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Attempting a Knowledge Commons in the Field: the Response to the January 12th, 2010 Haitian Earthquake

Steve Scheinert and Ralitsa Konstantinova

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CENTER FOR DISASTER MANAGEMENT
Graduate School of Public and International Affairs
University of Pittsburgh
3913 Wesley W. Posvar Hall
230 S. Bouquet St
Pittsburgh, PA 15260
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ABSTRACT

This paper examines the response system that emerged in Haiti following the 2010 Earthquake in an operational context with no national disaster plan, but a very large presence of international aid organizations operating under the official framework of the United Nations. This analysis is based on data from UN OCHA situation reports that documented actions taken in response to needs generated by the earthquake and validated through semi-structured interviews with key managers in the system. These data are analyzed using UCINet and ORA software to compare the identified networks against the UN OCHA cluster framework for humanitarian assistance and across the period of the first three weeks following the earthquake. It is intended to document the details of communication breakdown during the response to support efforts to improve future disaster response efforts.

Steve Scheinert
Graduate School for Public and International Affairs
Center for Disaster Management
University of Pittsburgh
Pittsburgh, PA 15260
srs71@pitt.edu

Ralitsa Konstantinova
Anthropology Department
University of Pittsburgh
rpk7@pitt.edu

The Shape of International Disaster Response

Earthquake Event and Immediate Response

The news of the January 12th, 2010 Haitian Earthquake spread very quickly after the event. Within hours, the United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA) published the first of many situation reports, indicating the epicenter, strength, and the first damage assessments, however vague, from the earthquake. The report also noted that UNOCHA and the United States Agency for International Development's (USAID) Office of Foreign Disaster Assistance (OFDA) had activated response teams which were already preparing to deploy (OCHA, 2010a). Over the next three weeks, hundreds of organizations took part in response and recovery operations, bringing resources in the form of funds and materiel, all in an effort to save lives and ease Haiti's transition out of recovery and into long-term rebuilding.

One year later, newspapers across the world carried a litany of stories about the lack of progress in rebuilding Haiti and in moving the country out of the trauma of the earthquake and into long-term, sustainable recovery and development. The initial response offers insight to how this failure of the response happened. Many of the patterns of that response and recovery operations will take over their lifespan are set in the first three weeks (Comfort *et al*, 2011a, Comfort, 1999), and then solidify as the response transitions to recovery and newer responders learn patterns from prior responders. Comfort, Siciliano, and Okada (2011) showed that communication within this system broke down, preventing continual, timely influxes of information, despite the presence of internet-based communication systems built into the United Nations response. Knowledge of breakdowns, though, is not enough to prevent future breakdowns. This requires deeper analysis of where and how the breakdowns occurred. In Haiti, the patterns of coordination show that the breakdown occurred due the many gaps in communication and coordination between organizations that existed, gaps in what information organizations shared when they did coordinate, and that the organizations that took central coordinating and logistical roles were not those intended, generating a situation that required participating organizations to relearn policies and procedures for communication and coordination. This pattern represents a failure of the response's communication platforms, OneResponse and ReliefWeb, to build the kind of common operating picture, or knowledge commons, necessary to coordinate a response with a large number of organizations, spread out geographically, and facing a range of challenges from limited infrastructure (Comfort, Wukich, Scheinert, and Huggins, 2011).

United Nations Cluster System

Other research has documented the events of the earthquake and the damage toll (Comfort *et al*, 2011a). Over the days following the earthquake, UNOCHA and the World Food Program (WFP) initiated the United Nation's (UN) system for disaster response coordination, the UN Cluster System (WFP, 2010a; USAID, 2010a, 2010b), forming the context in which response

and recovery efforts took place. As soon as a disaster happens, a huge number of organizations mobilize to provide aid both locally and internationally. In Haiti, using software from the Sahana Foundation, the WFP documented nearly 700 organizations taking part in the response (Sahana, 2010). As they enter the field, each of these organizations brings with it certain knowledge and resources. As each organization attempts to achieve its humanitarian mission, in whatever part of the disaster area it works, it learns about the events of the disaster and about how events are continuing to develop after the disaster. Ideally, each organization makes improvements in this situation and these developments. In order for all the other organizations to continue to respond appropriately and effectively, it must learn what tasks other organizations have and have not been able to complete and why (Hutchins, 1995, Comfort, 1999). The goal of the cluster system is to facilitate this kind of coordination between organizations.

