

NPS-LM-17-215



ACQUISITION RESEARCH PROGRAM SPONSORED REPORT SERIES

Metrics for the Naval Humanitarian Assistance and Disaster Relief (HADR) Operations

18 September 2017

Dr. Aruna Apte, Associate Professor

Graduate School of Business & Public Policy

Naval Postgraduate School

Approved for public release; distribution is unlimited.

Prepared for the Naval Postgraduate School, Monterey, CA 93943.



ACQUISITION RESEARCH PROGRAM
GRADUATE SCHOOL OF BUSINESS & PUBLIC POLICY
NAVAL POSTGRADUATE SCHOOL

The research presented in this report was supported by the Acquisition Research Program of the Graduate School of Business & Public Policy at the Naval Postgraduate School.

To request defense acquisition research, to become a research sponsor, or to print additional copies of reports, please contact any of the staff listed on the Acquisition Research Program website (www.acquisitionresearch.net).



ACQUISITION RESEARCH PROGRAM
GRADUATE SCHOOL OF BUSINESS & PUBLIC POLICY
NAVAL POSTGRADUATE SCHOOL



ACQUISITION RESEARCH PROGRAM SPONSORED REPORT SERIES

Metrics for the Naval Humanitarian Assistance and Disaster Relief (HADR) Operations

18 September 2017

Dr. Aruna Apte, Associate Professor

Graduate School of Business & Public Policy

Naval Postgraduate School

Disclaimer: The views represented in this report are those of the author and do not reflect the official policy position of the Navy, the Department of Defense, or the federal government.



THIS PAGE LEFT INTENTIONALLY BLANK



Table of Contents

Introduction	1
Background	1
Literature Review	5
Endogenous Factors	6
Performance Indicators and Readiness Metrics	6
Core Competencies and Capabilities.....	11
Issues and Challenges in Humanitarian Operations	13
Exogenous Factors	14
Disasters and Lessons Learned: Haiti	14
Disasters and Lessons Learned: Japan.....	17
Disasters and Lessons Learned: Philippines	20
Disasters and Lessons Learned: Nepal	22
Summary of Lessons Learned	25
Issues and Challenges in the “Three Cs” of Civil-Military Organizations	26
Framework Based on Literature Survey.....	33
The Case for Naval HADR Operations.....	35
References	39



THIS PAGE LEFT INTENTIONALLY BLANK



List of Figures

Figure 1: Humanitarian Assistance in 2012, Top Five Government Donors. Source: Global Humanitarian Assistance (2013).	2
Figure 2: Humanitarian Aid by United States. Source: Margesson (2015).....	2
Figure 3: Total Economic Damage Caused by Reported Natural Disasters Between 2000 and 2014. Adapted from Guha-Sapir, Hoyois, & Below (2014).....	3
Figure 4: SORTS Reporting System. Source: Trunkey (2013).	7
Figure 5: Classification of Disasters. Source: Apte & Yoho (2013).	14
Figure 6: Proposed Model. Source: Pettit & Beresford (2005).	27
Figure 7: Process for Identifying Readiness Metrics in Organizations.	34
Figure 8: Overview of Readiness Assessment Model.....	37



THIS PAGE LEFT INTENTIONALLY BLANK



List of Tables

Table 1: Improvements of DRRS. Source: Trunkey (2013).....	8
Table 2: Review of Literature on Performance Objectives. Source: Haavisto & Goentzel (2015).	9
Table 3: Critical Areas and Key Findings. Source: Carafano (2011).....	19
Table 4: Comparison of Effects of Typhoons Haiyan and Hagupit. Source: CFE-DM (2015).....	22
Table 5: Challenges and Lessons Learned in Nepal. Source: Wendelbo et al. (2016).	24
Table 6: Lessons Learned by Global Logistics Cluster.	25
Table 7: Conflicts Arising From Military Involvement. Source: Pettit & Beresford (2005).....	28
Table 8: Process for Readiness Metrics From Capabilities.....	35



THIS PAGE LEFT INTENTIONALLY BLANK



Introduction

Humanitarian assistance and disaster relief (HADR) operations are part of the Cooperative Strategy for the 21st Century Seapower of the United States (U.S.). In this research, we further investigate, through literature survey, whether any metrics can be defined and developed to enhance the efficacy and efficiency of HADR operations. Such measurement will be instrumental in successfully following a fundamental principle: “If we are going to do HADR anyway, then why not do it smartly.”

In the past 2-3 decades, the United States Navy (USN) has been the active and principal supplier of disaster relief due to its many unique and critical capabilities (Apte, Yoho, Greenfield, & Ingram, 2013; Apte, Goncalves, & Yoho, 2016). Whether this effort will continue and be sustained in an environment of fiscal austerity and budget cuts is not given. Therefore, it is critical to identify resources the USN possesses, due to its core competencies and capabilities, that support humanitarian logistics, and to understand the USN’s readiness level to utilize these resources in the best possible way.

The United States Marine Corps (USMC) can rapidly respond to disasters because it maintains high levels of readiness on a constant basis. The USMC provides critical resources for these missions through their Marine Expeditionary Units (MEUs), which are flexible and adaptable enough to accomplish a wide range of operations, including non-combat missions (Apte & Yoho, 2014). Given the recent frequency of disasters around the world, it is probable that the occurrence of these events will continue, thus creating a demand for the relief capabilities. The MEUs have flexible and adept forces that can be deployed to austere environments while meeting urgent timelines (USMC, 2009).

Background

There have recently been significant suffering and casualties due to natural disasters across the world. Some governments offer humanitarian assistance.

Figure 1 shows which donors provided the most humanitarian assistance in 2012.



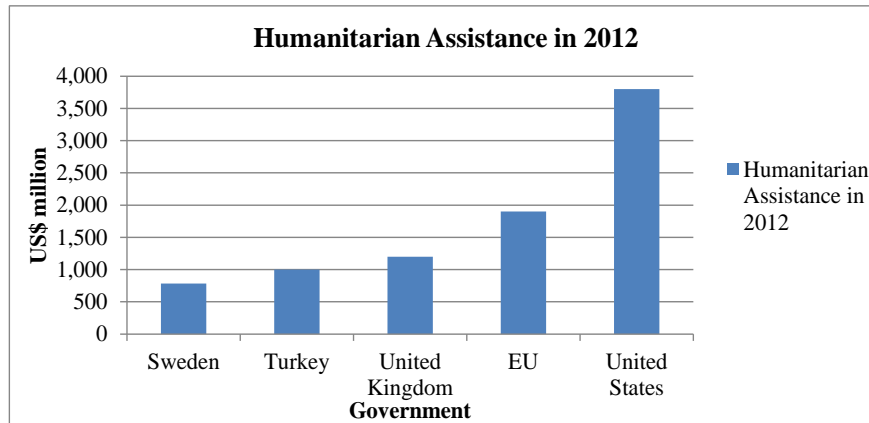


Figure 1: Humanitarian Assistance in 2012, Top Five Government Donors. Source: Global Humanitarian Assistance (2013).

The United States spent almost twice as much as the next highest donor, the European Union (EU). Since 2008, the United States has spent substantial capital on humanitarian aid, as shown in Figure 2.

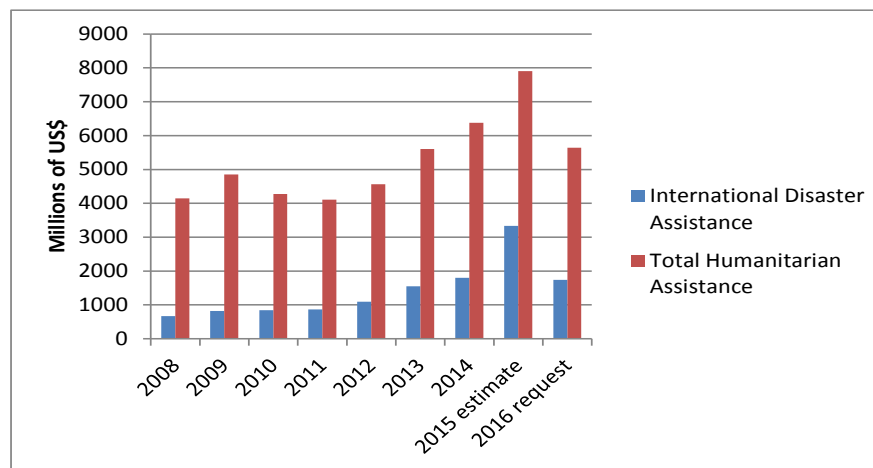


Figure 2: Humanitarian Aid by United States. Source: Margesson (2015).

When the USN steps in to help, the naval combatant commands, such as Pacific Command (PACOM) and Southern Command (SOUTHCOM), are the organizations that have to act. Figure 3 shows the economic damages in the different continents that are part of the area of responsibility (AOR) of Co-Commands (COCOM). Asia has had the most economic damage, which is in the AOR of PACOM, and the Americas are next in economic damage, which is in the AOR of SOUTHCOM.



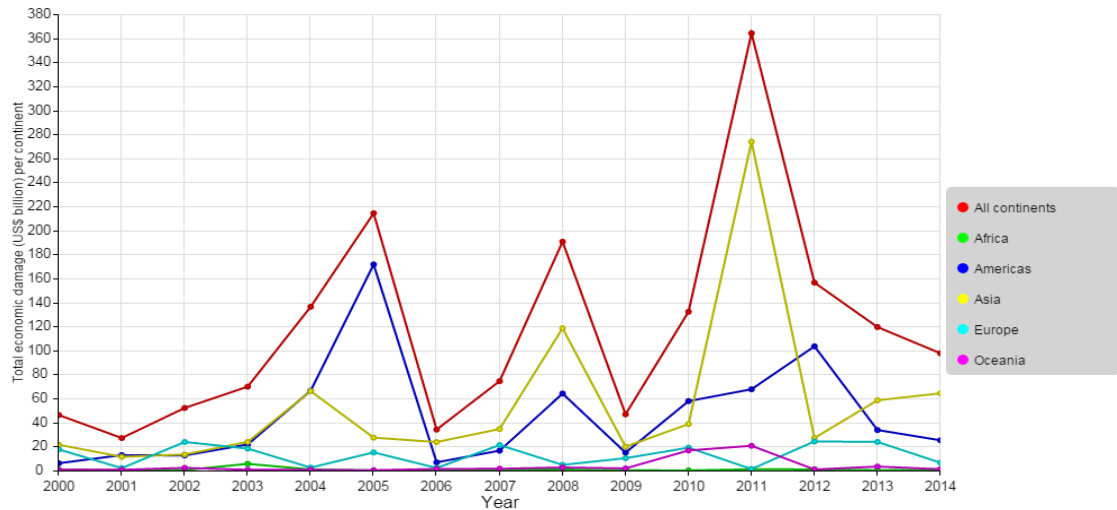


Figure 3: Total Economic Damage Caused by Reported Natural Disasters Between 2000 and 2014. Adapted from Guha-Sapir, Hoyois, & Below (2014).

