 2012 South Sudan WASH crisis
- 2004 Indian Ocean tsunami.

Among the events, there were stark differences and striking similarities that allowed the study to pull out common themes. For example, Hurricane Katrina and the 2004

Indian Ocean tsunami were both natural disasters; however, the response to Katrina was handled by the U.S., whereas the Indian Ocean Tsunami required a multinational effort.

The Indian Ocean Tsunami and the Ebola outbreak affected multiple countries, and elicited multinational responses. However, the implications of not reacting to contain the Ebola virus had potentially immeasurable negative effects on a global scale, a possible consequence not seen in our other events.

The search for flight MH370 also prompted a multinational response. This crisis is different from the others in that it is still unresolved as of the writing of this paper: the plane and its passengers are still missing. Additionally, the response was strictly a search and rescue (SAR) event, with a fixed number of people affected. While swift action was required, there wasn't the potential for additional victims, as there was with the Ebola outbreak or the refugee crises studied.

The African refugee crises (in Cameroon and South Sudan) had the potential to be very similar to each other, but in fact the two camps were established under different frameworks and faced unique challenges. The two camps had similar actors, but different outcomes, making them especially appealing for our study of social networks in humanitarian responses.

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Vignettes

To analyze the effects of social networking, this report focuses on six crisis responses that varied substantially in nature (epidemic, refugee crises, hurricane, SAR, and tsunami), scale (from 300 to 300,000 casualties), geographic location (more than 20 impacted countries across the vignettes), and participating response organizations. The goal of analyzing such a set of diverse events was to determine whether common themes existed that could be universally applicable and therefore useful for developing a framework for the JLEnt. For each event, we scoped down to examine specific aspects of the response groups. Also, we acknowledge that political, local, and financial factors did have effects in many—if not all—of these events; however, they were only discussed when they had direct effects on the communication flows of the social networks.

2014 Ebola outbreak

"This was an outbreak that became an epidemic because of the failure of global public health institutions, and particularly the failure of the WHO. This…was much worse than it should have been."
- Ron Klain, U.S. Ebola czar, December 3, 2015

In March 2014, Ebola was confirmed in Guinea and Liberia, and Doctors Without Borders (in French, *Médecins Sans Frontières*, or MSF) raised warning flags, saying the spread of Ebola was "unprecedented [8]."

Three months later, in June, MSF said it was "out of control," and by then, Guinea and Sierra Leone had declared Ebola outbreaks in their countries [8-9].

The WHO—whose primary role is to direct and coordinate international health efforts within the United Nations' system—declared a Grade 3 emergency (what the WHO describes as an event "with substantial public health consequences that requires a substantial [WHO country office] response and/or substantial international WHO response") in July 2014. But despite calls for earlier, swift action, the WHO waited until August 8, 2014, to officially declare a public health emergency of international concern (PHEIC), which is what prompts a significant international response.

The delay[7] meant significantly higher costs—both in lives lost and in dollars spent. More than 11,000 people have died from Ebola—and thousands of them could have been saved [10]. More than twice that number have been infected and many are still living with side effects. An independent panel convened by the Harvard Global Health Institute called the situation a "$5 billion scramble [9]."

Another cost of the delay was the public's trust and confidence in the WHO.

To be sure, there were many successes in the global response to the Ebola crisis. Hundreds of individuals from the affected countries and from the international response treated Ebola patients and taught local community members how to prevent Ebola, saving countless lives; MSF was in Africa early on and in force; and the United States, after joining the effort in September 2014, contributed more than half of the total funding expended to end the epidemic, and sent personnel and resources who made a dramatic difference.

These are just a handful of the many entities that made hugely positive contributions. However, the scope of this analysis is restricted to what can be learned from the internal WHO social network prior to the PHEIC announcement, and how its network breakdowns contributed to the situation where the PHEIC declaration came too late. We focus on the WHO because of the central and lead role it should have had, as illustrated by the quote below.

> "*…fixing WHO needs to be the top priority. That is the single most conspicuous requisite for restoring the trust and confidence of the world's leaders that there will not be a repeat of the Ebola catastrophe when the next outbreak occurs…If WHO is not fixed, the world's powers will revert tacitly to plan B: assume the worst on the part of the WHO, and assume the United States, other major powers, the UN Security Council, and UN agencies will again scramble, in an ad hoc and chaotic fashion, to piece together a response.*" – J. Stephen Morrison of the Center for Strategic and International Studies in his November 2015 article, "After the Ebola Catastrophe."

The WHO is structured into three levels:

1. Headquarters (Geneva, Switzerland)
2. Regional offices (6)
3. Country offices (more than 150).

[7] Although there is no consensus on a specific date the PHEIC should have been declared, there is consensus that it should have been closer to when the outbreak was known (MSF was sounding the alarm as early as March).

Our analysis examined the social network of the WHO during the time of the Ebola crisis, and how the WHO's communication structure/network affected the timeline of the PHEIC. There were low levels of trust among the three levels of the WHO, which had a negative effect on the crisis overall because of the delayed PHEIC. However, from what we have learned about the international response post-PHEIC, the tremendous efforts put forth ultimately conquered the outbreak.

2013 Cameroon refugee camp

Millions of people in central Africa have fled their homes because of the violence and political unrest caused by Boko Haram extremists [11]. Nigeria, Niger, and the Central African Republic have experienced a significant insurgency from Boko Haram and many citizens have fled to neighboring Cameroon. The UN estimates that as of June 2015, there were 302,293 refugees residing in Cameroon. During the early summer of 2013, terror attacks increased in northeastern Nigeria, in the states of Borno, Yobe, and Adamawa.

The increased violence triggered a mass displacement of people into the far northern region of Cameroon during June 2013. The Cameroonian government alerted the international community to the deteriorating humanitarian situation and potential refugee crisis at the northern Nigeria-Cameroon border.

The UN mandates that the United Nations High Commissioner for Refugees (UNHCR) lead and coordinate international actions related to protecting refugees and resolving refugee problems. UN agencies and regional authorities traveled to the region and discovered that an estimated 3,300 refugees were occupying a church and a school [12]. More than half of the refugees were women and about one quarter were children under the age of five [13], and a joint assessment carried out by UN agencies and regional authorities projected that the number of refugees would grow to 10,000. The government of Cameroon donated the land in the village of Minawao to house the refugees.

For this event, we will analyze the social network formed during the response to the Boko Haram crisis. Because the area affected by the terrorist group is so large, we focused on the social network that stemmed from the establishment of Camp Minawao, which is located 90 miles from the Nigerian-Cameroon border. The players that are bolded in the list below are UN agencies or specialized agencies, meaning they coordinate with each other through the UN Economic and Social Council (ECOSOC), which is one of the main councils of the UN and is responsible for coordinating the economic, social, and related work of the UN specialized agencies. The remaining entities are local agencies that work closely with the UN.

The responders at Camp Minawao were:

- **UNHCR**
- **WHO**
- **World Food Programme (WFP)**
- **United Nations Children's Emergency Fund (UNICEF)**
- Government of Cameroon
- Public Concern (a local NGO)
- Association Camerounaise pour l'Education Environmentale (ACEEN)
- Ministry of Water, Resources, and Energy (Cameroon)
- Action Locale pour une Développement participatif et Autogéré (ALDEPA)
- Ministry of Public Health (Cameroon)
- Ministry of Youth Affairs and Civic Education (Cameroon)
- Services d'Appui aux Initiatives Locales de Développement (SAILD)
- The French Red Cross (FRC)
- Centre de Nutrition Thérapeutique Interne (CNTI)
- Centre de Nutrition Ambulatoire.

The UN became involved once the UN Country Team (UNCT) realized the extent of the situation. The refugees were located in a desperate region of Cameroon, where the level of poverty is was even worse than the national average of 40 percent [14]. Refugees were being hosted by local communities, and that placed a greater strain on an already vulnerable community.

It is the UN's policy to let the local government handle refugee affairs unless it does not have the capacity. For example, the refugee camp in Kilis, Turkey, is run by the Turkish government (Turkey's Disaster and Emergency Management Presidency) [15]. However, countries with refugee crises typically do not have the capability to provide the same level of assistance as Turkey without UN support. The UNHCR is tasked with camp set-up and refugee registration. Initially, UNHCR deployed a site planner with tents to house 10,000 refugees. Because the UN's main goal was for the country to be self-sufficient, it quickly handed over the management of the camp to the local NGO, Public Concern [16]. However, it appeared that UNHCR provided many of the

supplies for shelter. The UNHCR also transferred refugees to the camp under the armed protection of the Cameroonian armed forces [16].

The WHO was the lead for providing health care to arriving refugees, who were mostly women, children, and the elderly. Refugees arrived in poor physical condition. Malaria, gastroenteritis, and various bronchopulmonary infections were observed. Many refugees had also suffered injuries while fleeing the insurgencies. The WHO worked with the local Ministry of Public Health to provide medical care. The FRC also assisted the WHO by providing water heaters, syringes, and drugs. The FRC worked with CNTI and the Centre de Nutrition Ambulatoire to care for malnourished children and provided equipment and supplies [16].

The WFP led the food assistance sector along with local NGO SAILD to provide food to incoming refugees. Refugees had been relying on food from the local population and food security was a concern, especially for young children and for pregnant and lactating women. It should be noted that the WFP is not responsible for drinking water.

UNICEF is the lead for the Water, Sanitation and Hygiene (WASH) sector, and partnered with local NGO ACEEN and the Ministry of Water, Resources and Energy. We have evidence that as the camp manager, Public Concern was somewhat involved in WASH efforts. Public Concern initially built 10 latrines and 8 showers [16]. UNICEF built 32 latrines and 13 showers, and provided garbage bins. UNICEF was also tasked with providing water. During the initiation of the camp, UNICEF constructed a borehole and installed two 10,000-liter bladders [17]. UNICEF was also responsible for protection, and sourced local NGO ALDEPA to ensure that the camp was a safe place for children and women [14].

The camp was successfully established due to coordination between UN organizations, local NGOs, and the local Cameroonian government. Today, the refugee population at Camp Minawao is around 50,000 [18].

Finding complete sources for this vignette was a challenge, as most of the relevant documents were produced by the large UN organizations. We have limited visibility into the information flow from the UN agencies to the local NGOs and governmental agencies. However, we can assume that, because the camp is still running successfully today and has grown to adequately accommodate (i.e., provide food, water, shelter, security, and health care) [19] five times the original, estimated number of refugees, that the established social network contributed to the effort's success.

2005 Hurricane Katrina

On August 29, 2005, Hurricane Katrina made landfall in southeast Louisiana as a Category 3 hurricane. In the days leading up to landfall, residents of the Gulf Coast were encouraged to leave, and a mandatory evacuation was issued for New Orleans. Residents who remained in the city after landfall experienced slow and uncoordinated aid from federal, state, and local sources.

Many agencies have produced documents detailing the response efforts to better understand the lessons learned [20-23]. In this report, we will not recite the lessons learned from those documents, but instead discuss the social network created by the U.S. Navy (USN) in response to the breakdown of an established and rehearsed social network that was developed prior to Katrina.

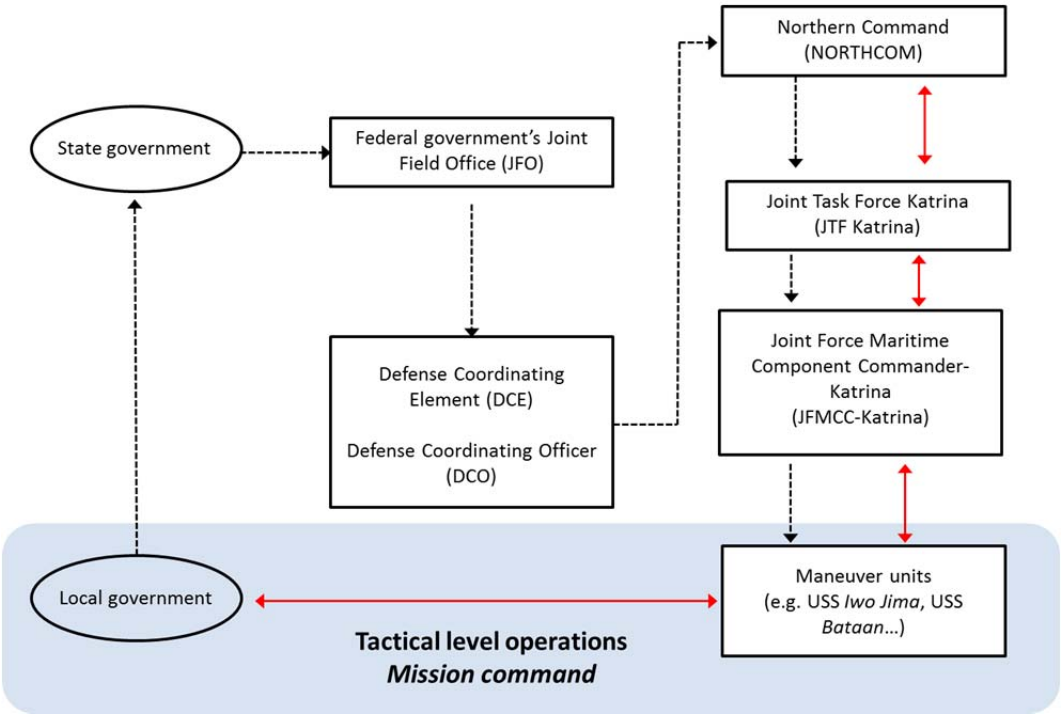
Our analysis is derived from data collected from lessons learned documents, but also from analysis conducted by CNA. We were fortunate to have access to an analyst who was deployed on USS *Iwo Jima* and who was assigned to assist the Joint Force Maritime Component Commander (JFMCC-Katrina) during the response. The analyst's personal accounts and formal documents aided the analysis.

In August 2005, the National Response Plan (NRP) held that during a disaster in a U.S. state, the state authorities were in charge of the response and could request assistance from the federal government. The Federal Emergency Management Agency (FEMA) acted as the liaison between state officials and other federal agencies. Additionally, FEMA established a Joint Field Office (JFO) to facilitate coordination between the state and federal governments [23].

Katrina's path created three regions of disaster response: Mississippi, Louisiana, and Alabama. Thus FEMA created a JFO in each of these three states, where requests for aid were processed and delivered to the correct federal agency (in Figure 1 below—which indicates how state requests for aid are communicated to the federal government—only DoD is shown for simplicity). The Navy's tasking should have come from the Joint Task Force (JTF), which is responsible for tasking the armed services, via the U.S. Northern Command (NORTHCOM).

In Figure 1, the dashed lines represent the preplanned flow of requirements as designated by the NRP [23-25]. We focused on the response in Louisiana, because there was a major breakdown in the prescribed plan there. The red lines illustrate how information flowed in Louisiana, based on our analysis.

Figure 1. Flow of state requests to federal agencies (DoD), according to the NRP



Dotted lines represent the anticipated or assumed flow of information. Red lines indicate the actual flow of information during the immediate response.

The responses in Alabama and Mississippi appeared to follow the NRP command structure. In each of those two states, an effective JFO was established either before or soon after the storm made landfall [23]. The JFOs included representatives from the state and federal governments, and the flows of requests were able to move through the correct channels.

In Louisiana, the JFO was not established in a timely manner and did not function as instructed by the NRP. Michael Brown, who led the response from FEMA, was not able to assemble a team for the JFO. As of August 31, an organizational chart was still being established [21]. Key components of the office were not established until two weeks after the storm hit.

Katrina was a hurricane of historic strength, and decimated the communication and transportation grids in Louisiana. Around 890,000 people were without power in Louisiana and an estimated 1.75 million people did not have phone service [22]. The local cell phone network was also taken out by the storm. Communication was limited, causing massive information flow problems, which, in turn, slowed response

time. Despite the lack of communications and tasking through the NRP chain of the command, the Navy was able to provide relief and aid within days of the storm hitting.

The JTF was the lead command element for the DoD response to Katrina. JFMCC-Katrina was supporting the JTF and was responsible for commanding all naval assists. The JTF also commanded Army, Marine, and Air Force commands. In this vignette, we focused on the Navy's response and operations during the response to Katrina.

The major players within the Navy's response were:

- JTF
- JFMCC-Katrina
- JFMCC-Katrina Air Component
- USN and coalition ships
- JFMCC-Katrina Meteorological and Oceanographic (METOC) Officer
- Naval crews ashore
- Local communities and residents.

USS *Bataan* arrived off the coast of Louisiana on August 30 and began operations. USS *Iwo Jima* left Norfolk, Va., on August 31 and arrived in the Gulf of Mexico three days later. The ship then steamed up the Mississippi and docked in New Orleans. *Iwo Jima* and *Bataan* operated under JFMCC-Katrina along with 17 additional U.S. naval ships, 6 coalition ships, and an estimated 70 naval helicopters. JFMCC-Katrina began operations on August 31 at Naval Air Station (NAS) Pensacola and later moved aboard *Iwo Jima* on September 7 [24]. Upon arriving on USS *Iwo Jima*, JFMCC-Katrina realized that regular tasking was not coming in from the JTF [26]. The JFMCC decided that the USN needed to act and use the assets it had.

Local cell networks were down, but the JFMCC staff recognized that out-of-state cell phones were still working. The JFMCC-METOC officer left *Iwo Jima* to make contact with the distressed communities in Louisiana [26]. The METOC officer drove between small towns in Louisiana passing out the cell phone numbers of the staff of JFMCC-Katrina and *Iwo Jima*; those cell phone numbers established links between the communities and *Iwo Jima.* The officer also shared the JFMCC-Katrina contact information with local government officials and representatives of relief organizations [24].