Based on the functional needs and experience as outlined in the UNOCHA guidelines, the clusters organize around substantive areas of response. In Haiti, these areas are Agriculture, Camp Coordination/Camp Management (CCCM), Early Recovery, Education, Shelter and Non-Food Items, Emergency Telecommunications, Food, Health, Information Management, Logistics, Nutrition, Water Sanitation and Hygiene (WASH), and Protection. Each cluster has a either a non-governmental organization (NGO) or a UN organization that oversees and manages that cluster as the cluster lead. In Haiti, each cluster holds regular meetings on the United Nations Logistics Base (Logbase) to coordinate the activities and resources of the organizations that are working in that cluster's substantive area.

In addition to the clusters, UNOCHA operates two different websites where it and the organizations publish documents related to their operations. The better known and longer-standing of these is ReliefWeb,[1] which maintains records well back into the early and mid-1990s. The second and newer site, having only begun with Haiti, is OneResponse.[2] ReliefWeb contains data from many different response efforts and collects all the documents together in a database that can be searched by a variety of characteristics, such as country, type of document, crisis or disaster, and several others. OneReponse organizes its documents by cluster within pages specific to each disaster or crisis. These website are aimed at facilitating communication and coordination between cluster meetings, and as a way to share information across clusters, much as might happen in an Emergency Operations Center operating the ESF system, though over a longer time period. The rest of this paper will document the shape of this coordination both through and outside of the cluster system, as documented by direct observation and the situation reports that many organizations published during their response efforts.

[1] ReliefWeb is online at: www.reliefweb.int.

[2] OneResponse's main site is http://oneresponse.info. The Haiti-specific site can be found at: http://haiti.humanitarianresponse.info.

Geographic Diversity of Information and Response Activities

OneResponse and ReliefWeb represent UNOCHA's current strategy for overcoming a challenge pandemic to all natural disasters, but particularly acute in Haiti. The events of any natural disaster affect a geographic area sufficiently large that no one person can observe the whole of the area at one time with the ability to recognize sufficient detail to completely comprehend the challenges that responders face at any static time (Hutchins, 1995). Even if such a degree of observation were possible, it would not be enough. A great deal of damage continues to occur even after the initial event. Flood waters may rise bearing debris that can cause further damage, and buildings damaged in an earthquake that did not fail immediately may be destabilized enough to fail later. In Haiti, the lack of infrastructure exacerbates this problem. The road network was poorly maintained and heavily choked with traffic prior to the earthquake, making rapid movement of people and supplies difficult before the earthquake further damaged the road network. Additionally, an unreliable power grid makes common tools that rely on the grid, such as internet routers and computers for internet-based communication, unreliable in turn. Nevertheless, responders require up to date information on the situation they face to be able to continue performing their relief tasks and to know if the task remains relevant to the overall response effort.

Coordination can help to solve this problem (Hutchins, 1995). Each individual responder within each organization directly observes some subset of the on-going events of a disaster both during and after the initial events. By sending information to some kind of central point, all responders, whether they are planning actions in a central coordinating agency like OCHA or USAID or a responder in the field, can gain access to it, so long as the information is posted and presented in a way that makes the information available. This is the intended role of OneResponse and ReliefWeb. Each website serves as a central repository for the reports of developments and activities that each organization makes, so that other actors can know what is being done and adapt accordingly.

Complex Adaptive Systems and Network Analysis

Disaster response takes place in the context of a rapidly changing environment that requires communication and coordination between the responders to remain effective (Hutchins, 1995). For researchers, this requires a similar adjustment in approaches to analyzing policy and performance. The rapid adjustments and information management creates a situation rife with multiple directions of causality and path dependence. This kind of situation, known as a complex adaptive system, is best analyzed through analysis of system and process rather than through cross-case comparisons or standard statistics (Ostrom, 2005; Axelrod and Cohen, 2000; Comfort, 1999). Rather, this method relies extensively on network analysis to build a network model of the system that allows for analysis of the patterns of change by identifying the patterns of communication and coordination (Comfort, Wukich, Scheinert, and Huggins, 2011).