After the 2010 Haiti earthquake, the functional organization and staffing of the COCOM had significant gaps in the ability to provide an effective and efficient response. A strategic plans officer for the UN said, “The military’s planning capability is not the most expensive part, but it is probably the most valuable. The international coordination structure would not have stood up if they weren’t there—we tapped into the Joint Task Force (JTF) planning capacity” (Joint Center for Operational Analysis [JCOA], 2010, slide 77). Given vast AORs, the number of disasters in the last decade, and the lack of lead time to prepare for relief for certain types of disasters (Apte, 2009), organizations such as the USN and the USMC need to have a playbook with readiness metrics. Therefore, three questions need to be answered:

1. How does an organization know when it is ready to respond to a disaster and whether it is capable of delivering relief?
2. What core competencies are these organizations exploiting to be ready for humanitarian missions?
3. What are the resources that can deploy the capabilities that support these core competencies?

We studied over 80 documents, including peer-reviewed scholarly articles, government documents, white papers, research papers, and DoD briefings. This review helped us understand the definitions and descriptions of post-disaster



performance indicators and pre-disaster readiness metrics. During the process, the literature was divided into four categories: disasters and lessons learned, civil and military collaboration, core competencies and capabilities, and challenges in humanitarian operations. These topics assist develop the path for recognizing readiness in humanitarian organizations. We follow the path to formulate conceptual model for readiness assessment. We studied four disasters in detail for the lessons learned: the 2010 earthquake in Haiti, the 2011 earthquake and tsunami in Japan, 2013's Typhoon Haiyan (Yolanda) in the Philippines, and the 2014 earthquake in Nepal. The literature review process helped us identify a framework for readiness metrics in naval humanitarian operations based on the core competencies of the USN and the USMC.



Literature Review

Many humanitarian organizations (HOs) respond to the disasters around the globe. In this research, we define HOs as those organizations that provide humanitarian relief, whether military or non-military (NMO) and whether government or non-government (NGO). These organizations have core capabilities and competencies (Apte et al., 2016) from which they provide humanitarian assistance. When a disaster strikes, the host nation requests outside assistance, if needed. When requested, the USN and the USMC, under the guidance of USAID, get deployed for HADR. Other HOs also provide assistance based on their core competencies and capabilities. Many times, the relief falls short of meeting the demand. The reasons why this happens will help us understand how to measure the readiness that is embedded into the core capabilities and competencies of the organizations. Relief falls short for many possible reasons:

- The disaster was massive in scope and scale.
- The distribution and transportation of critical supplies and services was not well-managed; hence, the affected region did not receive necessary supplies.
- Adequate needs assessment was not possible, resulting in mismatching of delivered commodities.
- Information and knowledge was not managed from previous humanitarian missions to identify lessons learned.
- In some cases lessons were learned, but no after action reports were generated, and as a consequence, no metrics were formulated to mitigate the next disaster.

We study the literature to explore, define, and develop these reasons. Some areas are endogenous to the organization and some are exogenous. The Endogenous Factors section is further divided into the following subsections:

- Performance Indicators and Readiness Metrics
- Core Competencies and Capabilities, and
- Issues and Challenges in Humanitarian Operations.



The Exogenous Factors section is further divided into

- Disasters and Lessons Learned and
- The “Three Cs” of Civil-Military Organizations.

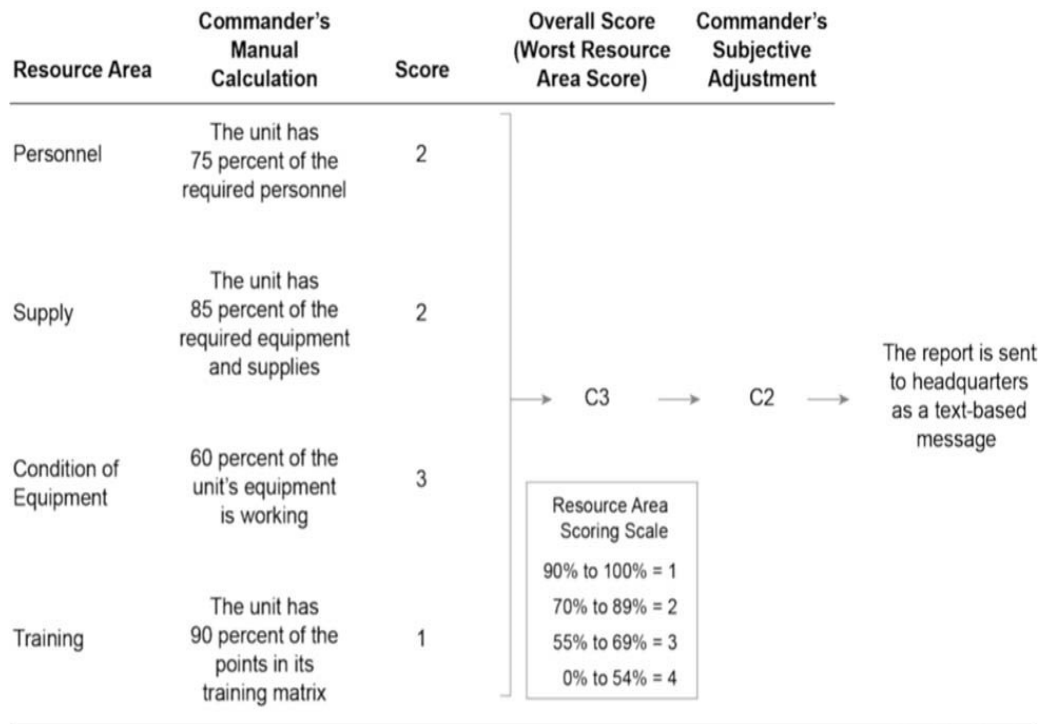
Endogenous Factors

Performance Indicators and Readiness Metrics

The absence of clear performance indicators and/or readiness metrics in humanitarian organizations (HOs) has been recognized by the humanitarian community. Davidson (2006) says that, due to the incapability and lack of time, the HOs do not measure the performance indicators. The organizations lack any fundamental framework to understand the readiness metrics since they do not have a good measure of performance indicators after the disaster. There are several factors that contribute to the difficulty of defining and measuring either the performance indicators or readiness metrics in HOs (Davidson, 2006).

In the U.S. Department of Defense (DoD) literature, there are discussions about military readiness metrics. However, these are predominantly about conflict readiness (Government Accountability Office [GAO], 2016). In a broad sense, the DoD defines readiness as the ability of the forces to combat, meet the demands to achieve security objectives and the needs of the national strategy. One observation is that the DoD’s rebuilding efforts for readiness may not work if there is not a comprehensive plan in place. A framework is necessary for combat readiness (GAO, 2016). This observation further accentuates the lack of any specific framework for readiness metrics for missions other than war, and it demands that such a framework be developed. Vast amounts of money, to the tune of \$350 billion, indicate the importance that the DoD places on the readiness of its services for current and future operations (Trunkey, 2013). The readiness is assessed at the individual service level and at the joint forces level. Typically, the DoD reports readiness through the Status of Resources and Training System (SORTS). Figure 4 (Trunkey, 2013) shows an example of the SORTS reporting process.





C1 = the unit can fully carry out its wartime mission; C2 = the unit can carry out most of its wartime mission; C3 = the unit can carry out portions of its wartime mission; C4 = the unit needs additional resources to perform its wartime mission.

The scoring scale percentages differ among the service branches.

Figure 4: SORTS Reporting System. Source: Trunkey (2013).

Recently SORTS, due to its limitations, was transitioned into Defense Readiness Reporting System (DRRS) that uses a dashboard style display. DRRS is a major improvement. Table 1 shows this improvement.



Table 1: Improvements of DRRS. Source: Trunkey (2013).

	SORTS	DRRS
Mission	Readiness is reported for one highlighted mission that the unit was designed for (usually the unit's core wartime mission). ^a	Readiness is reported for a range of missions and tasks including a unit's wartime mission.
Assessment	An overall readiness score is calculated from scores in four resource areas.	A commander gives an overall assessment for each mission based on assessments of tasks and the resources available.
Resource Areas	Personnel, equipment, supply, and training.	Personnel, equipment, supply, and training; the Navy separates ordnance from supply.
Calculating the Overall Score	The overall score is usually the worst of the four resources area scores, which are calculated from local unit records.	The commander enters the overall assessment directly. The resource scores are calculated from information in servicewide databases.
Scoring Scale	A scale of C1 to C4, with C1 as the highest level of readiness. Units with an overall score of C1 or C2 are considered to be ready for their mission. ^b	Each resource area is evaluated on a scale of 0 to 100 percent. A score of yes, no, or qualified yes is then given for each mission and task.
Sources of Data	Unit commanders track data and make calculations.	Calculations are automatic, using servicewide databases.
Commanders' Input	Commanders can change an overall score by one point.	Commanders cannot adjust resource calculations.
How the Scores are Reported	Commanders enter the scores by hand, and text reports are submitted to headquarters via a messaging system.	Reports and underlying data are generated automatically and are available to all users with appropriate credentials.
Reporting Units	Deployable combat and support units such as ships, squadrons, and brigades.	Deployable combat and support units such as ships, squadrons, and brigades, plus detachments, headquarters (including Combatant Commands), National Guard units (all missions), and installations.
Standardization Across the Services	The services have different reporting procedures, but all reports have the same formatting.	Each service had a distinct DRRS system. The systems are electronically compatible and are part of one common system.

Performance objectives have been studied for the NGOs in the context to response supply chains established for humanitarian efforts. Table 2 lists some of the articles and the performance measures they discuss.



Table 2: Review of Literature on Performance Objectives. Source: Haavisto & Goentzel (2015).

Humanitarian Supply Chain Performance Measure	Author
Output	Beamon and Balcik (2008); Blecken, Hellingrath, and Dangelmaier (2009)
Flexibility	Beamon and Balcik (2008)
Efficiency (resources)	Beamon and Balcik (2008); Blecken et al. (2009)
Cost	Blecken et al. (2009)
Service level (customer/beneficiary/donor)	Schulz and Heigh (2009); van der Laan, de Brito, and Vergunst (2009); de Leeuw (2010)
Accuracy	Davidson (2006); van der Laan et al. (2009)
Financial control and efficiency	Davidson (2006); Schulz and Heigh (2009); de Leeuw (2010)
Process adherence	Schulz and Heigh (2009)
Time (e.g., donation-to-delivery)	Davidson (2006)
Coverage, equity	Davidson (2006); Balcik et al. (2010)
Utilization	Blecken et al. (2009)
Innovation and learning	Schulz and Heigh (2009); de Leeuw (2010)
Quality of life and well	Tatham and Hughes (2011)

There are many more aspects to a supply chain (such as material and information flow, players of the supply chain) and one prevalent issue, especially in the commercial supply chain, is the *last-mile delivery problem*. In this particular issue efficiency or minimizing the cost is the objective. However, in response supply chains, the goal is more than these objectives due to humanitarian concerns. Huang, Smilowitz, and Balcik (2011) focus on meeting the need through quick and sufficient but equitable distribution. The authors measure the performance of the supply chains based on these three criteria. Their observations about number of vehicles,



routes, and impact of demand offer practical insight into relief operations. The performance measures suggest possible readiness metrics, such as maintaining a larger number of small vehicles for effective and equitable distribution of critical supplies and services; and they suggest some rules of thumb for quick decisions.

Van der Laan, de Brito, and Vergunst (2009) offer a review of literature identifying the necessary conditions for performance measures for humanitarian supply chains. The authors present a framework that involves two phases, design and implementation. The first phase depends on strategically important functions and the will of the organization to measure operational performance and implementation of an information system to do so. The second phase, which depends on implementation, includes the principles that the framework be future-oriented, that it be aligned with the selected strategy, and that it strike a balance between financial versus non-financial as well as quantitative and qualitative indicators.