Requests for supplies (food and water) and rescue came in via cell phone calls. A lieutenant aboard *Iwo Jima* processed the requests and pushed them to the

JFMCC-Katrina Air Component in Pensacola, FL. From there, a helicopter would either deliver the supplies or complete a specific mission (e.g., SAR, medical evacuation, etc.) [26]. The mission completion was then transmitted up the chain of command. In addition to New Orleans International Airport, *Iwo Jima* and *Bataan* acted as air launch and refueling station in New Orleans and the surrounding area.

Iwo Jima acted as the command center for the relief efforts. From there, JFMCC-Katrina tasked the other amphibious naval units. They followed a command and control (C2) principle termed *initiative under command* (referred to henceforth as *mission command*[8]) [24]. The principle refers to pushing operational and command decisions down the chain of command. Subordinates and lower echelon commanders are expected to make operational decisions using their best judgement to identify courses of action and execute their missions without tasking from higher authorities.

The principle was effective during the crisis response because it allowed commanders to operate quickly to match the needs with the capabilities they had [24]. The JFMCC provided six key mission areas to the maritime units as guidance for allowable courses of action without needing to reach back for authorization. If any decisions or actions fell clearly within any of the six mission areas, the tactical unit was empowered to derive their own course of action to achieve mission success.

Between August 31 and September 20, Navy aircraft and ships rescued 10,266 displaced persons either by evacuations from established points, medical evacuations, or rooftop rescues [24]. They also delivered an estimated 2.2 million pounds of food and water [24]. The USNS *Comfort* and medical staff from five ships treated an estimated 10,239 patients [24].

The Navy deployed six mine counter measure ships to assist with restoring maritime logistics [24]. These ships were able to survey offshore oil facilities, clear harbors, and conduct salvage operations at many of the ports, canals, and channels. Finally, Navy crew members were sent ashore in small landing crafts to provide assistance to the local communities. Their tasks included clearing roads, removing debris from government buildings, repairing generators, and assisting governmental and nongovernmental agencies in using supplies [24].

By operating under the *mission command* principle [27], the Navy, via JFMCC-Katrina, was able to provide lifesaving services to the citizens of Louisiana, especially during the first few days, when other agencies were attempting to move into the area.

[8] For this report, the term *mission command* is used instead of the term *initiative under command* to adhere to doctrinally accepted terminology [27].

Mission command enabled JFMCC-Katrina to respond rapidly to the crisis, allowing each echelon to administer its capabilities to tasks that fulfilled the six mission areas.

2014 search for MH370

MH370 disappeared on March 8, 2014, while on a scheduled flight from Kuala Lumpur, Malaysia, to Beijing, China. A total of 239 people, including 12 crew members and 227 passengers (two-thirds of who were Chinese), were on board.

Despite countless hours and more than $100 million spent trying to locate the aircraft; its whereabouts are still a mystery. Approximately 40 minutes after it took off from Kuala Lumpur, the plane made its final radio contact. The next four hours was spent attempting to contact and find the plane [28]. The planned flight duration was 5 hours and 34 minutes, and the aircraft had enough fuel to fly for 7 hours and 31 minutes [29]. Malaysia Airlines announced that the plane was missing approximately one hour after it was scheduled to land.

From the time MH370 was officially declared missing through March 17 (nine days after it disappeared), the Malaysia Ministry of Transportation (MOT) led the SAR mission. Malaysia had this role per the International Civil Aviation Organization's (ICAO) Convention on International Civil Aviation, also known as the Chicago Convention [30-31]. Per ICAO protocol, without a crash site, the role of investigation lead goes to the state of origin.

It was not until March 17 that investigators believed they had their final best estimate of where the plane crashed—somewhere in the Indian Ocean, southwest of Australia. The plane had flown well off course, heading west over the Strait of Malacca, and then south. A host of reasons caused this devastating delay in determining the area where the plane likely crashed, including, among others, friction and lack of trust (illustrated in the media) between the Chinese and Malaysian governments (China was heavily involved in the situation because most passengers were Chinese). This led to the following issues:

- Restricted information flow (perhaps because of the classified nature of international radar and satellite systems and their outputs)
- Lack of internal civil-military communication (radar data was not relayed quickly from militaries to their respective governing civil authorities)
- Unfamiliarity on the part of the Malaysian government with dealing with a significant international media presence (which took time and resources).

Operationally and tactically, the nine-day delay put SAR efforts at a significant disadvantage, not only because of the implications for the dispersal of the plane debris, but also because of the resources that had already been expended traversing many miles of sea in futile search efforts. SAR operations were initially located near Vietnam's Tho Chu Island, where the plane was thought to have crashed [23]. Soon after, based on new data, the operations shifted to the west coast of Malaysia, until finally the SAR area was defined to be in the Indian Ocean. The lead search role transitioned from Malaysia to Australia, as the final SAR location was in the Australian search and rescue region. Australia became the central hub, leading and coordinating the organizations involved in SAR and then in the incident investigation.

2012 South Sudan WASH crisis

In October 2011, bombardments by Sudanese government forces in the Blue Nile state in Sudan led to an influx of refugees from Sudan to South Sudan [32-34]. By December 2011, more than 32,000 refugees had settled in the newly formed Doro camp in South Sudan. By February 2012, more than 60,000 had arrived.

As a newly independent nation, this was South Sudan's first refugee crisis. Its government did not have the capability to establish refugee camps, and gave the UNHCR authority to help with the crisis. Four camps were opened over the course of 10 months (Doro, Batil, Jamam, and Gendrassa).

The UNHCR assessment teams arrived by November 2011 and set up leads for WASH, and for other sectors from within the UNHCR. It should be noted that the UNHCR did not call on other UN agencies for assistance (such as the Office for the Coordination of Humanitarian Affairs, or OCHA) and purportedly bypassed the existing cluster systems [32].

The situation became a crisis when an overwhelming number of refugees fled the conflict in Sudan. Assessment reports did not predict or foresee such a large influx of refugees [32] and the high number of people created a massive strain on the water and sanitation capacities of the camps (which reached as low as 2.6 liters per person per day (pppd)—the WHO requires at least 7.5 L/pppd and recommends at least 15 L/pppd in emergency situations [35]).

South Sudan's roads were not operational for most of the year due to flooding. Therefore, the WASH infrastructure needed to be developed and built on site. Although the WASH crisis was eventually resolved—MSF installed wells and the International Red Cross built a water pipeline—the process took longer than eight months to complete, resulting in the malnourishment and deaths of countless refugees [32].

When the UNHCR deployed to South Sudan and activated the appropriate leads required for the refugee crisis, it prompted the formation of a coordination network. The agencies/actors in this network are listed below. This list is current as of March 2012 [36], and bolded agencies are those that took part in WASH:

- GOAL
- International Medical Corps
- **International Organization for Migration**
- Medair
- **MSF - Belgium**
- **Oxfam**
- Relief International
- Samaritan's Purse
- Solidarities.

By September 2012, water and sanitation capabilities had been installed in the majority of the camps in South Sudan [32]. However, the process itself took much longer than is typically necessary, even in a challenging logistical situation as was found in the Maban province in South Sudan.

At the operational level, the UNHCR did not provide enough coordination or leadership [32]. At the tactical level, many NGOs oversold their capabilities, which further delayed crisis resolution [32].

In April 2012, MSF had realized that, without a stronger intervention, it would take many more months before a WHO minimum daily water intake for survival would be provided. Therefore, MSF took an action-based response to bring in the appropriate experts and logistics to assuage the water and sanitation crisis. The MSF response was a tactical success. Had MSF not provided the leadership and coordination that it did, the water and sanitation crisis would have been significantly prolonged.

2004 Indian Ocean tsunami

On December 26, 2004, a 9.1 magnitude earthquake in the Indian Ocean off the coast of Sumatra produced a series of tsunamis that devastated the coasts of the surrounding 14 countries, including Sri Lanka, Thailand, and Indonesia, killing more than 230,000 people [37]. In response, U.S. Pacific Command (PACOM) sent

USS *Abraham Lincoln* Carrier Strike Group (CSG), USS *Bonhomme Richard* expeditionary strike group, and the III Marine Expeditionary Force forward to the area [38-41].

By December 29, 2004, PACOM had formed JTF 536, which was later renamed Combined Support Force (CSF) 536 [42].

The rapid DoD response may have been facilitated by the presence of forces in PACOM's area of responsibility (AOR) prior to the disaster (e.g., for the response in Indonesia, USS *Abraham Lincoln* was less than seven days away, in the South China Sea, and USS *Bonhomme Richard* was about 10 days away, in the Philippine Sea) [43]. Each of the forces was able to be redirected to the area in need.

Although the U.S. military arrived in Indonesia quickly, there were still delays in delivering aid to many regions within Indonesia, specifically in the Banda Aceh province, because of a lack of interagency coordination, poor communications (specifically at the tactical level), the considerable number of humanitarian groups (NGOs, international organizations (IOs), etc.) arriving in the province, and friction between the military and other agencies, and among the agencies.

In addition to the military, the U.S. Agency for International Development (USAID) reacted quickly to provide aid. It dispatched staff from the Office of U.S. Foreign Disaster Assistance (OFDA) and Disaster Action Response Teams (DARTs) to the affected countries to work with UN agencies and assess the requirements for aid relief.

At the height of the response efforts, the United States alone provided more than 17,000 personnel, 17 warships, and 170 aircraft [44], and created an ideal model for intergovernmental coordination. Within the United States, the State Department, USAID, and PACOM formed an agreement to support host nations, with the embassies working at the local levels to provide information and pathways for supplies and manpower to flow [44].

Additionally, in order to deal with the vast distances between each country, the military created a combined support force; this established a way for regional task force commanders (e.g., Thailand, Sri Lanka, or Indonesia) to adapt to the individual issues within each country. The CSF 536 commander a "Nimitz" type role (e.g., a commander diverting and moving resources to areas in greater need rather than aggregating all resources in one area) in "coordinating and arbitrating the allotted resources [44]."

CSF 536 was not just an effort by the U.S. forces. A Combined Coordination Center (CCC) was established as the CSF 536 civil-military coordination epicenter for the U.S. military, coalition forces, IOs, and NGOs [42]. Its headquarters were in Utapao, Thailand, along with the CSF headquarters [42]. The CCC included military

representatives from Australia, Austria, Britain, Canada, France, Germany, India, Indonesia, Japan, South Korea, Malaysia, the Maldives, New Zealand, Pakistan, Singapore, Switzerland, Sri Lanka, and Thailand [42, 45].

The major actors in this (Indonesia, Sri Lanka, and Thailand) response were [38-39, 44, 46]:

- Host nations (we focused on Indonesia, Sri Lanka, Thailand)
- Ambassadors/embassies
- PACOM and its interagency units
    - Joint operations center (JOC)
- CSF 536 and its interagency units
    - CCC and Civil-Military Operations Center (CMOC)
- USAID
- OFDA/DARTs
- UN/OCHA
- Interagency Standing Council (IASC)
- Navy maneuver units (e.g., the CSGs)
- Crisis action teams (CATs)
- More than 200 NGOs, IOs, and private voluntary organizations (PVOs)
- Other nations (Australia, Austria, Britain, Canada, France, Germany, Japan, South Korea, Malaysia, New Zealand, Pakistan, Singapore, and Switzerland)
- WHO
- Victims.

Hundreds of thousands of displaced persons and refugees were provided aid and relief in the days and months after the 2004 Indian Ocean tsunami, and many thousands more would have died without the massive, global intervention. Nonetheless, there are always ways in which crisis responses could be better, and issues to be addressed in future large-scale disaster responses.

Discussion and Analysis

The following sections will provide background information on types of social networks (how communication and information flows), network governance (the "who" and "how" behind decisions), and TMS theory (the ways that information is stored and used in groups). After each background section, we analyze the events within the vignettes to draw correlations between types of social network, governance, or TMS theory and successful crisis responses. We can use key factors for success as the basis for the development of a future JLEnt framework.

Random and free-scale social networks

As we discussed earlier, the Joint Staff J-4 believes that the framework for an operational JLEnt is not a rigid C2 metastructure, but instead, a series of pathways for formal and informal communication among participating members of a JLEnt response [1-2]. Social network theorists focus on how people, organizations, or groups interact with others inside of a network. For that reason, we apply social networking theory to the JLEnt to gain a better understanding of how members in a crisis response interact and how those interactions can be improved for a faster and more effective JLEnt response.

The idea of social networks to describe large, complex systems was made famous by Stanley Milgram's small world experiment, which concluded that any two random people are only six or fewer steps, by way of introductions, apart from each other [47]. The experiment later gave rise to the phrase, "six degrees of separation."

Since then, the concept has moved beyond the field of sociology and into the realms of biology (e.g., mapping the development of the brain and its axons), computer science (e.g., describing the topology of the Internet), and intelligence (e.g., understanding terrorist networks [48]).

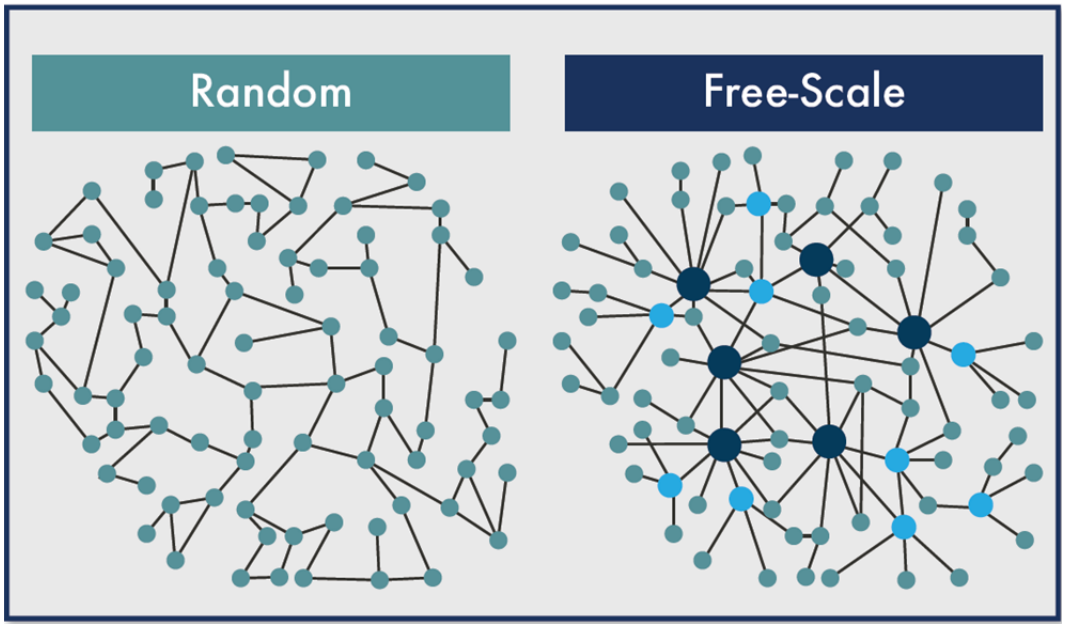
Social networks are structures made up of nodes connected by one or more relationships to other nodes in the system. For this report, we examine social networking in terms of communication and information flow during a crisis response event. It is important to note that social networks are not C2 architectures. They differ from organizational charts, in that they describe more than how information flows formally. They also describe informal channels that may go outside the chains

of command or lines of authority. This is a particularly important distinction in the context of a crisis response, where for many response organizations the relationships with other responding entities involve coordination rather than direct control over people and resources, and therefore also involve informal communication.

This paper categorizes social networks into two classes: free-scale or random. These two types of social network have different characteristics and advantages over one another. A random social network gets its name from the random placement of links between its nodes. This randomness in linkages statistically leads to a high probability that all nodes will have generally the same number of links (see Figure 2).

In contrast, free-scale social networks include (among the other nodes) a small number of nodes that are connected to many other nodes (see Figure 2). These highly connected nodes are referred to as hubs, and the network is called free-scale in the sense that nodes can seemingly have unlimited numbers of links [12].