Data and Methodology

Data Sources

Regularly published during a disaster response, the reports stored on ReliefWeb and OneResponse document the response as it actually occurred. In presenting the cluster system, OneResponse presents how the response is supposed to operate. That is, each cluster has a lead organization that coordinates the actions of the cluster's membership, and UNOCHA provides organization, oversight, and coordination between the clusters. Cluster Meetings and documents record and communicate organizational and cluster actions to provide for real-time or near real-time communication and coordination between organizations. In actual performance, however, the response network may form and operate in ways that are very different from the plans. The representatives of a planned central agency may be unavailable at a key moment, allowing another organization to take over those duties, or coordination may collapse over clashes of personalities, are examples of two of many possible developments that change the system. The task of analyzing the response relies heavily on identifying what form the response actually took in practice. This allows the researcher to find and document strengths and weaknesses in the response by charting patterns of communication, coordination, and interaction. These data can be found in the documents on ReliefWeb and OneResponse, so that these documents allow an empirical analysis of the response.

The Center for Disaster Management (CDM) downloaded 139 situation reports ("sitreps") from ReliefWeb. Each situation was published by one of eleven different organizations. In its own sitreps, each organization focuses primarily on its own actions and observations, though few are entirely limited to the actions of the publishing organization. Nevertheless, due to that self-focus, building a responsibly accurate model of the response requires data from more than one organization. The CDM chose the set of organizations from experience in researching prior disasters, the official structure of the cluster system, and the local international organizations which focus on the Caribbean region, where Haiti is located. This list of organizations is:

- Caribbean Disaster Emergency Management Agency (CDEMA)
- UN Health Cluster
- UN Logistics Cluster
- United Nations Stabilization Mission in Haiti (MINUSTAH)
- UN Office for the Coordination of Humanitarian Affairs (UNOCHA)
- Pan-American Health Organization (PAHO)[3]
- United Nations Environmental Program (UNEP)
- United Nations Children's Fund (UNICEF)
- Office for Foreign Disaster Assistance (OFDA), USAID
- UN Water, Sanitation, and Hygiene (WASH) Cluster

[3] PAHO is also the local division of the World Health Organization. Most actions by either PAHO or WHO were reported as having been done by PAHO/WHO or WHO/PAHO.

- World Food Program (WFP)

Covering health and sanitation, logistics, food, vulnerable populations, security, and large-scale general aid operations, this list of organizations covers the primary aid tasks as well as the largest organizations. As mentioned above, the data collected covers the first three weeks following the earthquake, specifically 12 January 2010 – 1 February 2010, since this is the typical period of initial response before that response changes into long-term recovery (Comfort *et al*, 2011a, Comfort, 1999). This set of data, even with the self-focus of each organization's sitreps, covers the key organizations and structures of the response network.

To ensure the accuracy and validity of this data, CDM researchers, in conjunction with geologists from Vassar College and public health researchers from the University of Pittsburgh's School of Public Health, traveled to Haiti, following the earthquake, to observe the response directly. This trip took place from 2 May 2010 to 9 May 2010 and documented many aspects of the response and recovery efforts (Comfort *et al*, 2011a). The data collected on that trip will augment and extend the analysis from the network data collected from the sitreps.

Methods of Analysis

Primary analysis was conducted by building and analyzing network models of the response system that developed during the first three weeks following the earthquake. By reviewing the text of the situation reports, they revealed what organizations did and which organizations interacted with which other organizations, and which worked alone. CDM researchers built the network models by recording these dyads and monads, observed in the sitreps discussed above, and then processing the dyads and monads through network analysis software[4] to reveal the patterns of action and interaction following the earthquake. CDM researchers made two versions of this network. The first was a static network that combined all the interactions observed in all of the sitreps into a single network for analysis. The second was a set of dynamic networks. This set took each day during the first three weeks as a separate network, only coding for each day the dyads and monads that the researchers observed in the sitreps published on that day. This method shows the changes in the network over the course of the response. It shows how the network initially grew and developed.