A more focused approach, focused specifically on the rapid needs assessment that is defined as a core competency for HOs (Apte et al., 2016), is discussed by Benini and Chataigner (2014). Needs assessment being the key objective for determining the affected region and population, the authors describe a particular tool “prioritization matrix,” recently a prevalent tool in determining demand. They offer expansion of this tool based on logic behind it. The matrix is based on composite indicators that are managed through spreadsheets and is the intersection of decision science and humanitarian operations. The authors use the data from the 2013 Typhoon Haiyan (Yolanda) in the Philippines to substantiate their analysis.

Norio, Ye, Kajitani, Shi, & Tatano (2011) review the causes and impacts of the 2010 Japan earthquake and tsunami. The management of the expanded capacity and capability after the 1995 Hanshin-Awaji earthquake in Japan significantly helped provide disaster relief for the 2010 earthquake. However, the authors believe more can be done. When there is potential for a disaster to turn into a crisis (as in the 2010 earthquake and tsunami in Japan), it is necessary to deploy a collaborative framework based on available resources. Such a framework should



take into account the geographic scope of the disaster, thus enabling different governance approaches and mutual assistance and recovery systems. The authors believe that centralized power for sudden and dispersed disasters is vital, existence of a new international platform for joint management is essential, further research of such frameworks is needed, and the lessons learned from the 2010 Japan earthquake and tsunami mandate that infrastructure around the nuclear power plants be robustly planned and designed.

Figure 2 showed the extent of humanitarian aid provided by the United States. The DoD executes humanitarian operations with the budget granted by the State Department, since the DoD does not have its own budget for HADR. These humanitarian activities are rendered through the Overseas Humanitarian Disaster and Civic Aid (OHDACA) program. All HOs, including the DoD, currently face the challenge of measuring the impact of their work (Bonaventure, 2006). Bonaventure (2006) lists at least three reasons why the DoD should measure the impact of humanitarian assistance programs:

- First, measuring the impact of HOs offers opportunities for future and mid-course corrections in the projects through feedback loops enabling planners to underscore activities that are cost-effective.
- Second, collection and sharing of data prevents the duplication of activities performed by all HOs. Not duplicating activities helps us understand the core competencies and capabilities of HOs.
- Third, analysis based on collected data offers transparency and quantifiable results that do not leave any ambiguity.

The key point here is understanding core competencies and capabilities of all the organizations involved so duplication of efforts is reduced.

Core Competencies and Capabilities

Apte et al. (2016) identify the competencies and capabilities that are core to U.S. military and non-military organizations (NMOs) for HADR. The authors' motivation is that both military organizations and NMOs bring assets, skills, and capabilities to a humanitarian crisis; however, their competencies and capabilities are very diverse. Identification of the specific competencies and capabilities that are



core to these types of organizations can enable better planning by both military and NMOs, allowing them to achieve greater effectiveness and efficiency in their humanitarian responses. Apte et al. (2016) build on existing literature on the core competency of the corporations in the private sector. In their research, Apte et al. (2016) extend the concept of identifying, cultivating, and exploiting the core capabilities of the private sector to other organizations that seek to respond efficiently and effectively to disasters. They develop a Core Competencies Test for such organizations. The authors list the top five essential services and capabilities for disaster relief as Information and Knowledge Management, Needs Assessment, Supply, Distribution and Deployment, and Health Services Support.

One of the substantial players in humanitarian assistance and disaster relief around the globe is the U.S. Navy (USN). Roughead, Morrison, Cullison, and Gannon (2013) offer an in-depth analysis of the USN's humanitarian assistance, especially in the face of budget cuts and austerity. Their research does not focus on a specific disaster, but rather studies the proactive engagement or strategic pre-positioning (Apte, 2014) of humanitarian assistance. The authors describe the principal benefits of their research: strengthening relations in critical geographic areas through greater cultural understanding, improving the capabilities and readiness of the USN humanitarian assistance, and reinforcing other capabilities such as health systems of host nations.

HADR by the USN is evaluated by Apte, Yoho, Greenfield, and Ingram (2013), using a structured, qualitative evaluation schema complemented by expert ratings. The authors evaluate the capabilities and utility of ships in the USN. They find that there are specific types of vessels with significant disaster response utility and recommend a flotilla type that would be best suited for the humanitarian operations. Utilizing an exploratory framework that evaluates three diverse disaster cases, they scale the utility of each vessel through subject matter expertise. They find the type of ships most useful for contributing to effective disaster response.

Apte and Yoho (2014) study the USMC resources, including the Marine Expeditionary Unit (MEU), that are primarily responsible for the response. They



study recent HADR events to determine how demands were met by the USMC. They identify the supplies that can meet these demands by examining both assets and capabilities of the USMC. By exploring significant gaps, if any, that can be improved by the MEU, they suggest ways to improve the effectiveness of the USMC's response to HADR. A primary take-away from their work is the challenge faced by the USMC to match the capabilities of the USMC to the demand created by future disasters. More issues and challenges in humanitarian operations that deliver disaster relief are described in the next subsection.

Issues and Challenges in Humanitarian Operations

Roughead et al. (2013) list the operational challenges for the USN, such as short-term or discontinuous engagement in HADR lacking enduring coordination and development, insufficient integration with host nations and NGO operatives, dependence on sole assets of vessels that may not serve the necessary demand, inadequate and irregular funding, and most notably, difficulty in measuring alignment of humanitarian efforts with strategic goals. The authors recommend that the USN clarify and focus on the motivation behind the humanitarian assistance to fund the operations sufficiently and without rigidity, and increase the scope and scale of the planning process of HADR allowing coordination with NGOs and host nations. But most importantly they point out that the USN needs to develop and implement a robust set of metrics for readiness in humanitarian missions.

A major challenge in any supply chain management is measurement of performance of that supply chain. In the commercial sector, the focus is on resources for optimizing the input (cost) or output (profit). However, for a supply chain established to respond to a disaster, a response supply chain (RSC), the focus is on the time required to respond or the ability to meet the demand. An RSC is defined to be efficient based on the amount or number of resources used to meet the goal of that organization and to be effective based on the level at which it meets the preset goal (Beamon, 2004). Developing such a system for measurement is one of the issues associated with RSCs. The author lists the issues as structure of the RSC, distribution network, inventory control, type of measuring system, coordination



with other organizations involved in HA, acquisition of supplies, and finally, the actual measurement.

Beamon and Kotleba (2006) describe the stochasticity of the demand of the disaster, and if the disaster is large-scale, the strain that it creates on the physical distribution. Figure 5 shows the complexity and hence difficulty of humanitarian operations (Apte & Yoho, 2013).

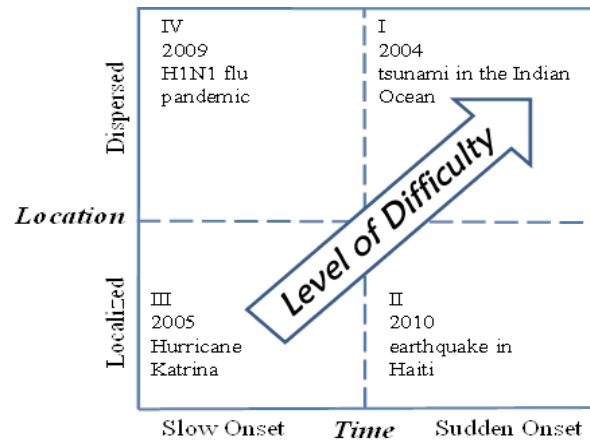


Figure 5: Classification of Disasters. Source: Apte & Yoho (2013).

Other issues that are challenging are the inadequate or incorrect estimation of demands that yield both further casualties and further suffering in the affected area (United Nations, 2007; Duran, Gutierrez, & Keskinocak, 2011; Apte & Yoho, 2011; World Meteorological Organization, 2009). Estimating where and when such demand is needed (McCoy, 2008; Apte, 2009; Apte et al., 2013) is even harder. Demand after a disaster strike in the host nation is external to the organization providing relief. We now focus on such exogenous factors.

Exogenous Factors

Disasters and Lessons Learned: Haiti

On January 10, 2010, a 7.0 magnitude earthquake struck Haiti near Port-au-Prince. The earthquake caused 316,000 casualties. In addition to the Haitian losses, the earthquake also claimed the lives of members of the United Nations Stabilization



Mission in Haiti. It injured 300,000 people, made one million people homeless, it collapsed 100,000, and damaged 200,000 structures. This earthquake decimated Haiti's infrastructure. Air and sea transportation was reduced to unworkable. Key access roads were impassable. The medical facilities also became practically nonexistent. The most critical shortage was fuel. The utility infrastructure, including electricity and telecommunications, fell apart. The paralyzed Haitian government was overwhelmed and requested immediate assistance from all over the world. The Dominican Republic received thousands of refugees, but being a small country, it had limitations. Haiti's urgent request to the U.S. government prompted an immediate response.

Even before the disaster, Haiti had fuel and water shortages as an underdeveloped country. Medical support was scarce. So after the disaster, conditions worsened quickly. Poor infrastructure and inadequate disaster preparedness limited the delivery of relief (McCunn et al., 2010). Though access to the airport was limited, the U.S. Air Force (USAF) stepped in to maintain security and air traffic control. After this rapid and successful transition, medical support was delivered by many HOs including the U.S. military and other military organizations, NGOs, and government organizations.

The earthquake damaged the Port of Haiti, and it was not operable. The bulk of supplies for immediate sustainment had to be delivered by sea. The lack of a designated logistics team within the Global Response Team at the Joint Task Force (JTF) headquarters meant that deployment planning had to be done at short notice, thus increasing obstacles to an already challenged supply chain. Many in the JTF team were not in the contingency status and, hence, were deployed with suboptimal preparation. This resulted in pushing the supplies quickly but in an ad-hoc way without formal planning, sourcing, and tracking processes. A substantial part of the bureaucracy was eliminated, which enabled a quick response.

The accomplishments of the JTF during Haiti HADR can be divided into the following areas: Air Port, Sea Port, DoD medical support, shelters, overall support,



and a secure environment for the operations (JCOA, 2010, slide 196). Best practices emerged from these activities:

- Deployment and support from strategic level liaisons to tactical level (National response)
- Use of unclassified operation environment for information sharing and collaboration between all stakeholders (COCOM)
- Establishing JTF Force Flow working group (Force projection)
- Interface between Humanitarian Assistance Coordination Center and Joint Operational Task Center and NGOs, Private Voluntary Organizations (PVO)s, and UN systems (Coordination)
- Establishing Joint Interagency Information Cell

After response to the 2010 Haiti earthquake there were many lessons learned. One of the important findings from the HADR provided by the Joint Center for Operational Analysis (JCOA) was the swift establishment of response structure (JCOA, 2010). . Also, civilian and military resources were pushed not only to resolve but to overcome the problem. This was done by (1) pre-established Response Management Team (RMT) that is dependent on the classification of the disaster (Apte, 2009) performed in five functional areas: management, planning, logistics, administrative and communications; (2) Joint Staff Team plugging in with RMT and turned out to be the best practice despite not having connectivity other than commercial internet. However, USAID had visibility for movement of DoD resources.

As long term planning for future disaster relief some implications could be described as follows:

- The president's declaration about making the disaster relief a priority would help the administration and the country focus on the effort.
- Civilian and military resources may be pushed to mitigate the disaster by establishing the national response structure rapidly.
- Roles, responsibilities, authorities, and essential capabilities need to be clarified at the outset.
- Division of labor within the DoD should be clearly defined.
- Integration of HOs may raise many policy issues that need to be resolved.
- Incomplete data on the ground at the onset of the disaster is a challenge for logistics requirements and priorities.