Figure 2. Graphic depiction of random versus free-scale social networks



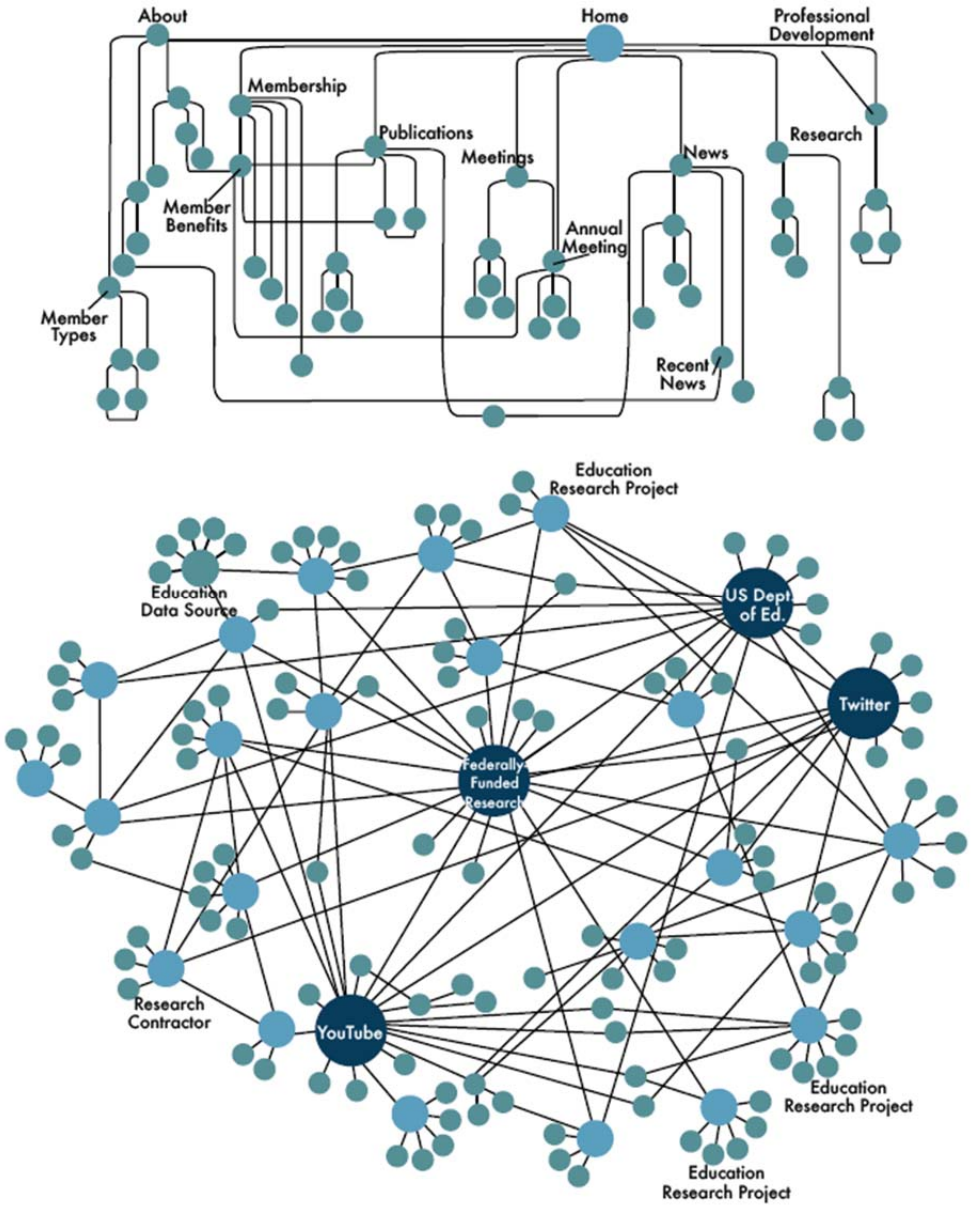
Graphic illustrating the difference between random and free-scale networks. The positions and numbers of dots/nodes are identical in both images. The only differences are the connections between nodes and the sizes of the nodes for the free-scale social network. The different-sized nodes depict the numbers of connections (the more connections to other nodes, the larger size of the node).

The difference between random and free-scale social networks is preferential attachments. In free-scale networks, new nodes tend to attach to an existing node that already has many other connections to the network. These popular nodes thus acquire more links over time than their less-connected neighbors in a "rich get richer" process, which generally favors the early nodes.

Figure 3 displays an analogy to conceptualize the difference between random and free-scale networks: the links to different webpages on a website (random) and the Internet (free-scale) [49]. In a website, the webpages are nodes that are linked by hyperlinks, and generally the different nodes of the system all have approximately the same number of links. The system of connected nodes in a random network requires several links to cross from one side of the system to the other.

In contrast, the free-scale-like Internet has a smaller group of highly connected nodes, or hubs, that have a substantially larger number of links than most of the nodes across the system (e.g., YouTube, Twitter, U.S. Department of Education). It takes significantly fewer links to move across the system in the free-scale network.

Figure 3. Conceptualizing random social networks (a website) and free-scale social networks (a portion of the internet)

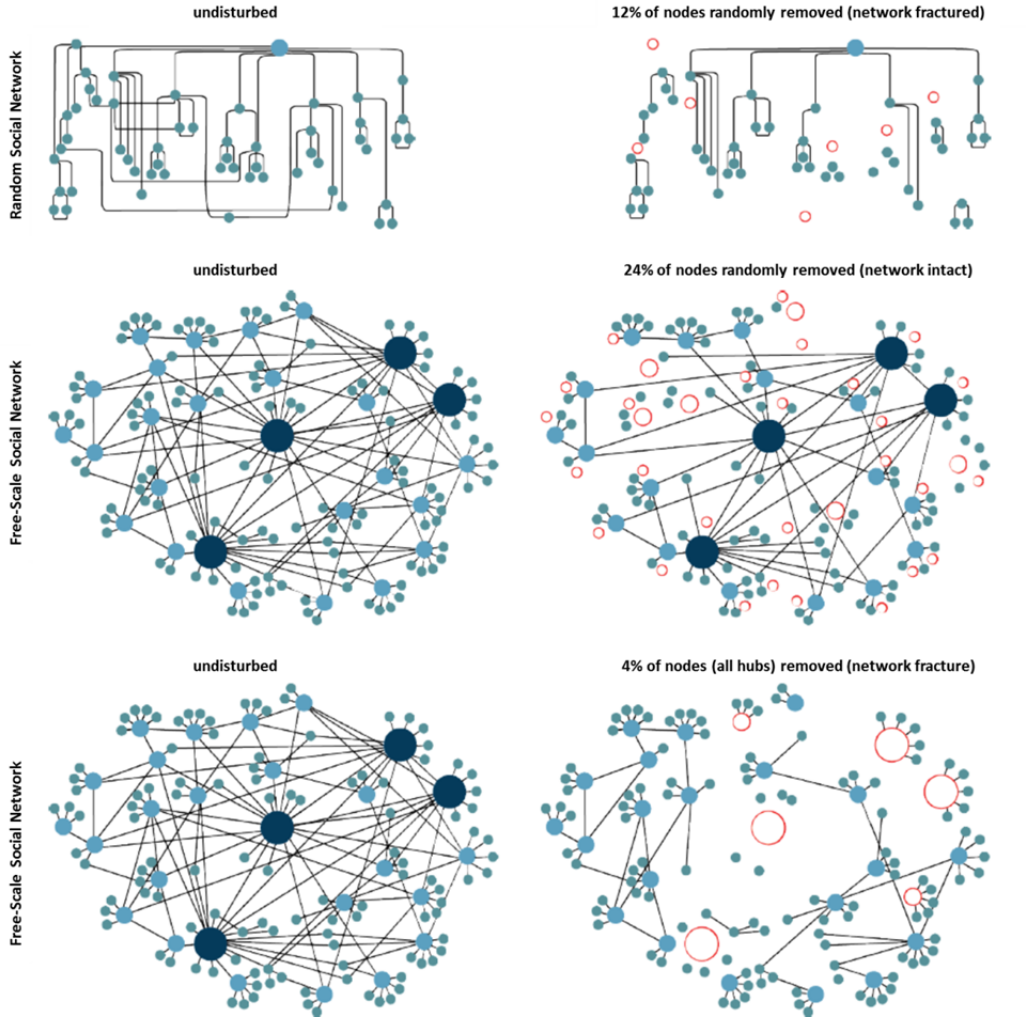


Random networks, which resemble a website (this figure is based on an actual research association website), consist of nodes that have generally the same number of connections. Free-scale networks, which resemble the Internet (this figure is based on a portion of the Internet related to education), contain a few nodes, called hubs that have many links. While the basic layout of this figure is accurate, it has been simplified and does not represent either the website or the Internet exactly, as this figure is intended only to illustrate the general flow of connections with nodes/hubs.

Figure 4 demonstrates how node failures affect the two types of social networks differently. For the random network (top two images), removing few random nodes can lead to the isolation of certain parts of the network and can seriously impede or completely stop the ability to move from one side of the network to another. For the website (random social network), 12 percent of the nodes are randomly taken away in the image on the right-hand side. These connection breaks create a fracture in the social network, meaning that isolation of certain parts of the network occurs and it becomes impossible to cross from one side of the network to the other.

In contrast, in the free-scale Internet social network (middle two images) when 24 percent of the nodes randomly fail, the network remains intact. Although it takes more jumps to get across the entire network, it is still possible. While free-scale networks are more resilient to random failures, targeted attacks on hubs can easily fracture a free-scale network (bottom two images). In the bottom right-hand figure, only 4 percent of the total number of hubs is removed, but those hubs are all major nodes. As a result, the free-scale network fractures. The figure demonstrates how a free-scale network is more resilient to random failures, but highly susceptible to targeted attacks.

Figure 4. Effects of node failures on random and free-scale networks



Failures of a number of nodes in a random network can fracture the network, leading to isolation of certain sections of the social network. Although free-scale networks are more robust to random failures, coordinated attacks on just a few hubs can fracture a free-scale network.

In a crisis environment, node failure can be caused by lack of communication, a node being overwhelmed, or an inability of the node to participate (e.g., from a lack of trust). In the case of a free-scale network, if the same percentage of nodes is removed, the system can still function and the flow across the network continues. One study suggested that a free-scale social network can function with up to 80 percent of random node failure [49]. However, while free-scale networks can usually withstand random node failure, they are highly susceptible to targeted

attacks. If as few as between 5 percent and 15 percent of the hubs are targeted and failure of those nodes occurs, the network will be unable to carry out its function.

Understanding the characteristics of these two types of social networks is important in correlating them with some of the positive and negative outcomes of the crisis events in the vignettes.

Social networks in crisis response events

In a crisis response event, orchestrating the efforts of different groups toward a common goal can quickly become complex and difficult to manage. This is why the JLEnt emphasizes collaboration and communication across the entire enterprise by all participating entities. The belief is that through the exchange of information and building of trust, different organizations can leverage assets outside of their capabilities (that they would otherwise be unaware of) to accomplish network goals, which they may have been incapable of achieving on their own.

The remainder of this section describes the types of social networks present in each of the vignettes and cites advantages and disadvantages of each type of network within a crisis environment.

Of the two social network types, free-scale allows a quicker and richer exchange of information because of its ability to connect more nodes in fewer steps [12]. In crisis response events, response time can have an effect on lives saved or damage incurred; thus, it is not surprising that the majority of crisis events that we examined in this report tended to involve a free-scale network.

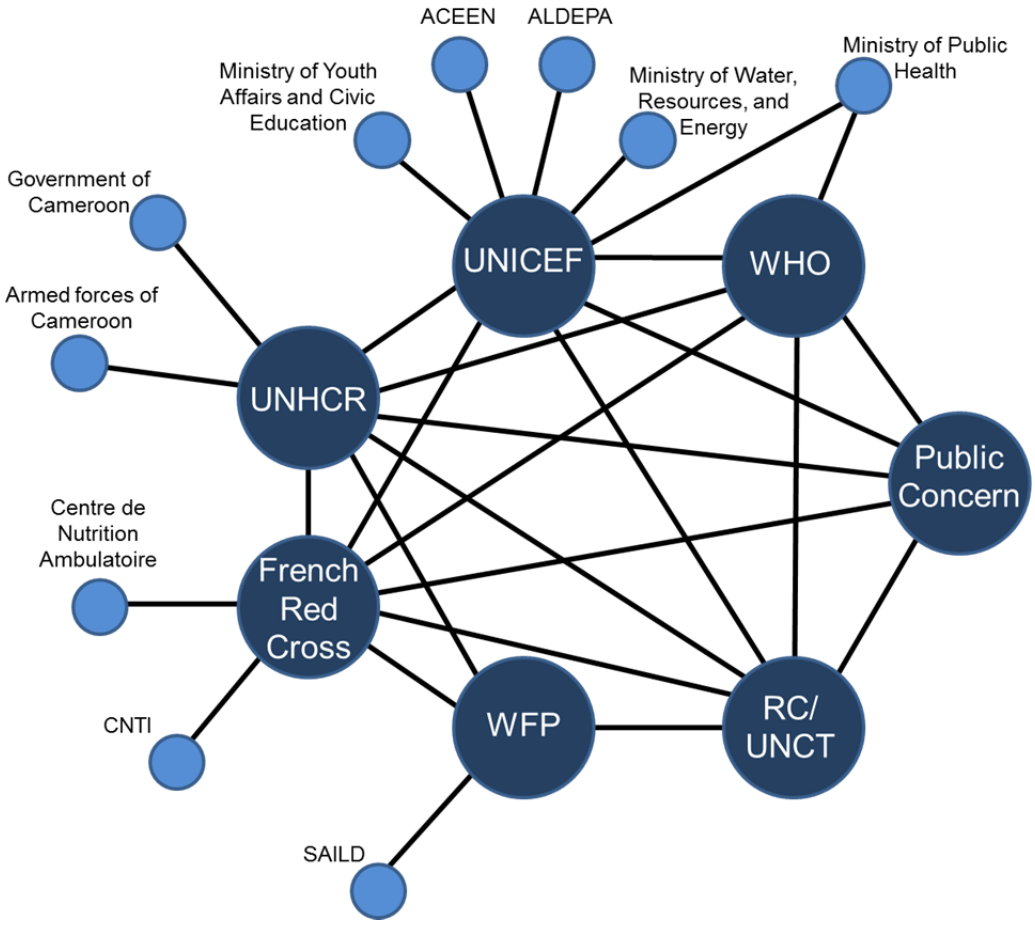
Visibility across a network

Hubs, at the operational level, can identify issues across a given crisis landscape and use bilateral communications to engage other organizations to assist in remedying those issues. One such instance was the creation of the Camp Minawao refugee camp in Cameroon.

For the Camp Minawao event, we were able to obtain enough data[9] about lines of communication to reconstruct a representative—although not comprehensive—social network for the establishment of the camp. The social network that evolved during the establishment of Camp Minawao can be categorized as a free-scale network with seven central hubs (UNHCR, UNICEF, WHO, Public Concern, FRC, RC/UNCT, and WFP), and smaller nodes branching off the larger hubs (see Figure 5).

[9] To construct this social network, we used situation reports and after-action reports. The major hubs were determined by how frequently they were mentioned in weekly meetings that took place at the WHO central office. The WFP was not listed in the weekly meetings attendee list, which is illustrated in Figure 5 by the lack of connections to some of the other major hubs. The WFP is still considered a major hub and was responsible for a sector within the UN response (along with the UNHCR, UNICEF, and the WHO). The UN agencies reported to the resident coordinator (RC) and the UNCT, but neither was mentioned in the weekly situation reports. It is unclear how information was communicated with the RC/UNCT, but we have evidence that weekly reports were required [50]. We might assume their position was at the strategic level, whereas the weekly reports are at the tactical/operational level.

Figure 5. Free-scale social network of Cameroon refugee camp



Due to limitations in time and scope we were unable to create a complete or comprehensive social network of every actor and agency that took part in this response; however, we believe that this social network is representative of the interconnectivity of the response.

At the operational level, the major hubs had links to each other, giving them visibility into areas outside of their normal purview. This became important for the collective group of hubs to quickly identify gaps across the entire network in both funding and aid.

For example, when Camp Minawao was stood up, the UN agencies involved (UNHCR, UNICEF, WFP, and the WHO) realized that there were gaps in coverage (and therefore, funding). Cameroon is not typically a region that requires assistance, so it did not have a humanitarian country team (HCT) in place. The resulting lack of leadership caused a delay in requesting additional funding from United Nations Central

Emergency Response Fund (UNCERF) for the hubs. The UNCT was established as an ad hoc organization made up of the UN agencies [11]. Once the UNCT was established, the agencies agreed on a sectoral coordination mechanism, where each major hub was responsible for a different life-saving service (WASH, food, protection, shelter, etc.) and was encouraged to work with NGOs and local partners [50].

Each UN agency became a major hub, with the NGOs preferentially attached as smaller nodes. This allowed all the players to be within one link of a central node, reducing poor communication, duplication of tasking, or gaps in tasking.

It is reasonable to assume that if the major players had not been in direct contact with each other and under the governing umbrella of the UN, the response would have been delayed further in light of the absence of an HCT. Refugees were accepted in July 2013, but UNCERF funding did not allow the procurement of additional supplies until September 2013 [50]. However, the UN agencies were able to coordinate with each other and with efforts elsewhere in Africa to procure the supplies they needed (which in some cases were on loan from sites in the eastern region of Cameroon, where refugees were fleeing from the Central African Republic).

An advantage of a free-scale social network is its ability to allow disaggregated groups to orient to a problem quickly. While the lack of an HCT initially caused some delays, the agencies were still able to establish the camp and provide food, water, shelter, and medical assistance to the refugees.[10]

This suggests that the interconnectivity of a free-scale social network can help a JLEnt respond, coordinate, and pull together resources from different organizations to accomplish network-level goals.