With the network models made, network analysis includes several measures of the pattern of connections in the model that can be used to describe the model. Centrality measures can be used to determine the most well connected nodes, and so the most important nodes, in the network. Network centralization measures, including clustering coefficients, average distance, and network density describe the shape and amount of possible connections in the network that

[4] This paper uses two pieces of software at different times: *ORA, programmed at the CASOS Institute, at Carnegie Mellon University (Carley, 2011), is used for primary construction of the networks and taking dynamic measures. Most of the maps presented in this paper are made using NetDraw, which is the visualizer for UCINet, which is published by Analytic Technologies (Borgatti *et al*, 2002).

are actually observed. As a mirror to that, isolate counts record how many nodes are observed in the network but which lack any connections to any other nodes and network fragmentation records how many separate pieces there are in the network that are connected within that piece, but not to other pieces (Wasserman and Faust, 1994). Taking these measurements to describe the shape and characteristics of the network will show any gaps in the response system.

Finally, the conclusions drawn from the network measures and models will be compared against the observations and insights drawn from field interviews. These observations will provide a basis for the gaps observed and some insights into how those gaps might be closed in Haiti. They should also provide explanations for why certain organizations became more central in Haiti when the cluster system calls for a different set of key organizations and why some clusters produced emerged as more important than others.