LTG Keen, who was in charge of Operation Unified Response had the following observations:

1. Respond quickly and effectively,
2. Protect the people always,
3. Build partnerships with key players,
4. Coordinate and Collaborate (C2) to achieve unity of effort,
5. Communicate – Communicate – Communicate,
6. Support the lead Federal Agency within clearly defined roles,
7. Pull from all available resources to form the Joint Task Force,
8. Include the Host Nation Government as much as possible,
9. Work Closely with the UN Humanitarian Community, and
10. Anticipate challenges with Internally Displaced Persons (IDPs).
(JCOA, 2010, slide 208)

Haiti also taught a few lessons to COCOM. They had to overcome internal organizational issues, gain situational awareness, and satisfy an extraordinary demand for information. Another lesson was that the use of “open” communications and unclassified information sharing over BlackBerry devices allowed for expanded coordination and collaboration with DoD organizations. Personal and professional relationships among key leaders permeated all levels of interaction and engagement within organizations. And lastly, quick establishment of land-based headquarters reassured the affected population and enhanced the coordination with the host country, state government, USAID, UN, and NGOs.

Disasters and Lessons Learned: Japan

On March 11, 2011, a 9.0 magnitude earthquake struck Japan. A tsunami followed soon after and the losses incurred were extremely severe. By April 13, there were 13,392 casualties, 15,133 missing people, and more than 335,000 people without food, water, shelter, and medical help (Norio et al., 2011). Several nuclear power plants were heavily damaged resulting in rolling blackouts. The earthquake also affected the transportation system, and for a short time, all the ports were closed. Part of the high speed rail line was shut down, and the Sendai airport suffered intensive damage due to the tsunami. But the devastating blow that



pushed this disaster into a crisis was the meltdown of the Fukushima nuclear power plant.

Carafano (2011) assesses the response to the 2011 earthquake in Japan and outlines the lessons for the U.S. to evaluate its own capacity to deal with a future crisis. The author studies critical areas and the corresponding key findings and resources in the United States (see Table 3).

Wilson (2012) has a focused view based on the response from the U.S., titled Operation Tomodachi, to the 2011 earthquake and tsunami in Japan. The response efforts and the collective use of the military stationed abroad offers a model for further U.S. efforts across the globe. The author identifies the activities that worked well such as the value of maintaining U.S. forces abroad, the use and capabilities of remotely piloted aircrafts, the voluntary evacuation of the U.S. dependents, bilateral coordination, and the benefit of social media through the disaster response. However, the lessons learned, such as improving bilateral coordination, removing control and command confusion, and preparing for large scale decontamination are also critical for handling future disasters. The author concludes that describing the success of Operation Tomodachi will induce lesser cuts in the DoD's budget since it will bring humanitarian assistance to the forefront as opposed to combat operations in Iraq and Afghanistan.



Table 3: Critical Areas and Key Findings. Source: Carafano (2011).

Preparedness and Response	<ul style="list-style-type: none"> • Effective planning, preparedness, and mitigation measures with possible decentralization for execution of this plan • Need to nurture a national culture of preparedness by concentrating on self-reliance in communities as well as individuals
Communicating the Risk	<ul style="list-style-type: none"> • Community awareness and understanding risk through communication fetches better cost effective results than protection measures such as building seawalls. • Communicating risk of low-dose radiation and building confidence for that risk
International Assistance	<ul style="list-style-type: none"> • The United States and, based on history, Japan have difficulty receiving aid. The United States needs to bolster its capacity to accept and apply international aid efficiently.
Critical Infrastructure	<ul style="list-style-type: none"> • Need to focus on the most 'vital' infrastructure (United States–Canada grid) to maintain resilient infrastructure that can recover quickly in case of disaster. • Industry and federal regulators need to work together to understand lessons from Fukushima and how they can be adapted for nuclear disasters in the United States.

Terada (2012) notes that during the assistance and relief following the 2011 earthquake in Japan, information should have been shared and appropriate tasking should have been implemented among the participants. There should be more training and exercises for USJF as the DoD support for HADR increases so that professionalism is enhanced and roles are clarified (Staff, 2012).

Japan is a developed nation and fairly self-sufficient in disaster relief. However, it did not have much experience in receiving aid from across the world. Thus, one of the lessons learned was to institute training for international guidelines (Smart, 2012). It is also imperative to establish an effective media strategy for controlling and dissipating information when there is a need of receiving real time facts.

Katoch (2012) stresses that no silos should be permitted. Clear protocols should be set with chain of control at all levels of the departments involved of the



host government, military organizations, and NGOs. Organizational structures and processes, in compliance with humanitarian and military doctrines, must be pre-established at local, national, and international levels. Only close ties with such organizations is not adequate for productive civil-military coordination. This was evident during the 2011 earthquake in Japan in the coordinating pains experienced by the United States and Japan even though they are allies (Katoch, 2012).

Wanlach (2012) emphasizes establishing relationships before a disaster to share information. The author also claims that agreements have to be in place for practical methods of coordination and the relief needs to be planned so that the strengths of the responding organization are exploited. Finally, better preparation by the host country will always help mitigate suffering.

The 2011 earthquake in Japan also taught lessons about the geographical perspective. Developing a tsunami response system using inundation maps helps disaster managers to model the potential effects of a tsunami so that the most suitable shelter locations and optional evacuation routes can be planned (Hong, 2012). Such lessons were also taught by Super Typhoon Haiyan (Yolanda) in the Philippines in 2014. Shallow draft adds to the destruction due to the fact that it produces more surges. Therefore, to understand threats, warnings must be accompanied by analysis of the impacts on the ground (Center for Excellence in Disaster Management and Humanitarian Assistance [CFE-DM], 2015).

Disasters and Lessons Learned: Philippines

On November 8, 2013, Typhoon Haiyan (Yolanda) made landfall in the Philippines causing extensive damage. More than 1.1 million houses were damaged, and 14.1 million people were affected. The confirmed death toll was 6,183. Though the Philippines is one of the most disaster-prone countries, this typhoon was among the strongest ever to strike the country.

The extensive damage to the internal infrastructure made transportation of goods extremely difficult to the point that signs of assistance and relief were only visible three to five days after the typhoon struck the Philippines (CFE-DM, 2014).



Among the international community, both military and non-military, the U.S. DoD, supporting the Armed Forces of the Philippines, and USAID played a significant role in HADR. UN agencies also responded immediately with teams for initial rapid assessment.

The heavy vertical lift capabilities of U.S. DoD and other military organizations helped in the face of infrastructure destruction. Their capabilities also helped in scouring the thousands of affected islands that were remote and almost impossible to access. The tactical military forces provided support immediately. There were many assets of the U.S. DoD stationed in Japan and Okinawa. These included USS George Washington naval task force and 31st MEU to form JTF 505. Approximately 1000 U.S. DoD personnel were deployed. Military aircraft provided support in needs assessment of remote areas, brought aid workers and supplies to these remote areas, and evacuated the affected population to other locations. The Marines helped in clearing roads and distributing supplies and services (Lum & Margesson, 2014).

One of the lessons learned (CFE-DM, 2014) during the Super Typhoon Haiyan assistance and relief was that civil-military collaboration needs to happen far faster than it did. It is also important to have trust among participating organizations, and this could be achieved through informal networks formed during training and exercises. It was also noted that the affected people from the most dangerous areas have to be evacuated. But two concepts that are important and applicable in any disaster, are the pre-positioning of supplies and the resilience of the local population.

In addition, visual messaging in the form of accurate scenario-based storm surge inundation maps facilitated a shared framework of the operating environment. Every foreign disaster response is a bilateral agreement between the assisting state and the affected state. The response in Super Typhoon Haiyan showed that the optimal use of defense assets is best coordinated through the Multinational Coordination Center (MNCC). Recognizing the need for the MNCC to operate at strategic and operational levels simultaneously, the MNCC in Camp Aguinaldo became fully operational 48 hours before Super Typhoon Hagupit the following year made landfall (CFE-DM, 2015). Recognizing the need to augment the government's



response capabilities, private sector-led organizations, as demonstrated by the Philippine Disaster Resilience Foundation (PDRF) 88, began putting mechanisms in place for a disaster operations center aimed at coordinating and collaborating disaster risk management initiatives of businesses across all industrial sectors. The difference between the after effects of the two typhoons is shown in Table 4.

Table 4: Comparison of Effects of Typhoons Haiyan and Hagupit. Source: CFE-DM (2015).

<i>Overview</i>	<i>Super Typhoon Haiyan</i>	<i>Super Typhoon Hagupit</i>
Philippine Area of Responsibility	November 6, 2013 (entered) November 9, 2013 (exited)	December 4, 2014 (entered) December 10, 2014 (exited)
Families Affected	3,424,593	944,249
Individuals Affected	16,078,181	4,149,484
Deaths	6,300	18
Injuries	28,689	916
Total Houses		
Damaged Completely	1,084,762	290,670
Damaged Partially	489,613	42,466
Damaged	595,149	248,204

Disasters and Lessons Learned: Nepal

On April 25, 2015, a 7.8 magnitude earthquake struck Nepal followed by 20 aftershocks. On May 12, 2015, a 7.3 magnitude earthquake with five aftershocks struck near Mount Everest. Within a week, there were 7,000 casualties, 70,000 structures damaged, and over eight million people affected (Sanderson & Ramalingam, 2015). The earthquakes and their aftershocks resulted in over 5,000 landslides, flooding many streams with sediments, and causing floods in low lying areas. This made the task of transporting supplies and services nearly impossible.

The U.S. DoD deployed soft and hard assets for HADR. The 3rd Marine Expeditionary Brigade (MEB) and other forces formed the JTF 505 to respond to this disaster under the guidance of USAID. There was substantial support for evacuation by JTF aircraft, transportation of local ambulances by JTF 505 medical personnel,



including squadron flight surgeons and DART physicians. However, being a landlocked country at a high elevation presented its own set of unsurmountable issues. This tested rotary wing and tilt rotor aircraft endurance. Another unique obstacle in providing relief was complications due to diplomatic requirements of coordination in overflight and clearances from multiple countries surrounding the affected area.

In addition to the substantial HADR delivered by the U.S. DoD, the Government of India responded within four hours due to the proximity with open borders, close cultural ties with Nepal, relationship with the Armed Forces, and bilateral pre-disaster planning and training. The Chinese government also responded at the request of the Nepalese government with search and rescue teams, helicopters, and 900 personnel. The World Health Organization, the UN Cluster System, international military forces, and other HOs added their support to the disaster relief.

One of the dreadful challenges was properly caring for children whose parents were missing. Urgent repair of the roads for immediate transportation was also a formidable challenge that could have been mitigated through helipads in rural areas. The inadequate collection of field information and dissemination of the same turned out to be a major handicap. Establishing call centers in each village would help overcome this difficulty. Due to damaged government structures, the basic problem of lack of office space, though not life-threatening, was a deterrent. This meant the building codes had not been followed and strict monitoring should have been implemented. Inadequate search and rescue capabilities turned out to be devastating, so one lesson learned was to strengthen the overall search and rescue capability through security forces and international support.