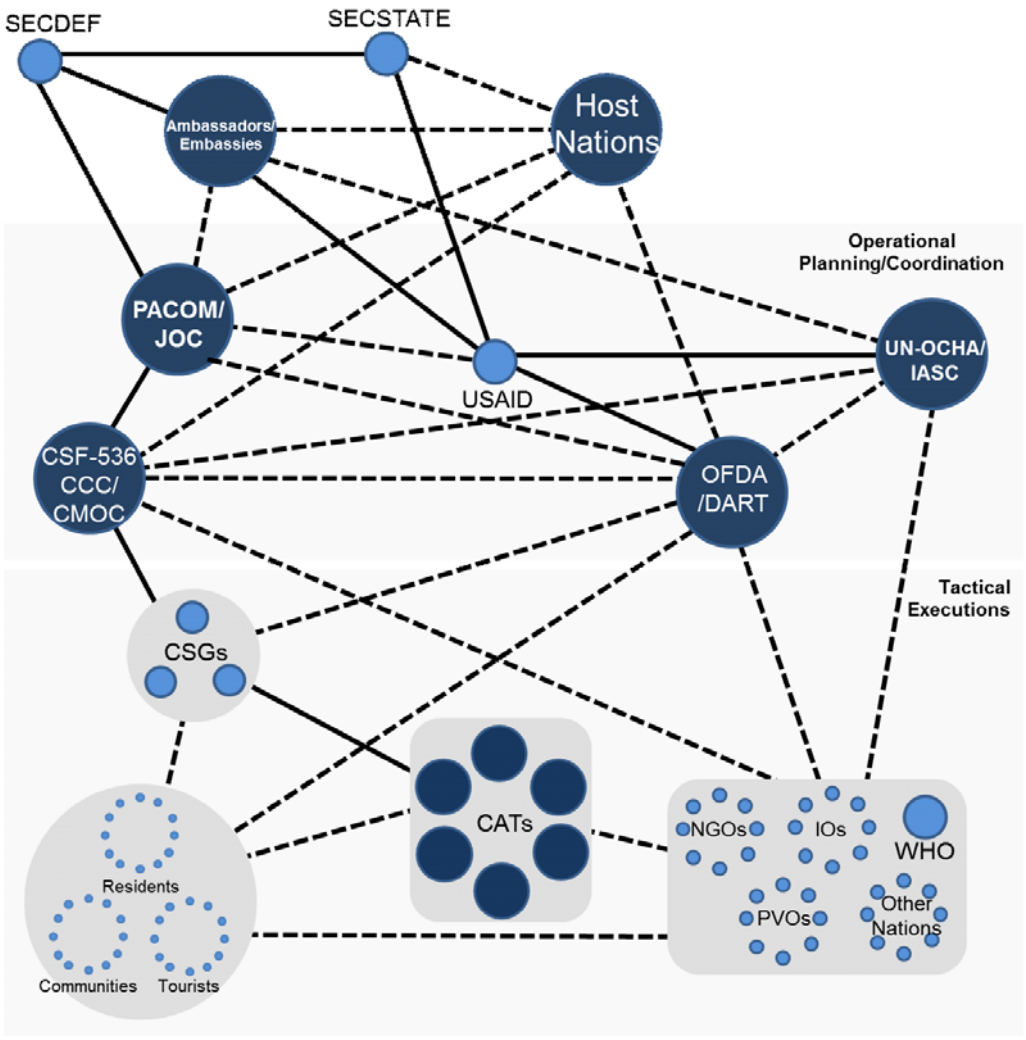
The Camp Minawao event was relatively small-scale compared with some of the other response events that we investigate in this report. In examining a larger HADR type of event, such as the 2004 Indian Ocean tsunami, coordination at the operational level is even more important and complex due to the scope and large number of participating organizations. For the purpose of the JLEnt, it is important to know whether efficiencies (providing supplies, medical care, etc.) due to hub interactions, like in the Camp Minawao, can be scaled up and realized as the size of the network increases.

[10] Camp Minawao was able to successfully provide [50] its refugees with 16.2 liters of water/day/person (the standard is 15) and tents. There were no water-born epidemics, malnutrition decreased in children under five, and there were no safety incidences.

Figure 6 represents the social network for the response to the Indonesian, Thai, and Sri Lankan parts of the 2004 Indian Ocean tsunami.[11] The social network is free-scale with several operational hubs. For these 3 countries (of the total 14 affected), the major operational hubs that we observed in our analysis were: CSF 536, PACOM, OFDA, and UN/OCHA, which organized three U.S. Carrier Strike Groups, more than 200 NGOs, countless smaller intergovernmental agencies, and host nation governments (including embassies from nearly every represented country) [38-39, 43-44, 46]. With such a large and complex group of entities working together, what enabled better communication between these major hubs and smaller nodes during the disaster response, both at the operational and tactical levels, were facilitators [39]. Key facilitators were: the DoD's CMOC and JOC, OFDA's DART, and the UN's IASC.

[11] We focused on investigating the combined relief efforts in Thailand, Indonesia, and Sri Lanka to concentrate on the interactions between DoD, the U.S. State Department, and international agencies (e.g., UN, WHO, NGOs.) [38-39, 43-44, 46, 51]. Due to the size of the response and because we were focused on the operational response, we did not include individual tactical organizations (of which there were more than 200). While this is not a complete social network of every actor and agency, we believe that it represents the interconnectivity of the response.

Figure 6. Free-scale social network of international response to the 2004 Indian Ocean tsunami in Indonesia, Sri Lanka, and Thailand



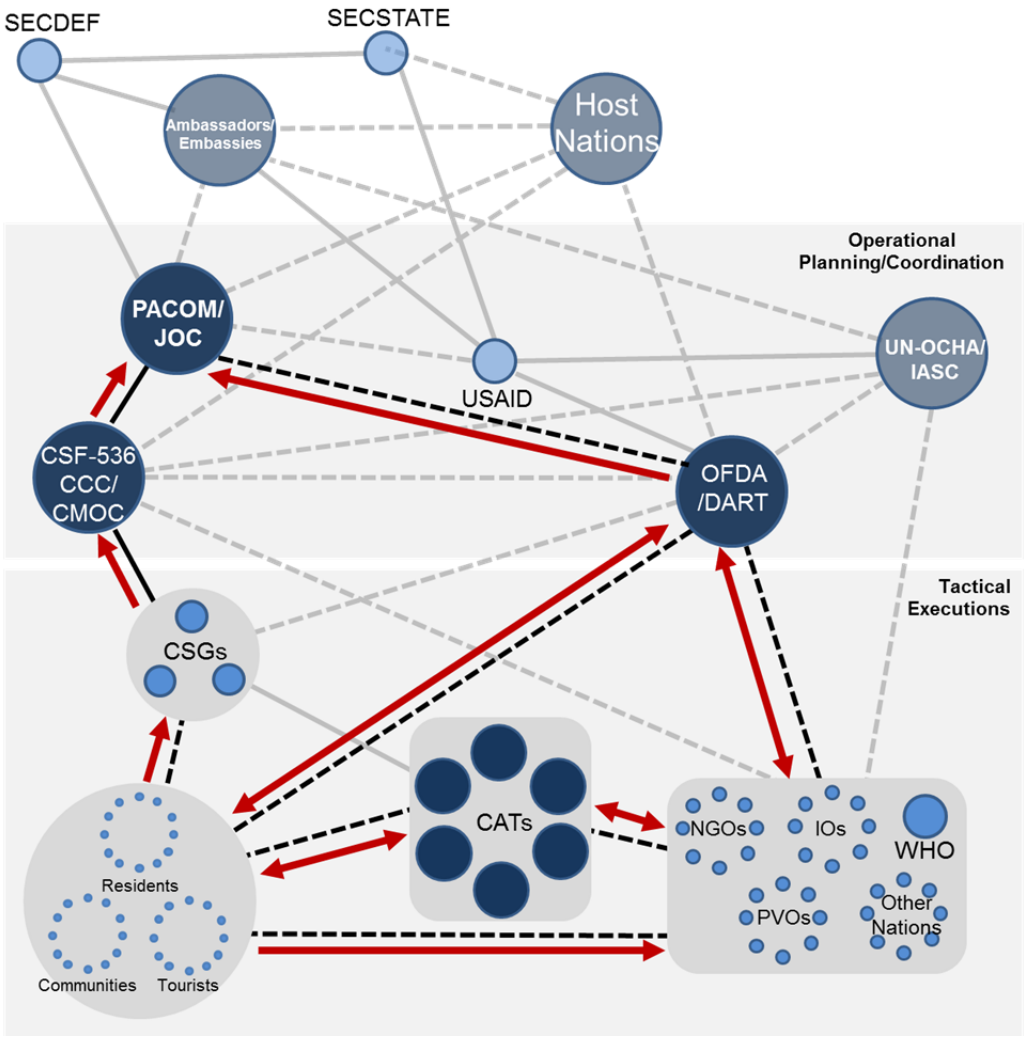
SECDEF is the DoD secretary; SECSTATE is the Secretary of State.

The solid lines show direct, pre-established links (pre-established through doctrine, previous interactions, and response planning), while the dashed lines exhibit links/connections that were formed during the crisis. The dark blue nodes signify hubs. Due to limitations in time and scope we were unable to create a complete or comprehensive social network of every actor and agency that took part in this response; however, we believe that this social network is representative of the interconnectivity of the response.

The facilitators were particularly effective when organizations of different backgrounds (e.g., a military command and an NGO) had to coordinate a response effort. For example, PACOM's JOC became a linking hub to establish tactical communications with commands within the carrier strike groups [44].

OFDA, a subset office of USAID, embedded representatives from its tactical DARTs within the JOC to improve communications to isolated communities within at least these three nations. This led to improved operational situational awareness, a direct connection from a major hub to previously isolated communities, and a likely increase in trust between vastly different organizations (Figure 7). At the tactical level, it is even more difficult to communicate with other tactical groups because of a lack of (or destruction of) infrastructure. However, the USN utilized the concept of mobile *connecting* hubs by deploying small crisis action teams (CATs) to organize and coordinate the specifics for daily missions for the naval assets in the areas [38]. Apart from providing aid and relief to the stricken communities and coordinating with non-military NGOs, LT Sean Clevenger (a CAT cell member) observed that the CATs were also seen "as the admiral's [tactical] command center of sorts" and "were the main POC [point of contact] for those calling in the Strike Group" such as the liaison officers, USAID officials, NGOs, and other organizations [38].

Figure 7. Free-scale social network for 2004 Indian Ocean tsunami response, highlighting the effects of the DARTs and CATs on increased tactical awareness. The red arrows show the direction of information flow



By coordinating missions and aid for NGOs, these CATs helped smooth the friction that typically occurs between military and non-military agencies. They also helped link a number of isolated communities and smaller NGOs to the larger organization hubs through their connection with the carrier strike groups (Figure 7).

While entities like CATs are not usually needed in smaller disasters, where far fewer lateral and tactical-to-organizational communications are being passed through a

series of hubs, there are many more examples showing the usefulness of such groups in multinational, multi-hub responses.

The 2004 Indian Ocean tsunami demonstrated that as the complexity and numbers of participants grow, it may be necessary for there to be specified entities focused on bridging different hubs in the network to facilitate network-wide visibility. Although having extra nodes between hubs (thus increasing the number of jumps) will reduce the information flow, having just a few information-keepers (facilitators) can drastically increase the network's overall effectiveness [52].

Network fracture

Although the analysis to this point has focused on free-scale social networks, there was one crisis response that we found that used a random network configuration.[12] In the Ebola outbreak, the WHO was organized into a random social network.

The WHO's primary role in the Ebola crisis was to coordinate [53] the international response. For purposes of this analysis, we focus solely on the WHO itself, which at the time was a decentralized agency with a network that included headquarters (HQ)/the director general (DG), regional offices (ROs), and WHO country offices (WCOs)[13] [54]. This random social network created communication gaps between WCOs, ROs, and headquarters. Within the ROs and headquarters, specific units/functions were set up to support countries, but even among these units there was no coherence in their reporting and communication lines [54].

In the outbreak event, the nature of the random network led to different levels of isolation of sections of the network. This stemmed from a host of reasons, which included RO autonomy, politics, unclear lines of authority within the WHO, and short staffing due to WHO budget cuts.

The WHO Ebola Interim Assessment Panel "heard of country offices' frustration at the lack of response from headquarters and regional levels…" [53]. Conflicts of interest and political pressures (described in more detail below) were also causes for

[12] Based on the information available, we believe that this is a random social network, namely as the WHO was a decentralized organization that aimed to give the ROs a certain level of autonomy in their regions, and as it did not have clear lines of either communication nor authority emanating from a central hub.

[13] The six ROs in the WHO—and the numbers of WCOs under each RO—are: Regional Office for Africa with 46 WCOs, Regional Office for the Americas with 29 WCOs, Regional Office for Europe with 30 WCOs, Regional Office for the Eastern Mediterranean with 19 WCOs, Regional Office for South-East Asia with 11 WCOs, and Regional Office for the Western Pacific with 16 WCOs.

communication breakdowns, which may have been avoided if the nodes had been united and commanded through a hub rather than in a random social network. (The primary nodes involved were the Regional Office for Africa (AFRO) node and the WCOs in the affected area.) The degraded link between AFRO and the WHO HQ created a lack of coordination in the response effort. Furthermore, ROs operated with a focus on their own countries/regions rather than global health, having implications for the timeliness of the PHEIC declaration, as detailed below.

In the WHO, regional directors officially come under the DG's authority. However, since regional directors are elected by the member states of their regions, this has implications for where their loyalties lie when it comes time for making decisions. According to the Commission on a Global Health Risk Framework for the Future, "the election process makes the regional directors accountable first to their region's health ministers, rather than to headquarters, thereby impeding the WHO's ability to act as a unified organization" [55].

The High-level Panel on the Global Response to Health Crises (established by the UN Secretary-General) said it "heard that the WHO's management structure—in which regional directors are not directly appointed by the director-general—can undermine the ability of the director-general to command strategy and control the actions of all WHO secretariat staff [10]."

Similarly, when heads of WCOs are "national professional officers," as opposed to "international professional staff," (this is the case in 16 percent of WCOs) there is an "issue of concern … since as nationals in their respective countries of origin, they could be subject to conflicts of interest and their independence could be questioned [54]." Collectively, these chain of command and conflict of interest issues affect loyalties, trust, and, therefore, openness in communication among nodes.

The Harvard Global Health Institute and the London School of Hygiene & Tropical Medicine created the Independent Panel on the Global Response to Ebola, which did its own after-action report. The report found that Guinean authorities at first downplayed the outbreak (after MSF had already sounded the alarm, but before the PHEIC) because of the potential for economic, trade, and social fallout, and to mitigate panic [9]—this meant the communication flow included the dissemination of skewed information.

According to leaked emails, the DG was under political pressure because of these same concerns not to declare a PHEIC [9, 56]. "…the WHO Ebola Interim Assessment Panel and leaked internal emails suggest several reasons for the delay [in declaring the PHEIC] including concerns about political opposition from West African leaders, economic ramifications, and a culture within WHO discouraging open debate about sensitive issues, such as emergency declaration [9]."

In conjunction with the competing interests of the different organizations, another cause for diminished communication between nodes may be a lack of capacity. The WHO's staff had recently been downsized due to a half-billion dollar budget cut that cost the organization 300 headquarters jobs and two-thirds of its emergency response staff, including 9 of the 12 emergency response specialists in AFRO [10, 57]. This indicates that the three remaining AFRO emergency responders were oversaturated, as their area of responsibility had remained the same as when there were 12. The reduction in emergency response specialists created a bottleneck in communication flow. If there are only single avenues for a node to communicate to the network at large, oversaturation of that dyadic relationship can diminish the effectiveness of the network as critical information is slowed through the bottleneck.

As a JLEnt forms to respond to an event, different organizations will sometimes have competing interests. When this is the case, frequent, transparent, and accurate communication between the various nodes may be needed to ensure that network-level goals are still met. This type of communication was not present within the WHO nodes during the Ebola outbreak.

In a random network, only a small percentage of links between nodes need to break before the network is fractured. This appears to be what occurred. As one after-action report on the Ebola crisis noted, "Discordant relationships [among WHO regional offices and WHO headquarters] were evident in the recent Ebola crisis, hindering swift and effective outbreak response [55]."

Another report stated, "The poor cohesiveness between headquarters and AFRO became evident during Ebola," and noted that, "…the Guinea country office reportedly impeded aid and technical assistance…" [57].

Yet another report noted, "During the Ebola outbreak, WHO headquarters and [AFRO] were in tension, with AFRO and African country offices sometimes blocking visas for foreign aid workers and failing to rapidly issue permits to offload critical medical supplies … there needs to be greater coherence between the Organization's different levels [56]." The tension and lack of coherence would have negative implications for information and communication flows.

The Ebola Outbreak highlighted the pitfalls of the structural and communication systems in place within the WHO. The susceptibility of random failure in this random social network leading to isolation was a serious problem either due to oversaturation of a node or to communication breakdowns because of competing interests and lack of trust. But simply moving from a random network to a free-scale network does not ensure success. While social networking theory predicts that free-scale networks are more resilient to failures of any random node, failures at central hubs can cause fracture and complete network disruption [12]. As detailed below for the SAR effort during the MH370 event, a lack of transparency and breakdown in

communication links coming out of the central hub created isolation of key players in the social network.[14]

In the MH370 SAR event, there were several instances when nodes (sources of pertinent information) were not connected to the central hub (the MOT) and, therefore, did not communicate key information.

In the first few days of the SAR, Malaysia seemed to have had trouble with transparency [59]. The Malaysian government came across as evasive and inconsistent, which led many people to question whether it was withholding information about the plane's disappearance [59], which in turn fueled distrust among nodes. (Much of the Malaysian government's inconsistency and lack of transparency can be attributed to the lack of experience in handling a large international media presence [59]; however, the reason is less relevant for our study than the result.)

As the perception of the MOT hub in the network worsened, links to other critical nodes began to erode. The most obvious example of this is China's interactions with MOT. China displayed a significant lack of trust for Malaysia during the initial SAR. Days after the plane's disappearance, China's Foreign Ministry was pressuring MOT for a faster response and demanded that the government provide more accurate information [60].

As links to the central hub of this free-scale network began to dissolve, the effect was a fractured network. The mistrust and doubt in Malaysia's ability to lead the SAR response hindered other nations' willingness to follow instructions and guidance from MOT [61].

If the central hub of this network, the MOT, had garnered more trust, the SAR process may have been expedited.

Whether pre-established or emerging organically during a crisis response, it may be important for the JLEnt to consider safeguards or redundancies—such as

[14] ICAO doctrine dictated that the responsibility of leading the SAR operations fell to Malaysia as the aircraft's country of origin. It is clear that Malaysia held the majority of the responsibilities in the early SAR phase (March 8-17, 2014). Because of this, there is some indication that the social network structure was free-scale, with MOT as the central hub. Vietnam shutting down SAR operations while waiting to hear from Malaysia on how to proceed is one example that highlights the status of the communication channels during this period [58]. At least one node—Vietnam—and potentially others were dependent on communicating directly with MOT, the lead organization, and minimally dependent on lateral communication through the network, indicating a free-scale network. However, there is limited data to corroborate this theory.

facilitators—at the hubs of free-scale networks. As we saw in the MH370 event, distrust can result in the failure of a hub. Just as social network theory predicts [62]—and the MH370 event confirmed—failures of a small percentage of network hubs can quickly fracture a free-scale network.