Network Results

Static Network

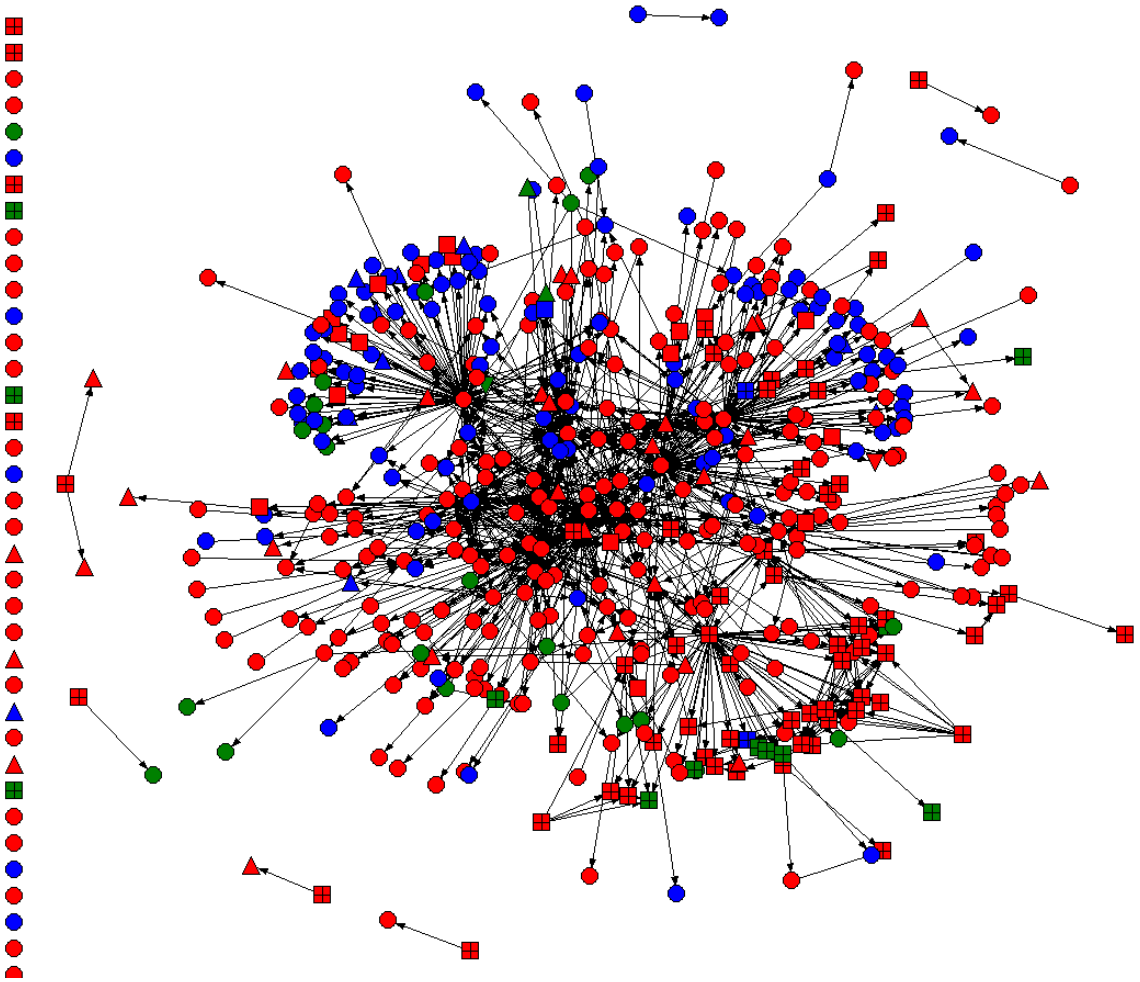
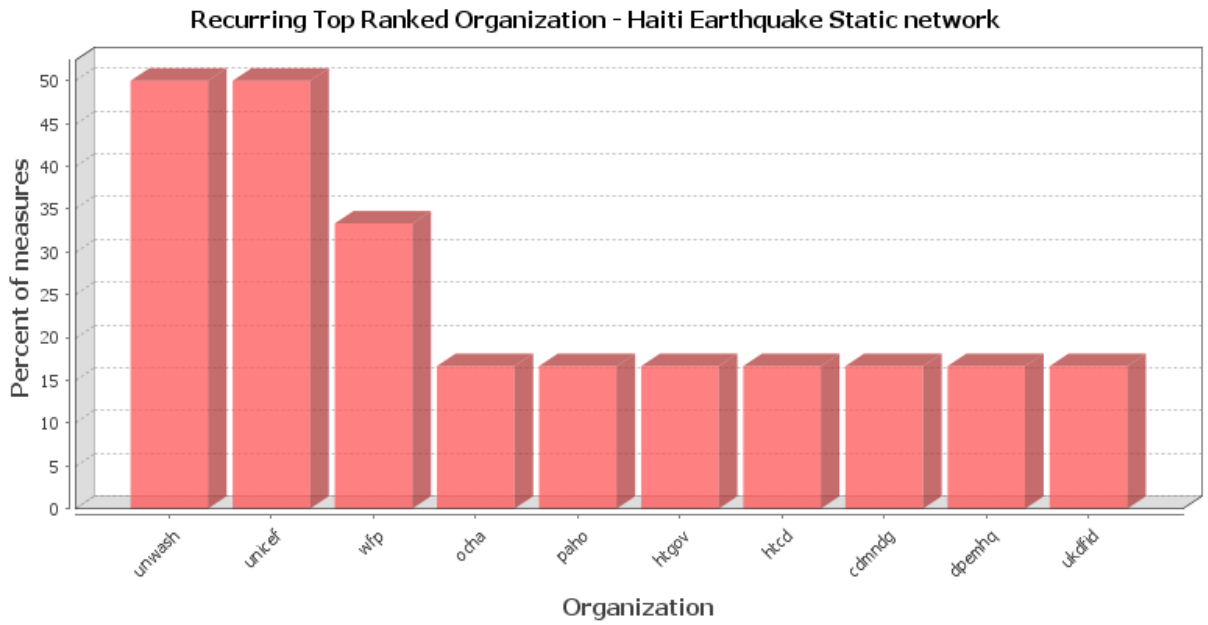


Figure 1: Static Network (Generated in UCINet; See Appendix 1 for Color and Shape Key)

Figure 1 visually depicts the results for the static network model for all the sitreps. After coding these data, CDM researchers identified 3142 unique dyads and monads, each representing a unique organizational action or interaction between two of the 532 organizations identified in the data. The color of each node in the network map represents its source of funding while the shape represents the jurisdiction. Jurisdictions are all based in reference to Haiti, meaning that Regional organizations pertain to the Caribbean region while organizations based outside of the region are considered to be "International," even if they do not operate worldwide. Appendix 1 contains the full list funding sources, jurisdictions, and the colors and shape used to represent each. The most striking feature of this map is its degree of fragmentation. As is typical, and which the CDM has observed in previous disasters, there is a single, large interconnected map that contains most organizations (Comfort *et al*, 2010). What is not typical is the amount of small side groupings that contain only one or two dyads. What is even less typical is the large number of isolates, the organizations that are not connected to any other organization in the network. These are the nodes organized in a list down the left side of the network map. Isolates are common in a response network (Comfort *et al*, 2010), but there are rarely this many of them. An organization this disconnected will have difficulty managing itself as the lack of linkages undermines the ability of organizations to learn from, and adapt to, each other's actions.