Wendelbo et al. (2016) outline the challenges in executing disaster relief and the lessons learned after the Nepal earthquake, as described in Table 5.



Table 5: Challenges and Lessons Learned in Nepal. Source: Wendelbo et al. (2016).

Planning:	In spite of sound planning for disasters, the efforts fell short. The framework with rules and regulations were not fully funded and therefore not enforced.
Building codes:	The scientifically strong building codes that exist in Nepal were not enforced.
Household damages:	Though the damage to the infrastructure and public facilities was mitigated through inside as well as outside help, the rural households remained damaged.
Logistical challenges:	Being a poor and underdeveloped country, the infrastructure in Nepal was inadequate. The country has a single airport, which turned out to be the bottleneck. The relief efforts could not be utilized in spite of sufficiently available supply, and some teams had to return without delivering the aid.
Communication:	Nepal's communication networks physically and virtually collapsed, so the local responders could not convey the existing conditions and needs to the authorities.
Coordination:	The inadequate physical infrastructure, before and after the disaster, intensified the lack of coordination between HOs delivering support.
Misdirected focus:	Trendy methodologies were used by some HOs that are costly for locals to sustain, such as K9 teams for search and rescue instead of more efficient methods.
Funding:	Though about US \$4 billion was pledged within a month, when Nepalese government launched the recovery efforts, not all the funds came through. Perhaps it was due to lack of fulfilling the promises on the donors' part or not having faith in utilization of the funds by the host nation.

The overwhelming support from HOs across the globe complicated relief efforts in Nepal. Nepal had only one runway airport and very few helicopters to transport relief workers to the inaccessible mountainous areas. Unfortunately, the lessons learned in the 2004 Indian Ocean tsunami were not well understood or implemented (Salmeron & Apte, 2010). After the tsunami, the donated supplies that could have mitigated needs to a large extent could not be distributed due to a single airstrip and a single fork-lift in Banda Ache (Apte, 2009).



Summary of Lessons Learned

No amount of planning for disasters can prevent casualties, suffering, and damages. But “good” planning, based on lessons learned from past disasters, can mitigate the effects of the disaster. However, a significant theme that emerges from the literature review is articulated by Markus (2012) – the sharing of information among stakeholders in terms of their mandates, activity scope, capacity, technical expertise, and funding capital has to happen before a disaster strikes.

The U.S. DoD is one of the organizations providing HADR in the Asia-Pacific region with other government organizations, NGOs. Moroney, Pezard, Miller, Engstrom, and Doll (2013) claim that the following changes need to be made to spread goodwill through HADR:

- Improve the DoD’s efficiency in HADR
- Enhance interagency coordination
- Develop coordination with the host nation
- Increase work with the UN and NGOs
- Align security activities and regional HADR capabilities

Another organization that plays a major role in humanitarian operations is the Logistics Cluster of the United Nations (UN). Global Logistics Cluster (2016) has extensively studied the relief provided in the past disasters to understand the lessons from these experiences. The lessons learned are tabulated in Table 6.

Table 6: Lessons Learned by Global Logistics Cluster.

Coordination	Mechanisms such as meetings for unifying response, reduction of duplication in logistics operations and identification of common needs
Information Management	Website managed by the cluster providing maps, Geographic Information System (GIS), situation reports, and consistent and timely meetings notes
Logistics Service Delivery	Humanitarian staging areas need to be pre-established so they can be activated immediately, thus reducing delays in delivery. Existing support services such as pre-positioned equipment and their handlers, fleet of vehicles with smaller secondary vehicles, air ambulances operated by local staff added significantly to the success of certain occurrences. The shortcomings, however, were delays in air transport capacity that led to reduction in cost-effectiveness.



The authors recommend that investments should be made in pre-preparedness activities that have turned out to be invaluable in certain instances. They also comment on the information management tools used, such as having an accessible system to enrich the competency further. In terms of accountability, the authors suggest that there should be clarification of roles and responsibilities associated with them in addition to pre-established tracking system. Most importantly, coordination efforts between the strategic partners in preparedness planning and advisory board for decision-makers should be done with priority given to logistics.

Evans (2016) outlines necessity of interagency training as the lesson learned. The author describes the lessons as (1) a Mobile Training Team traveling to disaster-prone areas and offering training to country teams, (2) Adding courses at the end of annually held conferences at USPACOM, and (3) Incorporating a specific and significant disaster management content into existing preparatory courses.

Advantages from these lessons are that each member of the DoD will go through the training so that participants will learn about

- Available resources
- Utilization of the same
- Lessons from previous disasters
- Relevant topics they may face such as basic search and rescue, medical first responder
- Appreciation of options available during the lifecycle of the disaster

Issues and Challenges in the “Three Cs” of Civil-Military Organizations

Civil-military organizations are needed to establish, maintain, influence, and exploit relations between military, government, and non-government organizations, including the host country of the disaster. The “three Cs” for civil military organizations are communication, coordination, and collaboration. With complimentary capabilities and competencies other government and non-government organizations participate with the U.S. in HADR. Therefore it is essential that coordination and communication among all these organizations be explored and



enhanced. The premise is that such processes will enable the DoD to respond efficiently and effectively with the unique capabilities that they possess in the future of limited budgets (Apte et al., 2016; Moroney et al., 2013).

The type of collaboration between military and non-military organizations is predominantly determined by the disaster classification. Logistical support and delivery of supplies continues irrespective of the alliance (Pettit & Beresford, 2005). The authors propose a model for logistical requirements in the affected regions. The model is given in Figure 6.

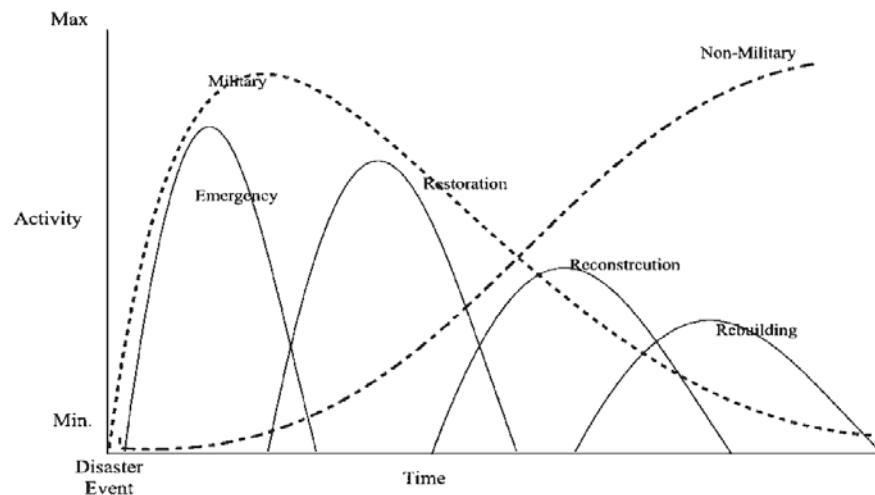


Figure 6: Proposed Model. Source: Pettit & Beresford (2005).

The authors also present issues and challenges for measuring disaster preparedness and response. These factors can help in developing the framework for readiness metrics. More importantly, the authors describe the possible conflicts arising from military involvement in humanitarian crises. Table 7 describes these conflicts.



Table 7: Conflicts Arising From Military Involvement. Source: Pettit & Beresford (2005).

Medical care	Military medicine is not necessarily appropriate for humanitarian crises. Supplies readily available to military forces may be inappropriate for refugees and disaster victims, although at the outset of a crisis they may be all that is available.
Conflict resolution	Military forces are not well suited to aid long-term redevelopment efforts. The imposition of security by outside military forces may also impede negotiation and conflict resolution.
Interaction with other organizations	Military commanders may be unfamiliar with the roles of major international organizations, and, conversely, civilians will have little experience of military organizations. There will be differences in strategy, objectives, and tactics.
Conflict with humanitarian agenda	Using military resources to achieve humanitarian goals creates tension and can undermine the appearance of neutrality of relief organizations.
Adequacy of training	Few military officers receive training in disaster relief or humanitarian assistance. There is also likely to be ambiguity over the role of military physicians in complex emergencies in international humanitarian law.
Limited commitment to disaster response	The principal mission of the military is to resolve military conflicts, and, generally, less effort and fewer resources are devoted to humanitarian aid unless an HA-specific mission is being conducted.

In November 2005, a DoD directive defined “stability operations” as a “core US military mission” with a Priority comparable to combat operations” (DoD, 2005). This directive recommends the use of outcome-based performance measure and installing process for transparency of information. Reaves, Schor, and Burkle (2008) describe the gaps in the DoD’s ability to measure the effects of HADR operations when compared with international standards. The authors’ analysis reveals that only 0.7% of the 1000 after action reports studied, refer to performance measures. The authors conclude that most of the humanitarian operations performed by the DoD did not have records to identify the activities that could be quantified for most contribution to the HADR. In a focused study Reineck (2004) estimates readiness and deployability index for emergency centers registered nurses to prepare for disaster relief.



U.S. Forces in Japan (USFJ) maintained necessary coordination and daily workings with the State Department (Embassy in Japan) and Japan Self-Defense Forces (JSDF; Terrada, 2012). This was informally done without any structured support at operational level of command and control.

Yoshitomi et al. (2012) describe the bilateral coordination between JSDF and USFJ. They suggest that the solution to preparedness issues may be establishing a standing bilateral coordination center that is staffed with people from both the forces so they could share information and plan before the disaster strikes. They also recommend that for effective coordination, more activities and exercises are needed. This will enable clarification of communications, roles, missions, and capabilities with the counterparts of other nations. Acquisition and interagency agreements are necessary to pre-position supplies and services. For successful coordination, it is also essential to understand the capabilities and equipment of the host nation counterparts.

Japan is one of the best prepared countries for earthquake in the world but had limited experience in receiving international assistance (Katoch, 2012). Absence of institutionalized civil-military coordination is a significant void that is exacerbated when a country is facing a super disaster or crisis. In spite of this, the Great East Japan Earthquake (GEJE) of 2012 is a great example of coordination between JSDF, USFJ, Swiss Humanitarian Aid Unit (SHA), and German Federal Agency for Technical Relief (THW; Terada, 2012; Smart, 2012; Fichter, 2012).

At a national level, cooperation between the Red Cross and Red Crescent Movement (RCRC) and military is common, but this cooperation gets complex when military assets are involved in an international context in the case of natural disaster (Markus, 2012). Guidelines from RCRC state that “while maintaining a dialogue with armed forces at all levels, the components of Movement preserve their independence of decision-making and action, in order to ensure adequate access to all people in need of humanitarian assistance” (Counsel of Delegates, 2005).

Super Typhoon Haiyan (Yolanda) was notably one of the best instances of the civil-military coordination (CFE-DM, 2014). There were many previous



experiences from the disasters in the Philippines that contributed to the disaster relief. However, connections between personnel involved in the relief and other players helped expedite the collaboration between civil and military organizations.

There were 57 countries contributing to the relief operations in Super Typhoon Haiyan. Multinational Coordinate Center (MNCC) was set up for this purpose with 29 foreign militaries that responded to the disaster. The coordination predominantly revolved around warehousing, transportation, and distribution—that is, logistics. However, a lack of framework for a common operating process and a lack of consensus on needs assessment ended up causing a duplication of efforts in the face of scarce resources. The study by Center for Excellence in Disaster Management (CFE-DM, 2015) shows the following best practices:

Best Practice1: A commonly understood “end-to end warning system” prepares a nation for crises

Best Practice2: Bilateral commitment executed multilaterally on the ground through the Multinational Coordination Center (MNCC) promotes optimal civilian use of foreign defense assets.