Communication with the tactical nodes

Thus far, the links that we have discussed have been at the operational level and between hubs in free-scale networks, or between operational organizations in the random network in the Ebola event. However, we also found three examples of breakdowns in communication at the tactical level. Staying with the MH370 event, from the start of the SAR operations there was significant confusion about the plane's flight path.[15] This was of paramount importance, because it directly affected pinpointing the search area for SAR efforts and the response time for the rescue operation. There appeared to be a breakdown in civil-military communication, leading to isolation of nodes.

As efforts to ascertain the flight path and location of MH370 continued, there seemed to be either reluctance on the part of foreign militaries to share radar data and/or other reasons for delays in communication of military radar data. This was likely due at least in part to the classified nature of military radar technologies [63]. For example, India gave conflicting statements regarding whether its radar systems near where MH370 would have flown were operational at the time. Also, on March 18, 10 days after the plane was declared missing, the Thai military came forward with new information, stating its radar had detected a plane that might have been MH370 just minutes after communications went down [64]. Thailand's military later explained that it did not share the information earlier because it was not asked to do so and it "did not pay any attention to it" [64]; however, it has been suggested by some that countries such as Thailand did not want to expose capabilities and/or weaknesses in their radar systems [65]. Although not addressed in this report, information classification is a pervasive problem [66] that could plague the JLEnt in any future response where the military is involved.

[15] Initially, the plane was thought to have crashed off the coast of Vietnam's Tho Chu Island. However, by March 11, 2014, the search was focused off the west coast of Malaysia and north of Indonesia's Sumatra Island. On March 13, 2014, U.S. investigators indicated that the plane may have continued to fly after it disappeared from radar, so by March 14, 2014, ships were sent to the Indian Ocean to continue the search. This was followed by the Malaysian Prime Minister Najib Razak's announcement that the plane was deliberately flown off course and continued to fly for hours after communication was lost.

While reluctance to share potentially sensitive information may be an underlying issue regardless of network type, unclear communication channels and isolation of nodes within the network may have also exacerbated the MH370 situation.

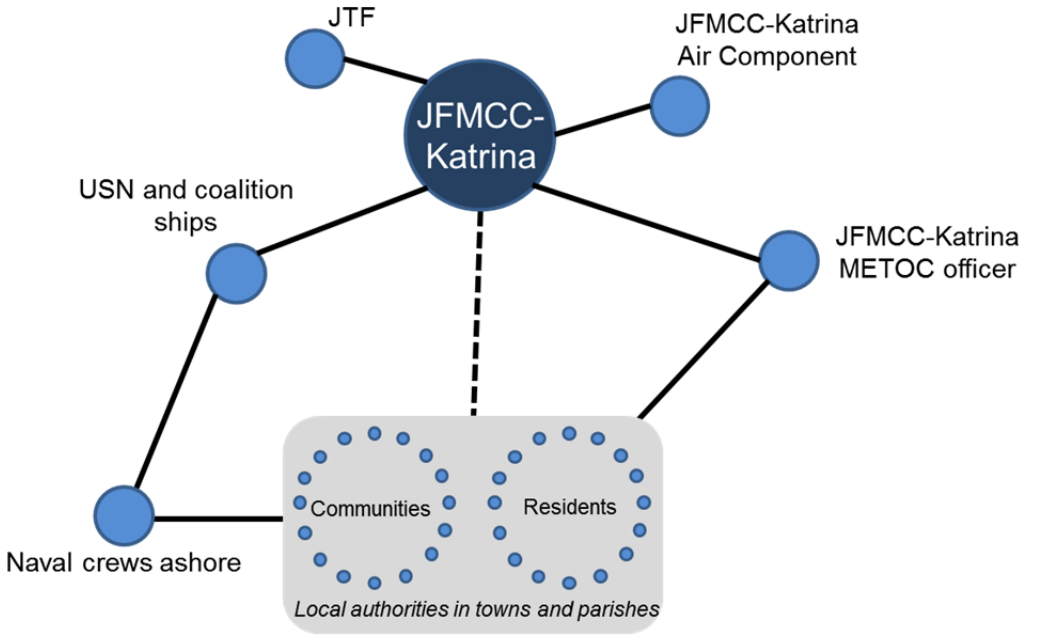
Additionally, there were several communication delays among individual countries' own civil and military authorities. The Malaysian military picked up an unidentified aircraft in its airspace on March 8 [67]. The then-unidentified aircraft was detected over northeast Malaysia before it headed to the Malaccan Strait [68]. However, this information was not associated with the investigation and was not passed to the civilian authorities for another two days [67]. If the Malaysian Air Force had immediately responded to the data it received about the unidentified aircraft in its air space, it might have saved the international community from such a large-scale SAR operation [68]. A similar communication breakdown was seen between Thailand's military and its civil authorities [67]. The Thai military tracked an unidentified aircraft after communication with MH370 was lost. However, this information was not communicated outside the Thai military to the Thai civil authorities until 10 days later [64, 67].

In a crisis response, accurate and timely information is imperative for successful operations. The MH370 incident demonstrates how the breakdown of links in a social network can impede the efforts of a crisis response, when important data is not delivered in a timely manner. If, at the operational level, MOT had stronger connections and was not fractured, perhaps it could have circumvented the problems of links breaking in its network. The lead organizations in the Katrina response were able to do just that.[16] The hubs were able to work around a lack of tactical communication from nodes.

As described in the Katrina vignette, the planned network (Figure 1) broke down due to the circumstances of the hurricane. When the USN circumvented the breakdown of its planned social network, the network took on a free-scale model. Figure 8 is a reconstruction of the network.

[16] It should be noted that the response to Katrina was limited to the actions and interactions of a single government operating within its boundaries. In contrast, in the MH370 situation, a multitude of nations searched vast areas of ungoverned oceans. It is unclear whether some of the lead organizations in Katrina would have been as effective had they been utilized in an MH370-type response.

Figure 8. Schematic of the social network used by the Navy during the response to Hurricane Katrina[17]



In this figure, the dashed line represents the connection that was made from the local communities to JFMCC-Katrina via the METOC officer.

The major hub was JFMCC-Katrina, which facilitated information flow down to smaller nodes. JFMCC-Katrina also directed tasking as orders were received. *Iwo Jima* served as a small airport and provided housing for JFMCC-Katrina and his staff. *Iwo Jima* was docked in the Mississippi River alongside New Orleans. This prime location meant that it could readily support flight operations.

JFMCC-Katrina was connected with the on-shore METOC officer; local communities were preferentially attached to the METOC officer, thus he served as a tactical connector between JFMCC-Katrina and the local communities. Other deployed naval assets on shore also served as tactical connections to JFMCC-Katrina. Communities and residents could submit requests through these various lines of communication to the JFMCC staff. JFMCC staff could then send requirements directly to the

[17] The sources for this figure were formal CNA reports and an interview with a CNA analyst who was deployed on *Iwo Jima* to assist JFMCC-Katrina during the Navy's response to Hurricane Katrina. While the social network is neither complete nor comprehensive, it is an accurate representation of the network, according to our research.

JFMCC-Katrina Air Component in Pensacola, which would deliver supplies to communities and residents (see Figure 8 above, specifically the link between the METOC officer and the rest of the network).

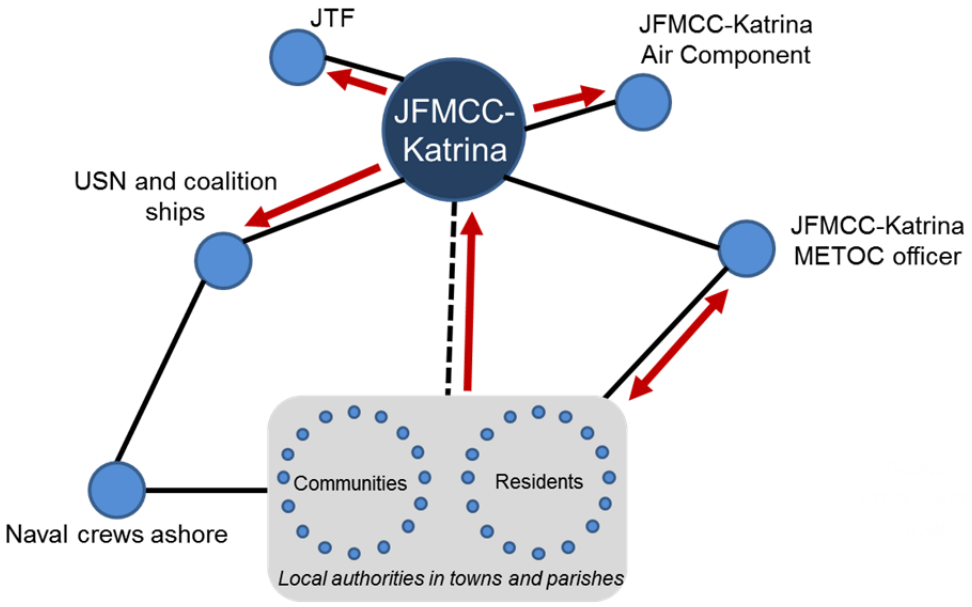
The JFMCC-Katrina Air Component would organize the airlift and the aid would be delivered. Additionally, the helicopters could refuel on *Iwo Jima* before heading back to Pensacola. Had the METOC officer not been attached to JFMCC-Katrina, we believe that the links between the isolated communities and JFMCC-Katrina might have been substantially delayed.

The benefit of this free-scale social network was that it allowed the Navy to respond rapidly and provide assistance. The quality of free-scale preferential attachment allowed the Navy to create a new hub that circumvented the issue of a damaged telecommunications infrastructure at the tactical level. Then, by having the resources of the hub only one or two nodes away from the tactical nodes that needed assistance, response time was greatly decreased.

OFDA's use of DARTs during the 2004 Indian Ocean tsunami response is another illustration of free-scale preferential attachment to an organizational hub [44]. DARTs are made up of local experts, local/regional contracting officers' technical representatives, medical staff, and disaster relief specialists who are sent to regions that experience a major catastrophe (e.g., they are sent to the field). These teams aim to gain situational awareness at the tactical level and relay the information up the chain of command to direct the appropriate aid response. While the deployment of these teams is a normal response, what OFDA did differently during the 2004 Indian Ocean tsunami response was to also embed DART members within the JOC hub with PACOM. This allowed a connection to be created between the operational hub and (tactically located) isolated communities.

Preferential attachment was also seen during the response to Hurricane Katrina. The METOC officer and other ashore assets to JFMCC-Katrina expedited the process of making the links and connections with isolated communities (See Figure 9). Both the Navy's and OFDA's responses to their respective disasters demonstrated the benefit of free-scale preferential attachment in improving the speed at which connections between tactical and operational assets are made (which ultimately enables the faster delivery of aid).

Figure 9. Social network of the Navy's response in Hurricane Katrina, highlighting the METOC officer's ability to link communities and residents to a central hub for disaster assistance



The red arrows show the direction of information flow. First, the METOC officer made connections with the local communities and provided them with information that enabled them to contact JFMCC-Katrina. Then, the communities connected with JFMCC-Katrina, who would either task specific naval assets or send the requirements to the appropriate entity. It should be noted that, in addition to the METOC officer, the naval crews ashore also acted as a linking node to the USN relief efforts.

Based on the events analyzed in this report, the characteristics of a free-scale network (as opposed to a random network) may give the JLEnt more of the needed flexibility and network-wide visibility to successfully address a crisis event.

Preferential attachment to critical hubs can provide tactical nodes with pathways for communication when previously existing links are cut off. Additionally, the robustness of a free-scale network offers advantages over random networks, reducing the likelihood of network fracture due to random node failures. The JLEnt should consider that, as networks grow; additional nodes may be needed between hubs to act as facilitators to prevent oversaturation. For the military, this would be like an expanded role for liaison officers, who help coordinate and communicate activities between two organizations.

Network governance theory

It is imperative that we understand not only the types of social networks that exist during a crisis, but also how the networks function. After we understand this, we may be able to correlate network process and the conditions that lead to a network's outcomes. Crisis response events usually involve complex issues that demand coordination between two or more autonomous organizations in order to achieve not only their own goals but also a collective goal.

By understanding how certain network governance styles fail or succeed in particular crisis environments, it may be possible to predict the most likely to succeed, given certain characteristics of a crisis and/or the demographics of JLEnt members. This knowledge would help participating JLEnt members in any given crisis response chose the best style of governance for the network.

Network governance is unlike organizational governance, in that the network is governed without hierarchy or ownership, and accountability for adhering to network goals or conforming to rules and procedural mandates is limited. This is a common observation in JLEnt crisis responses [2].

At one end of the spectrum, a network may be governed by all of the participating organizations. In this democratic style, every organization would have an equal voice and interact with every other organization to govern the network. The result would be a dense and highly decentralized form of governance called a "participant-governed network."

At the other end of the spectrum, a network can be highly centralized, with little interaction among organizations. Governance is brokered through a single organization acting as the lead organization. This is called a "lead organization-governed network."

The midpoint between these two extremes is a "network administrative organization," whereby a single organization that is not a participating member of the response activities governs the network and its activities. This external governing body exists exclusively for the purpose of network governance.

Organizational theorists Patrick Kenis and Keith Provan suggest that there may be a rationale for the adoption of one network style over another that would allow for the prediction of the network's success. Dr. Robert Drazin, a Columbia Business School professor, argues that each form of network governance requires certain network characteristics to be effective [69].

Kenis and Provan [70] asserted that four key factors determine the success of each of the different forms of governance: trust, number of participants, goal consensus, and the nature of the task—in particular, the need for network-level competencies.

The rest of this section describes each of the four factors as they relate to social networks, and uses the vignettes in determining the validity of the theory in the context of a JLEnt crisis response.

Trust in terms of network governance is about the distribution of trust within the network. Is trust widely distributed among most of the members of the network, or is there a low density of trust, and is it reserved for individual dyads or "cliques"?

Not every form of governance requires the same density of trust. Participant governance, also referred to as shared governance, is most likely to be affected by the level of trust. In this form of governance, trust ties must be pervasive among the many members of the network to provide a web of trust-based ties. Without this, there is little basis for collaboration among network members. Conversely, a low density of trust can work for lead organization governance or a network administrative organization. In these types of governance, the network can still function and be effective because governance is centered around the governing body; trust can be distributed among just a few (as long as those few members who are trusted are in the governing body).

The number of participants in the network also has an influence on the success of the network governance. Shared governance is often the preferred style. It allows participants to have a voice and help control the activities of the network. However, as the participation grows from a few to many, shared governance becomes highly inefficient, and results in participants being ignored, or in a substantial increase in the amount of time needed to coordinate effort across the network. To accommodate a moderate or large number of participants, governing through a lead organization or network administration can centralize coordination. Under these configurations, participants no longer have to interact with several different entities, but rather with one governing body.

Goal consensus has important implications for network governance. As with trust, when consensus on network goals is high, participants can govern themselves because they can work together without significant conflict. However, when network goal consensus is low, lead organization governance may be preferential in order to broker strategic and operational network decisions. With intermediate levels of goal consensus among participants, network administrative may be the most effective form of governance.

Participants' desires to accomplish tasks that they cannot achieve independently drive the creation of networks in a crisis response. The need for competencies outside of a participant's own ability requires coordination within the network. The

greater the interdependence for task-specific competencies, the more network-level coordination will be required. This means that shared governance will be less effective when tasks/activities require more network-level competencies. Instead, when high or moderate network coordination is needed, lead organization or network administrative organization may be the preferable forms of governance.

Table 1 shows the relationships of the four factors with the three types of network governance. Provan and Kenis state that "the greater the inconsistency between critical contingency factors and a particular governance form, the less likely that the particular form will be effective."

Table 1. Forms of network governance and their ideal characteristics

Governance forms	Trust	Number of participants	Goal consensus	Need for network-level competencies
Participant governed	High density	Few	High	Low
Lead organization	Low density	Moderate number	Moderately low	Moderate
Network administrative organization	Moderate density	Moderate to many	Moderately high	High

[a] Provan and Kenis et al. [70]

Lead organization governance

Within the context of the military, lead organization-governance is the most familiar. In joint or coalition operations, there is always one lead that coordinates all efforts of the participating entities. The armed forces train to this model in a C2 structure.

In the crisis response for Katrina, the Navy was forced to abandon the established construct for lines of authority and communication when Louisiana's infrastructure was rendered useless after the storm hit. The resulting social network, as we discussed earlier (see Figure 8), was a free-scale network, with JFMCC-Katrina acting as the lead in the Navy's response efforts to Hurricane Katrina.

Lead organization-governance in this event was successful because there was trust, goal consensus, a moderate number of participants, and, potentially, a moderate need for network-level competencies. Furthermore, through years of training in the military, trust[18] is developed that lead organization-governance (at the strategic, operational, or tactical level) will provide the appropriate directive (or orders) for any mission. Additionally, there is a trust from leadership that their orders will be followed and completed to the best of the unit's abilities. The military's training, flexibility, and interoperability build the trust necessary for this type of governance to succeed, especially in a fast-paced disaster relief operation.

We note that the nature of the Katrina response likely influenced the outcomes of this type of network governance in this situation. Most of the major participants in the social network that we studied in this event were military and trained to this type of governance structure. Furthermore, the response was contained within the United States and thus the USN did not have to address the issues of operating and cooperating with foreign nations, militaries, or local foreign communities. Although not available in the data collected for this crisis event, it would be interesting to see how incorporating NGOs or IOs into this social network may have changed the governing effectiveness. Typical communication issues between military and non-military partners may have impeded the flow of information and as a consequence, may have also impeded the level of trust across the entire network. Additionally, it would be interesting to see how the governance dynamic or effectiveness would have changed if the military had not been the lead governing body, and instead the network had been led by an NGO or non-military organization.

The USN's governance in the ad hoc social network created in the Katrina response, although not perfect, was effective in providing support to crisis victims. As discussed above, much of that had to do with the implicit trust, in this case gained from military training. The examples we discuss below demonstrate how lack of trust can undermine this governance style.

During the Ebola outbreak, WHO HQ was the lead organization governing the random social network, which included WHO HQ, the involved RO (AFRO), and the relevant WCOs. The breakdown in the social network was due to the divergence in the characteristics necessary [69] for success in this type of governance. For a lead

[18] It could be argued that the trust across the USN social network in the Katrina crisis response was high, seemingly contradicting the requirements for ideal characteristics for lead organization governance (see Table 1). However, our study found that these requirements are minimum thresholds that can be exceeded. While lead organization governance can be successful when there is low, moderate, or high trust, participant governance has a minimum requirement of high trust throughout the network. If the level of trust is below that minimum, the likelihood for success is diminished.

organization-governed network to be successful, the lead must have the trust of the other nodes.

As noted above, there was already structural discord (affecting trust) between AFRO and WHO HQ, as well as between WCOs and WHO HQ, and the distrust was likely mutual. Authority, communication, and reporting lines were unclear, and as a result, the trust in the social network eroded. Furthermore, a leader perceived as weak does not instill trust, and as the U.N. High-level Panel on the Global Response to Health Crises stated, "with stronger leadership from the director-general, a PHEIC could have been announced earlier [10]."

As described above, during the time before the PHEIC was declared, goal consensus was questionable; AFRO and the affected countries downplayed the outbreak because their goals included protecting their countries/region from the potential negative fallout from a widely broadcast outbreak (e.g., economic and social ramifications).

The low density trust and moderately low goal consensus in this situation indicate that the lead organization-governance should have worked. However, the other critical contingency factors that would foster a successful lead organization-governance scenario are:

- a moderate number of participants (in this case there were few nodes—probably too few—involved) and
- A moderate need for network-level competencies (in this case, there was a high need instead of a moderate need, and nodes fell short on the competencies needed).

Similarly, the MH370 SAR response was delayed due to lack of trust in the lead organization governing the network (MOT). The lead organization-governed free-scale network in this event was used because of the pre-established ICAO protocol. ICAO's Convention on International Civil Aviation, also known as the Chicago Convention, established doctrine for these types of situations.

This governance structure was unsuccessful in this event, as illustrated by the nine-day delay in determining a general search area for the crash [71]. The delay, as previously discussed, was rooted in a lack of communication and coordination among responding entities, which was most likely due to distrust of the MOT.

While network governance theory states that a wide distribution of trust is not vital to the success of lead organization-governance, it is critical that the trust that does exist be in the lead organization. In this case, the lack of trust for the Malaysian government (represented by MOT) was crippling because it was the central hub in the initial SAR operations. Perhaps if Malaysia had not been the lead organization, but a participating organization instead, the SAR would have had fewer delays due to poor communication and coordination. When Australia ultimately took over as lead, there

was far better communication and transparency, which led to a quicker and more effective response [72].

Where the lead organization-governance thrived in the U.S. military's Katrina response, it had several failings in the Ebola and MH370 events. A key difference between the success and failures in the governance of these three events was the level of trust for the lead organization. Although organizational theory says that lead organization-governed networks require the lowest amount of trust of the three governance types, the placement of even limited trust is critical.

Network administrative organization

Between the democratic governance of a participant-governed network and the oligarchy of a lead organization-governed network resides the network administrative organization. This organization has no role in the response effort other than oversight of the network.

This type of governance is typical in a UN crisis response. The sector, or cluster, approach is the current foundation of the humanitarian coordination system, which was adopted by the United Nations General Assembly during the Humanitarian Reform Agenda in 2005. The purpose of the cluster system is to strengthen preparedness and capacity to respond to emergencies, while also providing clear leadership and accountability in the major areas of crisis response [73]. The cluster system is also meant to reinforce partnerships through predictability and accountability. Partners within a cluster will become familiar with each other and learn the types of capabilities the other organizations can offer. They will also build trust prior to a crisis event.

We see this in the Camp Minawao response. At the strategic level, the UN governs through the RC as the network administrator. The RC for Cameroon is located in Yaoundé, Cameroon, about 1,100 km from Camp Minawao.

At the end of 2013, the UNHCR estimated that there were 103,170 refugees in Cameroon, 3,410 of whom were from Nigeria and who were most likely at Camp Minawao [32]. Camp Minawao is one of eight refugee camps in Cameroon under the governing umbrella of the UN via the RC. Because the RC governs all of the camps, the cluster is ideal for ensuring that no gaps exist in providing life-saving services to the refugees across all the camps.

The cluster system was created as a result of the frustrations from the humanitarian responses to the 2004 Indian Ocean tsunami and to the Darfur conflict. The consensus among the humanitarian community was that responses needed to be coordinated. However, there are two ideas about how this should be governed—one

is to have a central, unified, and hierarchical structure. The second is to implement more loosely centralized coordination. The cluster system is an attempt to combine both ideas (overlapping a network administration organization and a participant-governed network).

Early in the Camp Minawao response, the sector leads appeared to know which local agencies were in the area and could assist. In the situation reports from the first few months, local NGOs were already identified and working with UN agencies [17, 50, 74-75]. We can assume this was an effect of working together previously (during the establishment of the other seven refugee camps) on similar issues and having already built the trust and understanding needed for a participant-governed network. An after-action report highlights how existing contracts or partnerships with local NGOs aided in the rapid response of the refugee crisis [50].

The Camp Minawao event adhered closely to the four factors that Provan and Kenis cited as being necessary for proper implementation of a network administrative organization. Participants' previous experience—leading to high trust and goal consensus—enabled this governance style to run smooth and efficiently.

As with the USN's role in Katrina, conditions were ideal for this type of governance. What is not known is if any of the four characteristics had been different, how that would have affected the network administrator's ability to govern. We saw in the Ebola outbreak and the MH370 event how of lack of trust can be a pitfall for the lead organization. It would be useful to see what the critical failure point is for a network administrative organization.

Participant governance

In a JLEnt event, different organizations come into the response with different equities and organizational goals. Many of the organizations, particularly small ones, would like the network to be governed by the participants, allowing all voices to be heard and helping ensure that the organizations are working toward their goals.

At the tactical level in the Camp Minawao response, we believe that the major hubs had equal voices and formed a participant-governed network. From the situation reports during the early months of the camp, we conclude that each of the major players was addressing the tasks associated with its sector (shown in Table 2). We also conclude that the major players either directed or worked in a partnership with the other NGOs and local authorities that could assist with their sectors' needs. We note that in the situation reports and after-action reports, we could not identify a specific agency at the tactical level that was solely providing governance.

Table 2. UN leads and corresponding NGOs for each sector

Sector	UN lead	NGOs
Health	WHO & UNICEF	Ministry of Public Health, Ministry of Youth Affairs and Civic Education, French Red Cross, Centre de Nutrition Ambulatoire , CNTI
Food assistance	WFP	SAILD
Shelter	UNHCR	Public Concern
Protection	UNICEF	ALDEPA
WASH	UNICEF	ACEEN, Ministry of Water, Resources and Energy

The way the sectors operated seems to validate Drazen et al.'s theory on characteristics needed for a successful participant-governed network. There were a small number of sectors (four). There was a high density of trust between the sectors due to the fact that they had worked together before establishing other refugee camps. Although there is no literature that explicitly states this, we assume there was also goal consensus—both within each cluster and among the clusters. The common goal was to establish the camp and to provide the refugees with live-saving services. Finally, the need for network-level competencies within the clusters was low; the idea of the cluster system is that each agency or actor is assigned to a specific cluster that aligns with its capabilities (for example, WFP is the UN lead for food assistance).

The social network for the 2004 Indian Ocean tsunami response (in Indonesia, Sri Lanka, and Thailand) at the operational level seemed to be a participant-governed network. There were essentially three primary hubs or lead organizations working in tandem to help coordinate activities: PACOM/CSF 536 (U.S. military), USAID/OFDA, and UN/OCHA [37, 39, 43]. Since this was a multinational relief effort, there was no single organization with overarching authority. Additionally, there were smaller facilitators that helped coordination and information flow: JOC, CMOC/CCC, IASC, DART, and (tactically) the CATs. At the operational level, these nodes existed primarily to drive coordination among the hundreds of agencies and actors present during the relief effort. We believe that without these network facilitators, the coordination would have been drastically more challenging.

While no one organization had overarching authority, the coordinating hubs (PACOM/CSF 536, USAID/OFDA, and UN/OCHA) led the relief efforts by determining and planning the routes for relief support and supplies. There was goal consensus around providing the best and fastest relief possible. Typically, a participant-governed network operates best with fewer participants, but in this case, there were

a large number of participants. This governance structure in this large-scale response may have been successful due to the fact that only three entities were sharing governance at an operational level (despite the large number of responding entities, governance was only divided among three groups).

This type of multi-organizational governance may have been used because of the scale of the response. The earthquake and subsequent tsunami significantly affected 14 countries, including Indonesia, Sri Lanka, and Thailand. As a result of the magnitude of damage, there were more than 30 different militaries and more than 100 NGOs responding to the crisis [39]. With such a large humanitarian response, it likely would have been difficult for one organization to have the infrastructure or resources necessary to coordinate the large multinational response.

One problem that emerged during this humanitarian response was communication, particularly civil-military communication and coordination, as well as tactical level, lateral communication. Some of the communication problems might have been due to the type of governance employed. There were multiple communication channels among these organizations at the operational level; however, there did not seem to be many channels of communication at the tactical level. We can infer that this caused some confusion about who to talk to, particularly with so many organizations involved.

Fractures in participant governance

In the Katrina response, there was friction between the Louisiana state government and federal response efforts that were supposed to function together as a participant-governed network (see Figure 1). Making matters worse was that in addition to the lack of trust there were also too many participants, according to Provan and Kenis governance theory. For example, the governor of a state is the commander in chief of the state's National Guard. During Louisiana's response, Governor Blanco asked for significant federal military assistance (40,000 troops). Once the federal troops arrived, commanded by the JTF, it became clear that having two separate commanders (state and federal) for armed forces in the same AOR was an issue.

Initially, President George W. Bush was against federalizing the National Guard to unify the command, but he eventually understood that it was critical to the coordination effort. He proposed that the JTF commander have dual-status as commander of federal troops under the U.S. Secretary of Defense (SECDEF) and commander of the National Guard forces under Blanco [76]. Blanco rejected the idea.

The above example is one instance of a lack of trust at the strategic level in this crisis event; there were more. Many Louisiana government officials criticized the White House's responses. Rep. Charlie Melancon of Louisiana wrote to Blanco's staff after

meeting with the President in Mississippi that the "entire effort on behalf of the federal government has been reflected in [the President's] and his people's nonchalant attitude to the people of [Louisiana] [77]."

From the Camp Minawao event and the 2004 Indian Ocean tsunami response, we learned that participant-governed networks can indeed be quite successful when Provan and Kenis' conditions are met: few members, high trust and goal consensus, and low need for network-level competences. We also learned from the Katrina event how a participant-governed network can fall short.

Transitioning forms of governance

For the South Sudan WASH crisis, we believe that the governance of the social network evolved. Initially, the UNCHR was the lead organization and the network used UNHCR infrastructure to communicate. While there appeared to be some tactical level communication and links among the NGOs [32-33], the NGOs appeared to be in large part autonomous, and they communicated primarily during the coordination sessions run by the UNHCR [78].

As the crisis dragged on and the water and sanitation issues were not resolved, it seems that the NGOs lost trust in the UNHCR's ability to solve the WASH issues in a timely manner. A report from MSF stated: "As the coordinator of the response, UNHCR itself took too long to assert leadership in the WASH sector [32]."

In the early part of 2012, we believe the governance style shifted from lead-organization governance to a network administrative organization that included primarily NGOs acting to fix the water issue. The three organizations involved with WASH (MSF, Oxfam, and the International Organization for Migration) had goal consensus in that they wanted to provide potable water for the refugees. However, even during this time, there seemed to be a lack of trust among the NGOs. Oxfam was tasked with conducting hydrological surveys of the camps to find appropriate wells, but MSF considered the surveys "neither conclusive nor successful." This criticism caused tensions [32].

As the water crisis was still unresolved as of June 2012, more changes in the network occurred. The governance appeared to shift again, back to lead-organization governance, but with a different lead now, as MSF took the helm in the water crisis. The MSF unit in South Sudan reached back to another MSF cell in Holland (which appeared to have more expertise in WASH) and deployed it to begin providing emergency water relief in the camps [32]. MSF lobbied the International Committee of the Red Cross (ICRC) to aid with the relief efforts in South Sudan. The ICRC did respond and by the later parts of 2012, it installed the appropriate piping, tanks, and pumps required to provide clean water in two of the four camps.

The initial efforts led by the UNHCR seemed to take longer than they should have. We believe that the UNHCR relied on smaller, less capable NGOs to fix the water and sanitation issues within the camps. However, these NGOs did not have the capability to deal with the growing crisis, especially with the lack of funding, and with the difficulties in delivering the aid required on roads that were closed for a majority of the year due to flooding. MSF has stated that "the poor water and sanitation situation in the camps appears to have been the major contributing factor to the persistently high death rates [32]."

When MSF took the lead, it increased the amount of water provided to refugees by at least twofold in the camps within two months. However, this came at the cost of causing friction among the agencies present. The UNHCR stated: "MSF were putting ultimatums to NGOs and then having bilateral communications with NGOs and not including the UNHCR, and not understanding that the UNHCR will have to be part of the solution that they agree [32]."

For a coordination agency like the UNHCR, "this caused a lot of tension and confusion in the planning [32]." Additionally, while the interviews MSF gave to international media outlets did help convince the ICRC to provide relief to South Sudan, MSF's statements were also confrontational.

We believe the evolving network governance in this event was the result of weak leadership and guidance from the UNHCR. The lack of action in solving the WASH issues in South Sudan caused consternation among the tactical level NGOs working to fix the issues. The lack of capacity of the smaller NGOs like Oxfam and the International Organization for Migration prompted MSF to take the lead. While friction ensued, MSF brought in the proper experts and was effective in solving the WASH issues within the refugee camps in 2011/2012.

The South Sudan water crisis provides interesting insight on how a social network can be flexible mid-crisis, and can shift as certain players take action to address pressing needs. This flexibility may be a fundamental factor in the success of future JLEnt responses. It should be highlighted that this flexibility is not as much a process than a mentality. Having the ability to shift not only the form of governance but also the level and types of response in a dynamic crisis environment may be crucial in relief efforts. To explore this flexibility further, we look at transactive memory system theory.

Transactive memory system theory

A TMS is the process by which some asset is collected, stored, and used among individuals within a group or organization. In organizational science theory [79], the asset being collected, stored, and used is information. In this study, TMS theory is

the study of how a collection of people learn, store, use, and coordinate their knowledge to accomplish individual and organizational goals [80-81]. This has obvious implications for the JLEnt; understanding the role and effects of TMS theory could increase the effectiveness of overall JLEnt efforts.

The individuals in a group have different domains of knowledge and rely on the other members of the group for other areas of expertise. This expertise specialization reduces the cognitive load on the individual, reduces the amount of redundant knowledge within the group, and offers members of the group a larger pool of knowledge.

Research from Lewis [82] and Moreland and Argote [83] theorized that there are three factors that influence the level of TMS effectiveness in coordinating the actions of a group: **expertise specialization, credibility, and metastructure.**

For group members to be confident that they can achieve a task, they must first believe they have the expertise within the group to accomplish it (expertise specialization). However, expertise alone is not enough. There also needs to be belief in the credibility of each expert in the group. Finally, there must be a metastructure in place that enables the credible expert to use his/her expertise.

Evidence to substantiate TMS theory has been found in a variety of groups and organizations, including families, business project teams, laboratory researchers, and police officers [84]. In fact, the UN cluster system seems to be in line with this TMS theory. However, the foundation of **traditional** TMS theory is the idea that group membership is stable and the individuals in the group have worked together in the past. This is not usually the case in crisis response events. Researchers have recognized that in the event of a crisis, groups may form that have no experience working together and no cohesive structure through which to coordinate tasks. Members of this ad hoc type of group may not have skills or expertise directly related to the problems facing them [85-87].

Emergent response groups are new, novel, and non-institutionalized; their relationships and activities stray from the routine [88]. The factors that influence traditional TMS effectiveness are not the same as those that influence emergent groups. Instead of expertise specialization, in emergent response groups, research shows a group member's value is measured by his or her action-based tasks [79]. The reason for this is the nature of crises (particularly the requirement for rapid responses). In a crisis response, group members are typically required to be flexible in their task assignments and to pursue multiple, sometimes conflicting goals. Membership may be fleeting. This unstable environment allows for a higher tolerance for risk, in many cases because inaction can lead to further damage or loss of life. Higher risk acceptance translates into placing higher value on action-based members rather than members who will spend time deliberating the consequences of actions. This is particularly true when the members of the group do not have the required

expertise to accomplish the tasks at hand, which can happen in a crisis response event.

As action is more important than expertise when comparing emergent TMS theory to traditional TMS theory, trust is more important than credibility. In this case, trust is the belief that a member's action will generally have a positive outcome.

TMS theory predicts that trust can be built through repeated actions. This trust is continually created and recreated [89] among group members as the actions of individual members are perceived to be having positive results. This could be an important factor in how crisis response organizations approach interactions with other entities within the JLEnt, particularly when there is no previous relationship established.