Best Practice3: When closely coordinated with the government, the private sector multiplies a nation’s surge capacity to meet the life-saving needs of the affected population. (p. 5)

The authors of CFE-DM (2015) conclude that advances in civil-military coordination occur when (1) consensus in the operating environment paves the way for unity of effort; (2) systemic changes through an inclusive multi-sectoral approach streamlines disparate efforts on emergency response preparedness; (3) a convergence in concepts, frameworks, protocols, and procedures maintains a clear distinction of responsibilities and national sovereignty; and (4) institutionalized internal and external partnerships augment a country’s latent ability to surge.

The U.S. Operational Detachment-Alpha (ODA) served in Philippines during Super Typhoon Haiyan. This was not unique to the Philippines; ODA also served in Nepal. In the aftermath of the 2015 Nepal earthquake, two teams of the ODA, 1121 and 1126, happened to be in Khatmandu, Nepal (Elwood, 2016). They stayed on to help with the HADR mission since U.S. Special Forces Green Berets are known for their capability in diverse tasks of special warfare during combat missions and in



training with partner forces in coordinating exercises. This came in critical use in Nepal. The beneficial aspect of ODA can be exploited methodically if the team can be incorporated in a contingency plan for military-military collaboration. The competencies of Special Forces to react instantly with pre-established relationships and resources, critical language skills, and flexibility could then be utilized.

There was significant anticipation for a catastrophic earthquake in Nepal among many international governments and military organizations. This projection helped in a broad response from all the organizations when the actual disaster occurred. The United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA) led the effort for civil-military coordination through Humanitarian Military Coordination Center (HuMOCC; Tarantino, Suter, & Cooper, 2016). In Nepal, the military participation came in the areas of logistics and transportation, in addition to health and medical support.

The model for civil-military cooperation in disaster relief is the support provided by Joint Task Force (JTF) 505 and USAID to the 2015 Nepal earthquake (Bock, 2016). The author credits the success to the Mission Tasking Matrix (MITAM) Process. The major contributions of this tool are as follows:

- Transparency in information about needs, number of response participants, requirements, and coordination challenges
- Military planners' ability to expedite the planning process and analyze if JTF has the resources and authority to fill it
- The DoD's doctrine of supporting USAID
- Maintaining cost efficiency
- Constraining focus on specific requirements to avoid mission creep



THIS PAGE LEFT INTENTIONALLY BLANK



Framework Based on Literature Survey

Unfortunately, the absence of quantifiable or measurable performance indicators or readiness metrics in humanitarian organizations (HOs) has been acknowledged by organizations that are involved in HADR whether they be military or not. Literature on critical best practices for performance measurement describe that the metrics should be aligned with the objective. The objective in the case of the U.S. DoD according to the Cooperative Strategy for the 21st Century Seapower is to provide HADR with capabilities that complement the capabilities of other HOs in such operations. Learning from the lessons discussed previously in this article will help the U.S. DoD be effective and efficient in HADR and at the same time spread goodwill through the world by HADR.

Readiness is defined by the DoD as the ability of the U.S. military to fight for and meet the needs of the national strategy. No comprehensive plan exists, thus emphasizing that a framework is necessary readiness. There exist marked gaps between the way the DoD measures the performance of HADR and the international standards. It has been noted that out of 1000 after action reports studied only 0.7% even mention performance (Reaves et al., 2008).

Some of the reasons, as expressed before, that the DoD should measure the impact of humanitarian assistance programs are as follows: (1) Measuring them offers opportunities for future and mid-course corrections in the projects through feedback loops enabling planners to underscore activities that are cost-effective, (2) the collection and sharing of data decreases the likelihood that HOs duplicate activities , and (3) analysis based on collected data offers transparency and quantifiable results that do not leave any ambiguity.

However, operational challenges exist. Current naval HADR responses are mostly reactive, not proactive or preplanned and sustainable engagements. Such activities do not necessarily align with the strategic goal. Lessons learned point to deficient integration with host nations and other HOs. More importantly, the reliance



of the USN on vessels alone may not provide adequate HADR due to the complete dependence on the deployment of ships irrespective of their capabilities.

Figure 7 shows the endogenous and exogenous processes of the organizations providing relief to the affected region. Core competencies that are based on the assets and resources of the organization are endogenous to the organization.

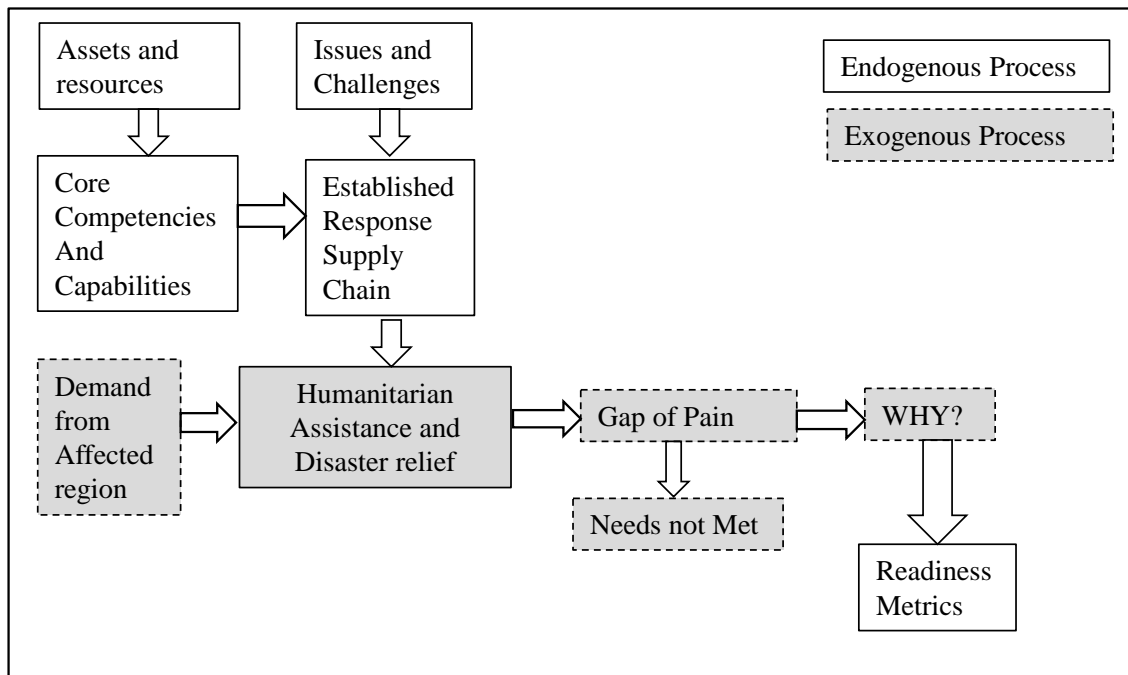


Figure 7: Process for Identifying Readiness Metrics in Organizations.

Originating from the core competencies and capabilities the organizations establish response supply chains (RSC) for products, services, and information. This step is endogenous to the organization. The response supply chains have their own issues and challenges inherent to the organization. The HADR delivered is at the intersection of establishment of RSC, an endogenous process of an organization and the demand due to disaster in the affected region, exogenous to the organization. The demand from the disaster in the affected region dictates the relief needed that is exogenous to the organization. However, the actual relief delivered is endogenous to the organization. The consequences of the delivery of HADR result



in gap of pain that originates when needs are not met by the organization. The gap of pain experienced by the regions affected by disasters forces the question of “why” to the players of the response supply chains. All these consequential steps are exogenous to the organization. However, the resulting playbook or a set of readiness metrics in answering of “why” is endogenous to the organization itself. The objective of our research in this project was to study existing literature to understand the process and ultimately to conceptualize a framework for readiness metrics.

The Case for Naval HADR Operations

The essential services and capabilities for disaster response as outlined by Apte et al. (2016) for military and non-military organizations are Information and Knowledge Management, Needs Assessment, Supply, Deployment and Distribution, and Health Service Support. If one focuses on military organizations and on the U.S. DoD, the capability of Information and Knowledge Management, for example, can be transformed into what is needed to be ready, an awareness of being ready, and a metric for readiness. Table 8 illustrates this process.

Table 8: Process for Readiness Metrics From Capabilities.

<i>Need</i>	<i>Awareness</i>	<i>Readiness Metric</i>
<ul style="list-style-type: none"> • Hard Assets: Aerial Platform, Satellites, IT Equipment • Soft Assets: Database, Skilled Staff • Preset Threshold: The Mission, Situation Assessment • Plans for Gathering Intelligence 	<ul style="list-style-type: none"> • Testing and Evaluation • Exercises and Drills • Wargames • Inspection • Contingency Scenario Analysis • Current Status • Tradeoff between Risk Tolerance and Threat Level 	<ul style="list-style-type: none"> • Mission Essential Tasks (MET) • Assessment for Hard Assets • Cost vs. Capability • Past Exposure • Lessons Learned



The disasters of the past few decades and the lessons learned from them offer insight into the needs of the countries affected, whether their needs were met by the U.S. DoD, and the effectiveness of the DoD's response. After Super Typhoon Haiyan there was massive damage to the infrastructure. The U.S. DoD's principal capability of heavy vertical lift capabilities was critical in delivering disaster relief. This capability helped transport goods and people despite infrastructure destruction. This capability also helped rescue the affected population stranded on the many islands of the Philippines that are remote and difficult to access. USS George Washington naval task force and 31st MEU formed JTF 505 with about 1000 U.S. DoD personnel and were deployed to the Philippines. Military aircraft helped in understanding the demand through intelligence gathering. Without the Marines, it would have been impossible to clear the roads and distribute supplies and services.

After the Nepal earthquake, the U.S. DoD service that could be used was the 3rd MEB located in Okinawa since Nepal is a landlocked country. Adding to the MEB, JTF 505 was formed for deployment to help with HADR under the guidance of USAID. The terrain in Nepal tested the DoD equipment and the staff. Though rotary wing and tilt rotor aircraft supported the mission, the team casualties tried the resolve of the teams.

The naval missions conducted for HADR in the past, as described in this research, help develop the Readiness Assessment Model. The output from the model must answer questions such as what is needed, is it there, what must be done, how can it be done, how can the gap between demand and supply be closed before a disaster strikes. There are many more variables that play a role in the model such as the type of the disaster (manmade or natural), onset of disaster (sudden or slow), relations with the host county, category of host country, and so forth. Figure 8 outlines the overview and conceptualization of the Readiness Assessment Model.