In traditional TMS, members train in an agreed upon metastructure that facilitates task coordination. However, in an emergent group, members have often not trained together and have different backgrounds with different expectations regarding metastructures. In such cases, trying to impose a single metastructure for task coordination will likely be difficult, particularly as members' goals may be different. Doing so is likely to create group member conflict and possible blame apportionment [90], while slowing down actions toward goal achievement.

Even if an emergent group were to successfully create a metastructure, the instability in members, roles, and tasks would likely rapidly make the metastructure obsolete. Instead of a metastructure, the group might need a set of fluid mechanisms for managing its activities. Depending on the circumstances of the crisis event, it may be less important what type of mechanism the group chooses, but that it choses one at all.

In certain environments, a rigid metastructure could be successful (e.g., in Cameroon). However, in the responses to Hurricane Katrina and the South Sudan WASH crisis, both the Navy and MSF used knowledge flexibility to pivot from a failing rigid metastructure to a more appropriate response structure. Response groups are often ad-hoc because of the time-sensitive nature of crises, which require swift coordination to assess the situation and determine the immediate needs.

Knowledge flexibility may come from individuals' own personal traits (they can cognitively process divergent information quickly), or it may come from previous experience with enough other disasters that they are able to quickly match incoming patterns to successful strategies from past efforts.

Table 3. TMS theory: Key factors for traditional and emergent response groups

	Traditional Group	Emergent Response Group
Value to group	Expertise specialization	Action-based
Basis of value	Credibility	Trust
Task coordination	Metastructure/C2	Knowledge flexibility

Source: Ann Majchrzak et al. [79]

Traditional groups in a crisis response

The UN cluster system closely follows traditional TMS theory. Cluster leaders are experts in their respective areas and have built their reputations, establishing credibility. Teams are formed around member expertise or specialization in a knowledge area. Additionally, the clusters work together frequently. Membership is fairly stable and therefore allows a sense of familiarity and trust to develop among all participants.

Enacted in 2005, the cluster system's first crisis response was to a 7.6 magnitude earthquake in Pakistan. After the event, ActionAid executed a study to understand how effective the clusters had been. Through a series of interviews with participating NGOs, UN agencies, and donors, ActionAid concluded that—although there were issues—"there are many positive aspects to it, including increased opportunities for collaboration and dialogue, improved coordination, and greater predictability [91]."

Traditional responses in 'ideal' conditions

The UN cluster system was used to establish Camp Minawao. This was one of eight refugee camps in Cameroon, all set up around the same time (mid-2013). The predictable nature of this type of crisis facilitated the success of the traditional TMS group. The combination of cluster members' previous experience working together, the existence of active contracts, and good relationships with local NGOs [50] all contributed to the successes in this crisis response. The clusters' predetermined and practiced metastructure allowed each cluster to complete designated tasks in their areas of expertise.

Traditional responses in 'non-ideal' conditions

It is important for the JLEnt is to understand potential outcomes if conditions for a traditional TMS group are not ideal. In the events that we studied, there were two instances of this traditional response in non-ideal situations: the MH370 SAR effort and the response to the Ebola outbreak.

During an aircraft SAR event, ICAO doctrine establishes a metastructure with prescribed protocols and authorities. Per the doctrine, Malaysia was automatically assigned the lead role. ICAO protocol itself seemed to be successful in that it allowed for high visibility and an expedient division of responsibilities, which can often be difficult, particularly when working with a SAR operation that includes more than 25 responding countries.

However, despite the expediency in establishing a metastructure, the lack of expertise and credibility in the MOT—two key factors in traditional TMS theory—created significant communication and coordination problems for the initial SAR response. We believe the failings in this situation were attributable to the lack of appropriate expertise. The MOT may not have had the necessary infrastructure or personnel (i.e., expertise) to efficiently organize and lead the response, causing other network members to distrust the MOT and, ultimately, causing network fracture.

Like the MH370 response, the Ebola outbreak response had a metastructure, but was missing the other two pieces: expertise and credibility. The preexisting metastructure dictated how the three levels of the WHO would coordinate and communicate with each other, and what the lines of authority were. The network relied on specialized expertise (at all three levels—country, region, and WHO headquarters) but, as previously described, due to competing interests of the WHO headquarters, AFRO, and the country offices, the experts' credibility was degraded. Furthermore, budget cuts may have magnified the problem of a lack of internal expertise.

For a social network to have the most effective response, it should identify whether the parameters for a successful traditional TMS model are present and, if not, it should have the flexibility to shift to an emergent response group model.

Emergent response groups in a crisis response

The dynamic and unpredictable nature of certain crisis events may not allow for a traditional TMS response. Required expertise may not be available; participating individuals or organizations may never have trained or worked together; and an accepted metastructure may not be in place or easily agreed upon. In such situations,

the flexibility to move to an emergent TMS model may be more appropriate for crisis response teams.

Emergent TMS at the tactical level

When Hurricane Katrina made landfall, and communications and tasking were non-existent due to damage to the infrastructure, the USN's response departed from the traditional TMS model and moved to an emergent TMS model.

JFMCC-Katrina's implementation of a *mission command* strategy demonstrated the effectiveness of this model during a real-world crisis [24]. This type of response structure was identified in post-event analyses, explaining how the maritime force was able to address a large number of needs. *Mission command* refers to pushing the command and decision responsibility down to the tactical level, where subordinates are expected to make decisions based on their best judgement without having to request permission from a higher authority. While the subordinate commands may not have expertise in humanitarian assistance, they can take quick actions, which can be more effective than a delayed expert response[19].

JFMCC-Katrina identified six mission areas during the hurricane response. Tactical commanders were expected to assess their situations, determine courses of action, and execute tasks within the commander's guidance [24].

Pushing decisions for action to the tactical level gave local commanders the choice to determine whether to provide immediate action or wait for more expertise. This created a more *action-based* emergent response. Naval commanders could utilize their assets (sailors, heavy equipment, helicopters, etc.) to provide relief and aid outside of their typical mission areas. Therefore, *mission command* was effective because it allowed the rapid matching of response capabilities to response requirements. In this operation, tactical level commanders had better situational awareness than did higher authorities. Therefore, they could better comprehend and address response needs, and they could do so quickly, because they did not have to constantly seek approval from higher authorities before acting [24, 27]. This action-based tactical response initially started as both the METOC officer and other naval crews ashore linking distressed communities to the Navy's social network [26].

[19] It should be noted that while term *mission command* originated within the military community, NGOs, IOs, and other relief agencies typically operate in this fashion as well. These entities arrive on scene and begin to administer aid and relief without asking for approval from their internal higher authorities.

The success of this initial action snowballed. By the conclusion of the USN's response to Katrina, 19 ships had provided assistance and at least 4 (USS *Bataan*, USS *Shreveport*, USS *Whidbey Island*, and USS *Iwo Jima*) had sent shore parties to help in this action-based response [24].

Mission command allowed the USN to: perform 195 medical evacuations; rescue 1,559 residents; deliver food and water; and clear many roads and ports [24].

The USN's *mission command* strategy during Katrina is not the only example we saw of the military employing an emergent TMS model in a volatile and unpredictable crisis environment. The U.S. Joint Forces also used an emergent TMS model in its response to the 2004 Indian Ocean tsunami. Although not called *mission command*, the U.S. Joint Forces' response was similar, although smaller-scale.

In the 2004 Indian Ocean tsunami response, many coordination challenges arose at the tactical level because of communication, isolation, and infrastructure issues [43, 46]. To overcome these issues, the U.S. Joint Forces deployed CATs to organize and coordinate daily missions for the naval assets in the areas [38].

As a CAT member recalled, these teams "assumed responsibility for many day-to-day activities, including finding qualified personnel to join shore parties that would be sent into disaster zones, organizing daily work, and keeping statistics."

He also stated that the CATs were seen "as the admiral's [tactical] command center of sorts" and "were the main POC [point of contact] for those calling in the Strike Group" such as the liaison officers, USAID officials, NGOs, and other organizations [38].

Because they provided aid and helped with day-to-day activities, the CATs drew local communities in close, effectively transforming the CATs into hubs at the tactical level. While the sailors and Marines who led these teams were not experts in humanitarian disaster relief, their swift and effective actions were well-received and fostered trust.

A key factor in the successes of the USN's response in Katrina and the Joint Force's response to the 2004 Indian Ocean tsunami was knowledge flexibility. The military trains to be warfighters, but its culture emphasizes improvisation and adaption to any potential challenge—this is essentially knowledge flexibility. The military had knowledge flexibility to apply skills and experiences from other types of training to the Katrina response and the tsunami response. An example of this was the USN's ability to distribute 2.2 million pounds of food and water using helicopters, small boats, and landing craft [24]. Knowledge flexibility enables emergent response groups to, at times, have greater effects than traditional TMS groups when the crisis environment is dynamic.

DoD should train its warfighters at the tactical level to operate with the mentality of knowledge flexibility during crises. With the resources available to the DoD and the unpredictable nature of crises, particularly in large-scale events, the DoD will likely be faced with more complex crisis events that require significant resources. When this happens, innovation (knowledge flexibility) is required to handle unfamiliar and rapidly changing environments.

While tactical level action-based responses have shown their merit, operational coordination is also critical. This was illustrated in the response to the 2004 Indian Ocean tsunami. Many NGOs conducted action-based responses by helping local communities, even taking on tasks in areas outside of their expertise [39]. However, insufficient lateral communication among responders led to overlapping efforts and gaps in meeting certain needs.

In one instance, a miscommunication between NGOs led to a number of houses being built on a plot of land originally planned for a road [39]. This tarnished the images of the NGOs involved, as well as other relief agencies in the area. Additional examples of a lack of lateral coordination were observed throughout the 2004 Indian Ocean tsunami relief efforts:

- In the first three weeks of the response in Indonesia, 17 different bilateral assessment teams arrived within the Banda Aceh province alone [92].
- Reports of the delivery and dispersal of inappropriate or duplicative aid were described in a variety of post-tsunami reports [39, 46, 92]. In Sri Lanka, these issues ranged from delivering cold-weather jackets to displaced victims (in a warm climate) to not delivering contents of warehouses full of relief aid [39].

Therefore, we believe that in the event that an emergent TMS group is required (e.g., in a large-scale disaster such as Hurricane Katrina or the 2004 Indian Ocean tsunami), coordination of *action-based* assets at the operational and strategic levels should be strongly considered to avoid past mistakes. In a free-scale social network, highly interconnected operational-level hubs can have visibility across the entire network and can enable fast communication flow to the tactical levels.

Transitions from traditional to emergent groups

Due to the evolving nature of the crisis in South Sudan, the event shows us both sides of the TMS theory—traditional and emergent—as well as the positives and negatives of both. In late 2011, the UNHCR initially recognized the refugee crisis and a traditional TMS group was formed. The UNHCR activated response sectors—WASH, Health, Food—and was able to coordinate and bring in additional assets and

expertise, including NGOs, to provide appropriate and targeted aid. These agencies have long worked with each other (although possibly not the same people) so they had institutional credibility.

However, problems soon began to arise. By running and coordinating this operation on its own, the UNHCR had to show that it and the NGOs were making a positive impact in order to secure additional funding. This made it difficult for the UNHCR to admit any problems [32]. Thus, other outside entities such as the Humanitarian Coordinator, UN/OCHA, the State Department, USAID, and OFDA were unaware of any relief issues. By not bringing in other agencies, the response effort substantially fell short in some areas, with the most obvious being water and sanitation (however, medical care, food delivery, and shelter provisions were also lacking) [32]. The suboptimal coordination, planning, and strategy in regard to delivering water and sanitation to the refugee camps spurned the emergent TMS response by MSF.

Initially, when the UNHCR was in the lead, MSF followed in the traditional approach, and relied on the expertise and capabilities of other agencies [32]. This strategy was criticized by WASH experts within MSF, who advocated a faster action-based response. Once it became clear that the other agencies could not provide an adequate response, MSF decided to take the lead in providing water. Although MSF assets on the ground were not WASH experts, they brought in help and resources from other MSF branches and began emergency water supply and distribution operations in mid-2012. In two of the camps with more dire water needs (Doro and Jamam), MSF provided at least 40 percent of the clean water supplies, despite the fact that it had lacked the infrastructure to do so just a few months earlier [32].

It should be noted that MSF was able to provide this level of response because of its large relief infrastructure and its funding. While other NGOs had to rely on local communities for logistics and supplies (which accounted for anywhere between 30 percent and 80 percent of their total budget), MSF was able to charter planes to provide regular, bi-weekly supply runs. Because of the substantial infrastructure MSF had already built up in South Sudan (MSF had at least five logistics managers present, while other NGOs had one or two), it was well positioned to provide the appropriate response to the WASH issues.

While MSF did help solve the WASH crisis in the Maban region of South Sudan, it was not without consequences. In addition to upsetting the UNHCR by taking control of the WASH response, MSF also was criticized by other NGOs for not providing enough situational awareness and data so that other NGOs could provide assistance [32]. This highlights the pitfalls of an action-based response that does not have adequate communication between all entities.

Conclusions

Systematically applying social networking theory to seemingly disparate past crisis events has provided insight into potentially critical aspects of national and global networked responses, which can be used to build a framework for future JLEnt responses. Although the number of vignettes in this study made for a small sample size, we believe that the variety in nature, scale, and geographic location of the events, as well as in the actions and circumstances described in the vignettes, indicate that the lessons learned can be relevant to future crisis responses. Furthermore, these lessons learned are not limited to HADR responses. The analysis and findings in this report can be applied to all types of JLEnt responses.

Understanding how social science theories apply to real-world events is a critical step in operationalizing an effective JLEnt. The results of this study can be used in the design of the next wargame, AGILE-17, and can be tested, validated, and refined, and ultimately help develop a better framework for the JLEnt.

One of the key takeaways from this study is that JLEnt participants should attempt to adopt a free-scale social network (as opposed to a random network). This type of network can communicate quickly, raising the probability that needed information and resources will be made available in a timely manner.

Another key takeaway is that a lack of trust can delay or halt response times, diminish willingness to collaborate/integrate, and fracture social networks. The levels of trust or familiarity within a network are factors for serious consideration:

- **It is essential to account for and address the levels of trust in the network when considering the correct type of network governance.** The four factors for network governance—trust, number of members, goal consensus, and need for network-level competencies—should be identified and quantified so that the correct type of governance is selected for any given JLEnt response. However, trust was consistently a point of failure in the crisis events we examined.

- **If trust or familiarity among the actors in the event is low, communication facilitators (e.g., CATs, DARTs, JOC, or liaison officers) should be used to help bridge gaps between nodes**, as they were used during the 2004 Indian Ocean tsunami. Additionally, facilitators that are connected to major hubs in a free-scale social network can help prevent oversaturation/hub failure.

However, it may be difficult to identify in real-time during a JLEnt response the organization or person that could or should take on the role of facilitator. Therefore, at a minimum, it is recommended that some of the major response organizations consider dedicating time and manpower to standing up facilitator teams whose primary objectives are to liaise and coordinate with other organizations (again, as was done after the Indian Ocean tsunami hit). Facilitator teams should continually work with other JLEnt organizations to build trust and familiarity even in times when there are no crises.

- **Increasing the visibility of response actions may be an incentive for NGOs to put forth an earnest effort to collaborate with other JLEnt members.** Participation in a JLEnt is strictly voluntary. Certain organizations generally work in near isolation (and in some cases complete autonomy). However, poor integration can have negative or wasteful effects, which are magnified in a resource-scarce environment. We discovered several instances where a lack of coordination, particularly at the tactical level, led to inappropriate aid delivery (e.g., too many field hospitals, winter clothing being sent to displaced persons in tropical regions [39], or incomplete and duplicative disaster assessments [43]). When these negative outcomes are publicized, it can be detrimental to NGOs and IOs that rely heavily on donors and stakeholders for funding. So, although there may not be an immediately obvious incentive for organizations that can work autonomously to communicate within a social network, their relief efforts could be more effective if they were incorporated into a social network that has a comprehensive perspective on the crisis environment across the multitude or response entities. The J-4 could message to non-collaborative NGOs that social networking and integration are potential avenues to increasing their response impacts, thereby possibly leading to more funding from their donors.

- **Training together can increase trust and familiarity among JLEnt members prior to JLEnt events.** The UN cluster system facilitates team building for this reason. However, the nature of the constant rotation of U.S. service members into new positions makes it unclear whether this strategy of building trust between DoD personnel and other JLEnt members can be effective. Since it is almost impossible to predict which military personnel will respond to the next JLEnt event, selecting the members of the military who should train and build trust with other JLEnt partners becomes problematic. To mitigate this issue, creating dedicated facilitator teams specifically for the military (e.g., the J-4 could create a logistics-centered response team that could deploy to or work with OFDA's DARTs) could be a method to bridge the gap with non-military organizations during a JLEnt event.

The UN cluster system is built on a traditional TMS model. Participating organizations spend their time and resources developing frameworks for effective and efficient processes for crisis event responses. Because the members in the cluster system are relatively static, their expertise is managed and grouped in ways that allow the system to be readily deployable. Familiarity and trust through training and operating together allows for an effective pre-established metastructure. However, as discussed earlier, this model can break down (or may be impractical) during large, unpredictable events, such as the 2004 Indian Ocean tsunami or Hurricane Katrina.

At times, the nature of a crisis (e.g., timing, distance, or infrastructure) restricts the tools, personnel, or expertise available. In these circumstances, the overall disaster response needs to be flexible enough to adopt an emergent TMS approach to the crisis. For this, the members in a JLEnt need to have three key traits: the ability to perform action-based (rather than expertise-based) responses, trust, and knowledge flexibility. In the limited number of crisis responses we examined, we found that the military showed an aptitude for pivoting to an emergent model when the pre-established architectures/frameworks broke down.

This study has demonstrated and outlined how in past crisis events, the characteristics of the social network of responders, the type of network governance, and TMS theory affected the success of the overall responses. Figure 10 in Appendix C is a flow chart showing how social network characteristics can be used to determine the ideal types of governance and TMS that should be implemented in any given JLEnt response.

Recommendations

With the conclusion of this study, CNA recommends the following be further pursued:

- In anticipation of future events, the JLEnt should identify the relevant key players (e.g., the UN, DoD, USAID, etc.) and be prepared to designate these organizations as operational and strategic hubs for other response participants to preferentially attach to. An in-depth scenario-based study could provide insight and recommendations on the most probable set of key players and smaller organizations likely to be participating JLEnt members in different geographic locations and event-types.
- When needed in a crisis event, much of the humanitarian community operates under the UN cluster system's framework; thus we recommend a more rigorous investigation into the UN cluster system and the methodologies it uses to respond to crises. This would help the J-4 better understand how the humanitarian community operates within and integrates

with the UN cluster system. The system designates leads in 13 areas of response (although not every area is activated for every event). This analysis would provide insight into a community that has dealt with (and continues to deal with) issues similar to those that an operationalized JLEnt would face.

- A deep dive analysis quantifying the DoD response efforts in past HADR events (e.g., the percentage of airlift provided or the DoD's response time compared to other agencies' response times) would provide valuable insight into how the world-wide humanitarian community utilizes (or improperly utilizes) the DoD's unique capabilities. Additionally, we recommend answering the question: what capabilities does the DoD have that aren't properly/most effectively used in response efforts? By better understanding how DoD assets are utilized, we can design scenarios or discussion topics for future workshops or for AGILE-17 more strategically and help planners understand the typical needs and requirements in JLEnt crisis responses.
- The importance of trust and communication in social networks was a key takeaway of this study. Currently, classification and information technology (IT) compatibility issues limit how military and non-military organizations interact—and, therefore, how they communicate and develop trust. Drawing together organizations with disparate or non-existent IT infrastructures will likely be critical to the success of the network. An investigation into potential technologies that enable and/or support trust and communication among JLEnt response organizations could prove valuable.
- The quick response nature of this study prohibited more thorough investigations of the social networks in these six crises. In the future, we could focus on one recent crisis event (e.g., the 2015 Nepal earthquake) and conduct interviews to more fully map out the social network among responders. This type of analysis would allow us to study social networks during crisis in far more detail and test the conclusions that we developed in this work.

Appendix A

Prior to LOGWAR-15, players shared what they believed were the most significant challenges facing the JLEnt. The comments below are from 20 players, most of whom were from DoD.

Issue

- Cannot completely resolve, therefore capitalize on the commodity
- Numerous requirements and transportation generation pipelines
- Mitigate uncoordinated responses
- Visibility on the common items/Lack of shared real-time asset tracking between commercial and DoD/government entities
- Identify the "sweet spot" of the common commodities
- Provide visibility to others/share live data/need a joint (STAMIS) information system/insufficient communication and information awareness between responding entities
- Who vets requirements/generating requirements, sourcing requirements, and delivering requirements/inability to assess requirements?
- Optimize lift requirements through a health priority vetting process
- Dealing with potential losses of capital assets
- Pre-coordinated capabilities, knowledge and information/adjudicating high-demand/low-density joint logistic enabling capabilities
- Conducting joint/coalition distributed operations
- Operating from degraded air and sea ports
- Moving and storing sensitive/contaminated (medical) materiel-storage capacity issues of the incoming requirements

Issue

- Potential impediments such as lack of country agreements, customs clearance and fees for processing
- Compatibility and synergy during requirements generation
- Capabilities the host nation brings/lack of understanding of capacity of local sources of supply
- Assess gross estimates for conveyance/infrastructure bottlenecks/continued congestion/bottlenecks
- Maintain a running inventory of HD/LD materiel resources/identify high-demand materiel issues throughout the operation
- Expand knowledge of the vendor base/reduce competitive bidding of the vendor base
- Actionable recommendations/tangible information to prioritize "first-in" due to limited transportation capacity or infrastructure through-put
- Training commonality and understanding for the HN to ensure they can sustain what we give them
- Potential interoperability (materiel and process) between the services, U.S. government agencies, NGOs, coalition forces
- Drawdown Fusion Center to synchronize all retrograde efforts to realize/communicate the requirements and priorities
- Prioritization process to maximize and allocate capabilities across CCMDs; especially when overlapping authorities exist
- Strategy for engaging regional partner participation to include sharing logistic assets
- Ability to share medical commodities and spare parts in the field/significant lack of commonality on medical materiel brought into theater by the Services
- Common vocabulary; cultivate relationships with services and coalition
- Spares account has a significant backlog of requirements that detrimentally affects our ability to provide for the carrier strike group

Issue

- Execution rates challenge our ability to stay within OSD benchmarks for execution/funds for investment in long-term O+S costs for WPN systems
- Integrated sustainment planning with combat operations/unit allowance standards
- Develops operational energy initiatives to reduce the future demand footprint
- Availability of fuel, ammo, and spare parts in pipeline
- Capabilities must be able to respond quickly to unforeseen requirements.
- Medical planning remains service-centric
- Class VIII remains a difficult commodity to distribute/Class VIII storage and distribution and medical equipment maintenance not well networked
- Accountability, visibility, sustainment support/documentation
- Establishing enduring processes for theater contracting and contract synchronization and oversight
- Evacuating broken and or not needed equipment and supplies
- Establishing enduring presence requirements and agreements/transitioning expeditionary sites to enduring locations as the conflict transitions
- Providing and receiving coalition support
- Determine force structure and sourcing requirements needed to support CONUS natural disaster and OCONUS military operations
- Identify and mitigate limiting factors due to competing supply demands
- Reconstitution of preposition equipment/materiel/op project stocks
- Host nation/partners/allies sustainment
- Health service support to DoD service personnel/beneficiaries
- Colors of money-crossing title 10 and title 22 funding lines
- Competition for resources—equipment and personnel—between expeditionary mission and the domestic mission

Issue

- Mobilization lag times will be an issue
- Aging of the fleets/equipment platforms/expeditionary maintenance of combat system platforms
- Collaboratively integrated operation, intelligence, and logistics data/interfaces that allow appropriate classification
- Vulnerability of logistics/sustainment networks/security for commodities and personnel
- Joint Theater Contracting Command/need for a log coordinating cell as a force multiplier
- Provision of Common User Items
- Understanding/application of existing national and MN Logistics Doctrine
- Joint Urgent Operational Need process
- Diminishing manufacturing sources for a wide variety of items (Med, Forgings, electronics, ammo, tires, etc.)
- Failure to formalize relationships/communicate with in theater commercial entities
- Inefficient/ineffective procurement and distribution of resources/coordination and distribution of assets to theater
- Deficient rapid sourcing of commodities/coordinate with industry to increase capacity
- Deficiency in critical infrastructure status evaluation and reporting
- Failure to utilize industry emergency response mechanisms
- Lack of focus on situational awareness in terms of health, safety, and location of responders
- Metrics and definitions of reports vary widely; greater commonality is necessary for all entities
- Failure to identify and leverage technology capabilities available from industry to enhance response and sustainment

Issue

- Lack of NGO ability to keep crisis data systems operational
- Insufficient communication and information awareness between responding entities/lack of social media applications
- Low volume, low frequency airlift
- Communicate, cooperate, collaborate between U.S. log community (≠JLEnt) and other country's or region's log community
- Provision of Common User Items

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Appendix B

In reviewing the players' comments (see Appendix A), CNA began identify common themes among the different player inputs. Below it the categorization of player inputs into different topic areas. Some of the inputs straddled multiple topic areas and were therefore placed in multiple categories.

Issues	Comments/Observations
Local Infrastructure	Operating from degraded air and sea ports
	Determine critical choke point, Resolve route, mode and node conflicts
	Materiel we can't take out of country due to no country over flight or landing clearances
	Moving and storing sensitive/contaminated (medical) materiel-Storage capacity issues of the incoming requirements
	Capabilities the Host Nation brings/Lack of understanding of capacity of local sources of supply
	Deficiency in critical infrastructure status evaluation and reporting

	Comments/Observations
Collaboration	Who vet requirements/generating requirements, sourcing requirements, and delivering
	Optimize lift requirements through a health priority vetting process
	Actionable recommendations/tangible information to prioritize "first-in" due to limited transportation capacity or infrastructure through-put
	Strategy for engaging regional partner participation to include sharing logistic assets
	Communicate, cooperate, collaborate between U.S. log community (≠JLEnt) and other country's or region's log community
	Joint Theater Contracting Command/need for a log coordinating cell as a force multiplier

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Issues	Comments/Observations
Authorities	Who vet requirements/generating requirements, sourcing requirements, and delivering
	Pre-coordinated capabilities, knowledge and information/Adjudicating high-demand/low-density joint logistic enabling capabilities
	Materiel we can't take out of country due to no country over flight or landing clearances
	Failure to utilize Industry emergency response mechanisms
	Collaboratively integrated operation, intelligence, and logistics data /interfaces that allow appropriate classification
	Numerous requirements and transportation generation pipelines
	Mitigate uncoordinated responses
	Visibility on the common items/ Lack of shared real time asset tracking between
	Capabilities the Host Nation brings/Lack of understanding of capacity of local sources of supply
	Maintain a running inventory of HD/LD materiel resources/Identify high-demand materiel issues throughout the operation
	Strategy for engaging regional partner participation to include sharing logistic assets
	Communicate, cooperate, collaborate between US log community (≠JLEnt) and other country's or region's log community
	Insufficient communication and information awareness between responding entities/Lack of social media applications
	Lack of NGO ability to keep crisis data systems operational
	Failure to formalize relationships/communicate with in theater commercial entities
	Strategy for engaging regional partner participation to include sharing logistics assets

Issues	Comments/Observations
Force Protection	Dealing with potential losses of capital assets
	Capabilities the Host Nation brings/Lack of understanding of capacity of local sources of supply
	Lack of focus on Situational Awareness in terms of health, safety, and location of responders
	Failure to utilize Industry emergency response mechanisms
	Vulnerability of logistics/sustainment networks/Security for commodities and personnel

Issues	Comments/Observations
Vetting Requirements	Numerous requirements and transportation generation pipelines
	Mitigate uncoordinated responses
	Visibility on the common items/ Lack of shared real time asset tracking between
	Who vet requirements/generating requirements, sourcing requirements, and delivering
	Optimize lift requirements through a health priority vetting process
	Compatibility and synergy during requirements generation
	Capabilities the Host Nation brings/Lack of understanding of capacity of local sources of supply
	Maintain a running inventory of HD/LD materiel resources/Identify high-demand materiel issues throughout the operation
	Actionable recommendations/tangible information to prioritize "first-in" due to limited transportation capacity or infrastructure through-put
	Prioritization process to maximize and allocate capabilities across CCMDs; especially when overlapping authorities exist
	Insufficient communication and information awareness between responding entities/Lack of social media applications
	Operating from degraded air and sea ports
	Materiel we can't take out of country due to no country over flight or landing clearances
	Moving and storing sensitive/contaminated (medical) materiel-Storage capacity issues of the incoming requirements
	Capabilities the Host Nation brings/Lack of understanding of capacity of local sources of supply
	Maintain a running inventory of HD/LD materiel resources/Identify high-demand materiel issues throughout the operation
	Actionable recommendations/tangible information to prioritize "first-in" due to limited transportation capacity or infrastructure through-put
	Communicate, cooperate, collaborate between US log community (≠JLEnt) and other country's or region's log community
	Capabilities must be able to respond quickly to unforeseen requirements
	Materiel we can't take out of country due to no country over flight or landing clearances
	Capabilities the Host Nation brings/Lack of understanding of capacity of local sources of supply
	Failure to identify and leverage technology capabilities available from industry to enhance response and sustainment
	Failure to utilize Industry emergency response mechanisms

Issues	Comments/Observations
	Diminishing manufacturing sources for a wide variety of items (Med, Forgings, electronics, ammo, tires, etc.)
	Identify and mitigate limiting factors due to competing supply demands
	Colors of money-Crossing title 10 and title 22 funding lines

Issues	Comments/Observations
Existing Doctrine	Pre-coordinated capabilities, knowledge and information/Adjudicating high-demand/low-density joint logistic enabling capabilities
	Prioritization process to maximize and allocate capabilities across CCMDs; especially when overlapping authorities exist
	Strategy for engaging regional partner participation to include sharing logistic assets
	Understanding / Application of existing national and MN Logistics Doctrine

Appendix C

Figure 10 below is a flow chart showing how social network characteristics can be used to determine the ideal types of governance and TMS that should be implemented in any given JLEnt response. Figure 10 is meant as a guide and not a set of definitive solutions, as our study found that the requirements provided by Provan and Kenis [93] are minimum thresholds that can be exceeded. For example, lead organization governance requires low trust between the actors/agencies, but this is the minimum level of trust needed—a higher level of trust could also be successful. Participant governance has a minimum requirement of moderate trust between the actors and agencies; therefore, participant governance can succeed with medium to high levels of trust, but would fail in a low trust network. Table 4 below illustrates these points. Please note that Figure 10 does not include this level of detail.

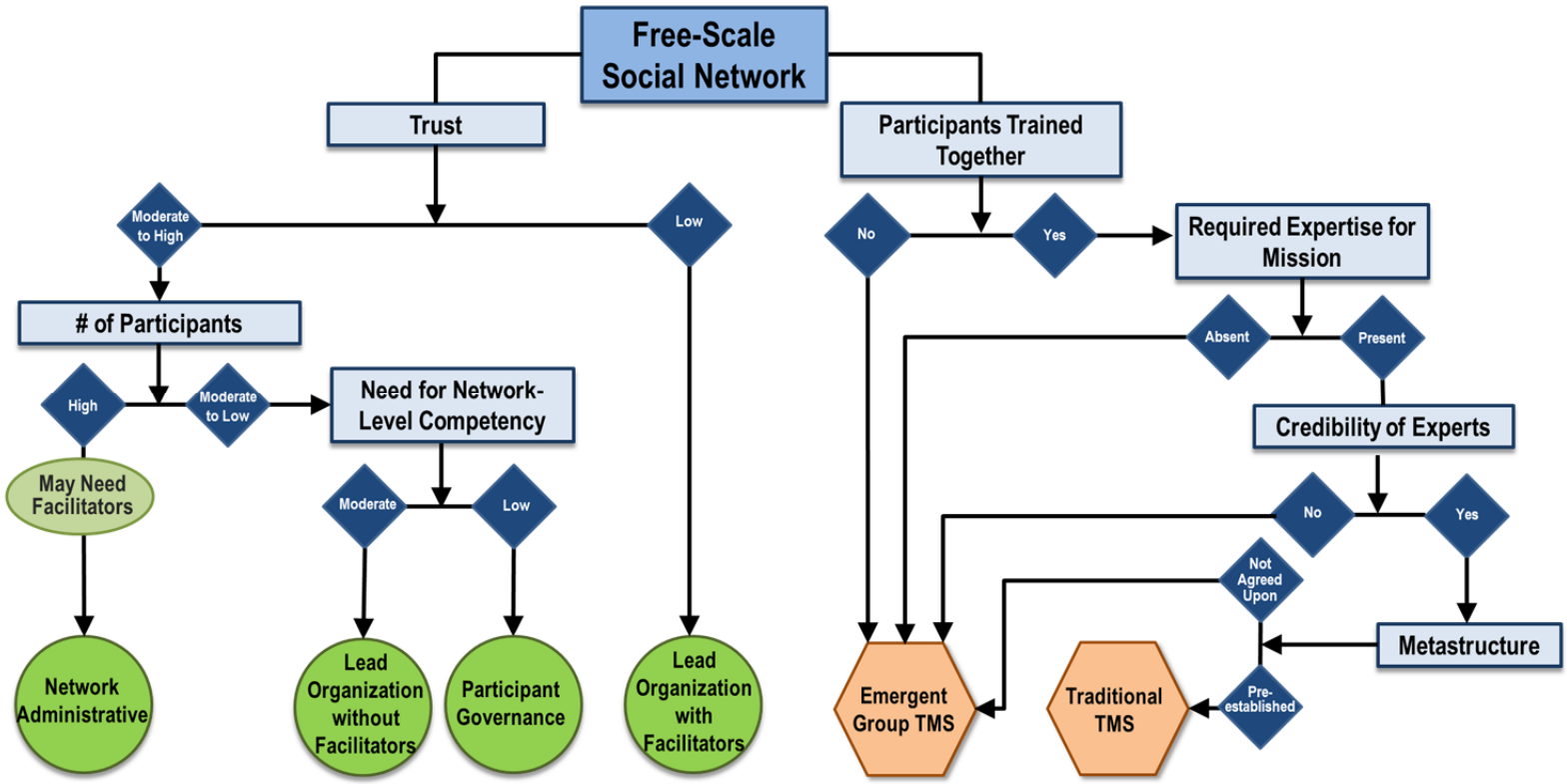
Table 4. Allowable levels of trust for the three types of network governance

	Lead Organization	Participant	Network administrative
Low Trust	x		
Medium Trust	x	x	
High Trust	x	x	x

After trust, the major factors for determining which type of governance is suitable for a social network are: (1) the number of participants, (2) the need for network-level competencies, and (3) goal consensus.[20]

[20] Our study found that goal consensus had minimal impact on governance success compared with the other three factors; therefore, goal consensus was not included in the flow chart (Figure 10).

Figure 10. Flow chart showing the ideal types of governance and TMS for various network characteristics



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