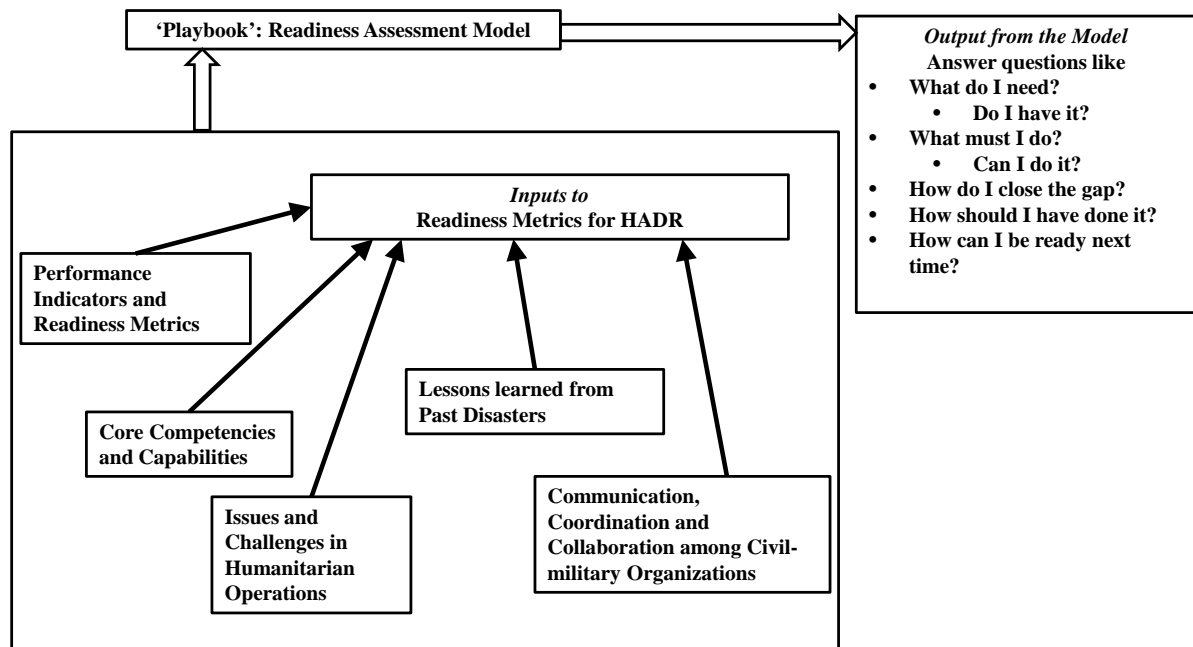


Figure 8: Overview of Readiness Assessment Model.

In future research, we plan to dig deeper and build on the actual experiences of USN and USMC officers involved in HADR. The objective is to articulate the strategic readiness through operational details and answer the questions posed in Figure 8.



THIS PAGE LEFT INTENTIONALLY BLANK



References

- Adams, S. M., Sarkis, J., & Liles, D. (1995). The development of strategic performance metrics. *Engineering Management Journal*, 7(1), 24–32.
- Altay, N., & Green, W. G., III. (2006). OR/MS research in disaster operations management. *European Journal of Operational Research*, 175, 475–493. doi:10.1016/j.ejor.2005.05.016
- Appleby, A. (2013). Connecting the last mile: The role of communications in the Great East Japan Earthquake. Retrieved from <http://reliefweb.int/report/world/connecting-last-mile-role-communications-great-east-japan-earthquake>
- Apte, A. (2009). Humanitarian logistics: A new field of research and action. *Foundations and Trends[®] in Technology, Information and Operations Management*, 3(1), 1–100. doi:10.1561/0200000014
- Apte, A. (2014). Strategic and operational prepositioning in case of seasonal natural disasters: A perspective. In *Wiley Encyclopedia of Operations Research and Management Science*, Wiley, Hoboken, NJ.1–13. onlinelibrary.wiley.com/doi/10.1002/9780470400531.eorms1095/pdf
- Apte, A., Goncalves, P., & Yoho, K. (2016). Capabilities and competencies in humanitarian operations. *Journal of Humanitarian Logistics and Supply Chain Management*, 6(2), 240–258.
- Apte, A., & Yoho, K. (2012, September). *Capabilities and competencies in humanitarian operations* (Acquisition Research Sponsored Report Series). Monterey, CA: Naval Postgraduate School, Graduate School of Business and Public Policy.
- Apte, A., & Yoho, K. (2014, September). *Analyzing resources of United States Marine Corps for humanitarian operations* (Acquisition Research Sponsored Report Series). Monterey, CA: Naval Postgraduate School, Graduate School of Business and Public Policy.
- Apte, A., Yoho, K., Greenfield, C., & Ingram, C. (2013). Selecting maritime disaster response capabilities. *Journal of Operations and Supply Chain Management*, 6(2), 40–58.
- Balcik, B., Iravani, S. and Smiloewith, K. (2010). A review of equity in nonprofit and public sector: a vehicle routing perspectives. *Wiley Encyclopedia of Operations Research and Management Science*, Wiley, Hoboken, NJ.
- Beamon, B. M. (2004). Humanitarian relief chains: Issues and challenges. In *Proceedings of the 34th International Conference on Computers & Industrial Engineering* (pp. 77–82) (<http://depts.washington.edu/iphr/>).



- Beamon, B. M., & Balcik, B. (2008). Performance measurement in humanitarian relief chains. *International Journal of Public Sector Management*, 21(1), 4–25.
- Beamon, B. M., & Kotleba, S. A. (2006). Inventory modeling for complex emergencies in humanitarian relief operations. *International Journal of Logistics: Research and Applications*, 9(1), 1–18.
- Benini, A. (2016, August). *Severity measures in humanitarian needs assessments: Purpose, measurement, integration* (Technical note). Geneva, Switzerland: Assessment Capacities Project (ACAPS). Retrieved from https://www.acaps.org/sites/acaps/files/resources/files/acaps_technical_note_severity_measures_aug_2016_0.pdf
- Benini, A., & Chataigner, P. (2014, May). *Composite measures of local disaster impact: Lessons from Typhoon Yolanda, Philippines*. Retrieved from http://aldo-benini.org/Level2/HumanitData/Acaps_140527_CompositeMeasures_Philippines.pdf
- Benini, A., Chataigner, P., Noumri, N., Tax, L., & Wilkins, M. C. (2016, February). *Information gaps in multiple needs assessments in disaster and conflict areas*. Retrieved from <http://reliefweb.int/report/world/information-gaps-multiple-needs-assessments-disaster-and-conflict-areas-guidelines>
- Blecken, A., Hellingrath, B., Dangelmaier, W., & Schulz, S. (2009). A humanitarian process reference model. *International Journal of Service Technology and Management*, 12(4), 391–413.
- Bock, Y. (2016, Spring). Form with content: Ensuring mission success in HADR. *Liaison: A Journal of Civil-Military Disaster Management & Humanitarian Relief Collaborations*, 13, 43–46.
- Bonventre, E. V. (2008, June). Monitoring and evaluation of Department of Defense: Humanitarian assistance programs. *Military Review*, 123.
- Bourne, M., Mills, J., Wilcox, M., Neely, A., & Platts, K. (2000). Designing, implementing and updating performance measurement systems. *International Journal of Operations & Production Management*, 20(7), 754–771. doi:10.1108/01443570010330739
- Buckmaster, N. (1999). Associations between outcome measurement, accountability and learning for non-profit organizations. *International Journal of Public Sector Management*, 12(2), 186–197.
- Carafano, J. J. (2011). The Great Eastern Japan Earthquake: Assessing disaster response and lessons for the U.S. Retrieved from <http://www.heritage.org/asia/report/the-great-eastern-japan-earthquake-assessing-disaster-response-and-lessons-the-us>



Cecchine, G., Morgan, F. E., Wermuth, M. A., Jackson, M., Schaefer, A. G., & Stafford, M. (2010). *The U.S. military response to the 2010 Haiti Earthquake: Considerations for Army leaders*. Santa Monica, CA: RAND. Retrieved from https://www.rand.org/content/dam/rand/pubs/research_reports/RR300/RR304/RAND_RR304.sum.pdf

Center for Excellence in Disaster Management and Humanitarian Assistance (CFE-DM). (2014). *Lessons from civil-military disaster management and humanitarian response to Typhoon Haiyan (Yolanda)*. Retrieved from <http://www.alnap.org/resource/21103>

Center for Excellence in Disaster Management and Humanitarian Assistance (CFE-DM). (2015). *Advances in civil-military coordination in catastrophes: How the Philippines turned lessons learned from Super Typhoon Haiyan (Yolanda) into best practices for disaster preparedness and response*. Retrieved from <https://www.cfe-dmha.org/LinkClick.aspx?fileticket=QEDCMIMtTc4%3D&portalid=0>

International Federation of Red Cross and Red Crescent Societies. (2005). *Council of Delegates: Seoul, 16–18 November 2005* (Resolution 7). Retrieved from https://www.icrc.org/eng/assets/files/other/cod-resolutions_2005_en.pdf

Davidson, A. L. (2006). *Key performance indicators in humanitarian logistics* (Master's thesis). Cambridge, MA: Massachusetts Institute of Technology.

de Leeuw, S. (2010). Towards a reference mission map for performance measurement in humanitarian supply chains. In L. M. Camarinha-Matos et al. (Eds.), *PRO-VE 2010, IFIP AICT 336* (pp. 181–188). Retrieved from https://www.researchgate.net/profile/Sander_De_Leeuw/publication/220832726_Towards_a_Reference_Mission_Map_for_Performance_Measurement_in_Humanitarian_Supply_Chains/links/00463516ed19f57972000000/Towards-a-Reference-Mission-Map-for-Performance-Measurement-in-Humanitarian-Supply-Chains.pdf

Department of Defense (DoD). (2005). *Military support for stability, security, transition, and reconstruction (SSTR) operations* (DoD Directive 3000.05). Retrieved from <http://www.dtic.mil/whs/directives/corres/pdf/300005p.pdf>

DiOrio, D. R. (2010). *Operation Unified Response Haiti Earthquake 2010* (Technical report). Retrieved from http://jfsc.ndu.edu/Portals/72/Documents/JC2IOS/Additional_Reading/4A_Haiti_HADR_Case_Study_revNov10.pdf

Dremsa, T. L., Resnick, B., Braun, R. F., Derogatis, L. R., McEntee, M., Turner, M., & Reineck, C. (2004). Pilot testing the Readiness Estimate and Deployability Index Revised for Air Force nurses. *Military Medicine*, 169(1), 11–15.

Duran, S., Gutierrez, M. A., & Keskinocak, P. (2011). Pre-positioning of emergency items for CARE International. *Interfaces*, 41(3), 223–237.



- Elwood, N. (2016, Spring). The Swiss Search and Rescue Team in Japan. *Liaison: A Journal of Civil-Military Disaster Management & Humanitarian Relief Collaborations*, 13, 8–12.
- Fichter, M. (2012). U.S. Army Green Berets save lives in Nepal. *Liaison: A Journal of Civil-Military Disaster Management & Humanitarian Relief Collaborations*, 5, 67–74.
- Folan, P., & Browne, J. (2005). A review of performance measurement: Towards performance management. *Computers in Industry*, 56(7), 663–680.
- Government Accountability Office (GAO). (2016). *Military readiness: DOD's readiness rebuilding efforts may be at risk without a comprehensive plan* (GAO-16-841). Retrieved from <http://www.gao.gov/assets/680/679556.pdf>
- Global Humanitarian Assistance (GHA). (2013). *Global humanitarian assistance report 2013*. Retrieved from <http://www.globalhumanitarianassistance.org/wp-content/uploads/2013/07/GHA-Report-2013.pdf>
- Global Logistics Cluster. (2016). The backbone of response: Lessons from the Logistics Cluster. *Liaison: A Journal of Civil-Military Disaster Management & Humanitarian Relief Collaborations*, 13(Spring), 39–42.
- Guha-Sapir, D., Hoyois, P., & Below, R. (2014). *Annual disaster statistical review 2013: The numbers and trends*. Brussels, Belgium: Centre for Research on the Epidemiology of Disasters (CRED).
- Harvey, J. C., Jr. (2008). *U. S. Navy Language Skills, Regional Expertise and Cultural Awareness Strategy*. Retrieved from https://www.researchgate.net/publication/235011977_US_Navy_Language_Skills_Regional_Expertise_and_Cultural_Awareness_Strategy
- Haavisto, I., & Goentzel, J. (2015). Measuring humanitarian supply chain performance in a multi-goal context. *Journal of Humanitarian Logistics and Supply Chain Management*, 5(3), 300–324.
- Hong, J. (2012). Creation of a tsunami disaster response system in the Republic of Korea using inundation maps. *Liaison: A Journal of Civil-Military Disaster Management & Humanitarian Relief Collaborations*, 5, 75–78.
- Huang, M., Smilowitz, K., & Balcik, B. (2011). Models for relief routing: Equity, efficiency and efficacy. *Transportation Research Part E: Logistics and Transportation Review*, 48(1), 2–18. doi:10.1016/j.tre.2011.05.004
- Joint Center for Operational Analysis (JCOA). (2010). Operation Unified Response Haiti Earthquake Response. Retrieved from https://community.apan.org/.../Operation-United-Response-JOCA-Report_5D00_.pdf



- Kaplan, R., & Norton, D. (1992). The balanced scorecard: Measures that drive performance. *Harvard Business Review*, 70(1), 71–79.
- Kaplan, R. S. (2001). Strategic performance measurement and management in nonprofit organizations. *Nonprofit Management and Leadership*, 11(3), 353–370.
- Katoch, A. (2012). International response to the Great East Japan Earthquake. *Liaison: A Journal of Civil-Military Disaster Management & Humanitarian Relief Collaborations*, 5, 85–88.
- Kovács, G., & Spens, K. M. (2009). Identifying challenges in humanitarian logistics. *International Journal of Physical Distribution and Logistics Management*, 39(6), 506–528.
- Lum, T., & Margesson, R. (2014). Typhoon Haiyan (Yolanda): U.S. and international response to Philippines disaster. *Current Politics and Economics of South, Southeastern, and Central Asia*, 23(2), 209–246.
- Maghsoudi, A., & Pazirandeh, A. (2016). Visibility, resource sharing and performance in supply chain relationships: Insights from humanitarian practitioners. *Supply Chain Management: An International Journal*, 21(1), 125–139.
- Margesson, R. (2015). *International crises and disasters: U.S. humanitarian assistance response mechanisms* (CRS Report RL33769). Washington, DC: Congressional Research Service. Retrieved from <https://www.fas.org/sqp/crs/row/RL33769.pdf>
- Markus, F. (2012). Japanese Red Cross cooperation with civilian and military responders in the Great East Japan Earthquake. *Liaison: A Journal of Civil-Military Disaster Management & Humanitarian Relief Collaborations*, 5, 81–84.
- McCoy, J. H. (2008). Humanitarian response: Improving logistics to save lives. *American Journal of Disaster Medicine*, 3(5), 283–293.
- McCunn, M., Ashburn, M. A., Floyd, T. F., Schwab, C. W., Harrington, P., Hanson, C. W., ... Fleisher, L. A. (2010). An organized, comprehensive, and security-enabled strategic response to the Haiti earthquake: A description of pre-deployment readiness preparation and preliminary experience from an academic anesthesiology department with no preexisting international disaster response program. *International Anesthesia Research Society*, 111(6), 1438–1444. doi:10.1213/ANE.0b013e3181f42fd3
- MEAL Humanitarian Technical Working Group, Save the Children. (2013). Key lessons to learn for Typhoon Haiyan response. Retrieved from <http://www.alnap.org/resource/9736>



- Medori, D., & Steeple, D. (2000). A framework for auditing and enhancing performance measurement systems. *International Journal of Operations & Production Management*, 20(5/6), 520–533.
- Micheli, P., & Kennerly, M. (2005). Performance measurement frameworks in public and non-profit sectors. *Production Planning and Control*, 16(2), 125–134.
- Moroney, J. D. P., Pezard, S., Miller, L. E., Engstrom, J., & Doll, A. (2013). *Lessons from Department of Defense disaster relief efforts in the Asia-Pacific Region* (Rand Corporation report). Retrieved from https://www.rand.org/pubs/research_reports/RR146.readonline.html
- Neely, A. (2005). The evolution of performance measurement research: Developments in the last decade and a research agenda for the next. *International Journal of Operations & Production Management*, 25(12), 1264–1277.
- Neely, A., Gregory, M., & Platts, K. (1995). Performance measurement system design: A literature review and research agenda. *International Journal of Operations & Production Management*, 15(4), 80–116. Reprinted in *International Journal of Operations & Production Management*, 25(12), 2005, 1228–1263.
- Norio, O., Ye, T., Kajitani, Y., Shi, P., & Tatano, H. (2011). The 2011 Eastern Japan Great Earthquake disaster: Overview and comments. *International Journal of Disaster Risk Science*, 2(1), 34–42. [doi:10.1007/s13753-011-0004-9](https://doi.org/10.1007/s13753-011-0004-9)
- Parker, T., Carroll, S. P., Sanders, G., King, J. E., & Chiu, I. (2015). *An inside look into USPACOM response to Super Typhoon Haiyan*. Retrieved from https://www.cfe-dmha.org/LinkClick.aspx?fileticket=eF0gtnF5_iQ=
- Pettit, S. J., & Beresford, A. K. C. (2005). Emergency relief logistic: An evaluation of military, non-military and composite response models. *International Journal of Logistics: Research and Applications*, 8(4), 313–331.
- Reaves, E. J., Schor, K. W., & Burkle, F. M., Jr. (2008). Implementation of evidence-based humanitarian programs in military-led missions: Part I. Qualitative gap analysis of current military and international aid programs. *Disaster Medicine and Public Health Preparedness*, 2(4), 230–236.
- Reineck, C. A. (2004). The Readiness Estimate and Deployability Index: A self-assessment tool for emergency center RNs in preparation for disaster care. *Topics in Emergency Medicine*, 26(4), 349–356.
- Roughead, G., Morrison, S. J., Cullison, T., & Gannon, S. (2013, March). *U.S. Navy humanitarian assistance in an era of austerity*. Washington, DC: Center for Strategic and International Studies.



- Rouse, P., & Putterill, M. (2003). An integral framework for performance measurement. *Management Decision*, 41(8), 791–805.
- Salmeron, J. & Apte, A. (2010). Stochastic Optimization for Natural Disaster Asset Prepositioning. *Production and Operations Management*, 19(5), 2010, pp 561 – 575.
- Sanderson, D., & Ramalingam, B. (2015). *Nepal Earthquake response: Lessons for operational agencies*. London: ALNAP/ODI.
- Sawhill, J. C., & Williamson, D. (2001). Mission impossible? Measuring success in nonprofit organizations. *Nonprofit Management and Leadership*, 11(3), 371–386.
- Schulz, S. F., & Heigh, I. (2009). Logistics performance management in action within a humanitarian organization. *Management Research News*, 32(11), 1038–1049.
- Smart, B. (2012). Responding in a new environment: Lessons learned by an Australian urban search and rescue team in Japan. *Liaison: A Journal of Civil-Military Disaster Management & Humanitarian Relief Collaborations*, 5, 61–66.
- Liason Staff. (2012). US military support: Operation Tomodachi. *Liaison: A Journal of Civil-Military Disaster Management & Humanitarian Relief Collaborations*, 5, 55–60.
- Tangen, S. (2004). Performance measurement: From philosophy to practice. *International Journal of Productivity and Performance Management*, 53(8), 726–737. doi:10.1108/17410400410569134
- Tarantino, D. A., Suter, K., & Cooper, J. (2016). Nepal Earthquake: Anatomy of a non-government response. *Liaison: A Journal of Civil-Military Disaster Management & Humanitarian Relief Collaborations*, 13(Spring), 67–74.
- Tatham, P., & Hughes, K. (2011). Humanitarian logistics metrics: Where we are and how we might improve. In M. Christopher & P. Tatham (Eds.), *Humanitarian logistics: Meeting the challenge of preparing for and responding to disasters* (pp. 249–263). Philadelphia, PA: Kogan Page Limited.
- Terada, H. (2012). Japan Self-Defense Force's response to the Great East Japan Earthquake. *Liaison: A Journal of Civil-Military Disaster Management & Humanitarian Relief Collaborations*, 5, 39–44.
- Trunkey, R. D. (2013). *Implications of the Department of Defense Readiness Reporting System* (CBO working paper). Retrieved from https://www.cbo.gov/sites/default/files/113th-congress-2013-2014/workingpaper/44127_DefenseReadiness_1.pdf



- United Nations. (2007). *United Nations Human Development Report 2007/2008—Fighting climate change: Human solidarity in a divided world*. New York, NY: Palgrave Macmillan.
- United States Marine Corps (USMC). (2009, August). *Policy for Marine expeditionary units (MEU) and expeditionary units (special operations capable) MEU (SOC) (MCO 3120.9C)*. Retrieved from <http://www.marines.mil/News/Publications/ELECTRONICLIBRARY/ElectronicLibraryDisplay/tabid/13082/Article/126201/mco-31209c-final.aspx>
- van der Laan, E. A., de Brito, M. P., & Vergunst, D. A. (2009). Performance measurement in humanitarian supply chains. *International Journal of Risk Assessment and Management*, 13(1), 22–45.
- Weinberger, S. N. (2010, November). *Who should set airlift priorities during foreign humanitarian assistance/disaster relief operations and on what basis?* Retrieved from <http://www.dtic.mil/docs/citations/ADA535096>
- Wanlach, J. (2012). Putting lessons into practice. *Liaison: A Journal of Civil-Military Disaster Management & Humanitarian Relief Collaborations*, 5, 89–94.
- Wendelbo, M., La China, F., Dekeyser, H., Taccetti, L., Mori, S., Aggarwal, V., Alam, O., Savoldi, A., and Zielonka, R. (2016). The Crisis Response to the Nepal Earthquake: Lessons Learned. *European Institute for Asian Studies*, May 2016. <http://www.eias.org/wp-content/uploads/2016/02/The-Crisis-Response-to-the-Nepal-Earthquake--Lessons-Learned-colour-1.pdf>
- Wilson, R. K. (2012). *Operation Tomodachi: A model for American disaster response efforts and the collective use of military forces abroad*. Retrieved from <http://www.dtic.mil/dtic/tr/fulltext/u2/a567991.pdf>
- Wisner, J. D., & Fawcett, S. E. (1991). Linking firm strategy to operating decisions through performance measurement. *Production and Inventory Management Journal*, 32(3), 5–11.
- World Meteorological Organization. (2009). Fact sheet: Climate information for reducing disaster risk. Retrieved from http://www.wmo.int/wcc3/documents/WCC3_factsheet1_disaster_EN.pdf
- Yoshitami, N., Arie, K., Tamura, S., Hirose, R., Imamura, E., Sakaguchi, D., & Saito, D. (2012). Military-public-private cooperation in disaster relief. *Liaison: A Journal of Civil-Military Disaster Management & Humanitarian Relief Collaborations*, 5, 21–37.





ACQUISITION RESEARCH PROGRAM
GRADUATE SCHOOL OF BUSINESS & PUBLIC POLICY
NAVAL POSTGRADUATE SCHOOL
555 DYER ROAD, INGERSOLL HALL
MONTEREY, CA 93943

www.acquisitionresearch.net