Figure 2: Most Central Organizations, Static Network (Generated in *ORA)

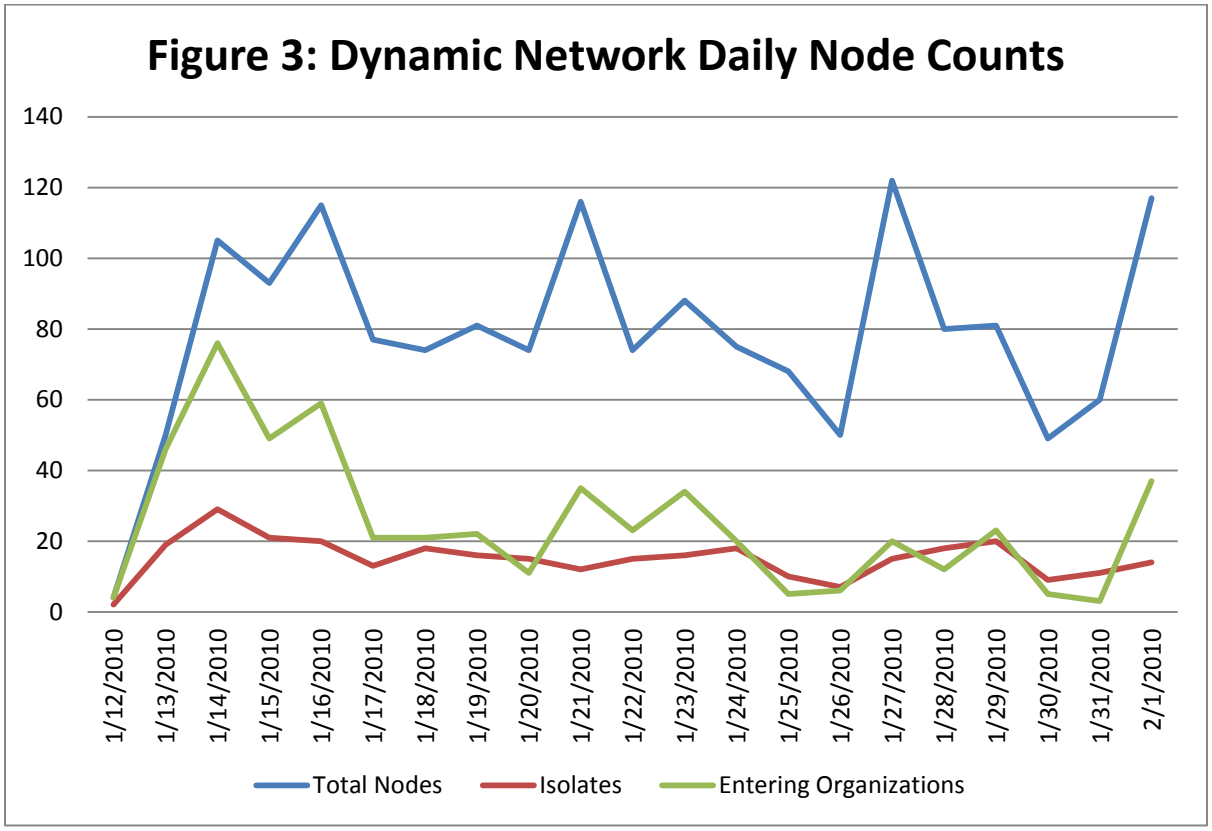


Using ORA, CDM researchers ran a "Key Entities" report, which calculates a set of centrality measures to identify which organization or organizations are the most connected. These organizations have the most ability to monitor and direct information flows and reach to other organizations to perform tasks and gain resources. The centrality measures taken in the Key Entities report are:

- Controlling Agency (total degree centrality)
- Inter-organization Leader (eigenvector centrality)
- Acts as a Hub (hub centrality)
- Acts as an Authority (authority centrality)
- Information Conduit (betweenness centrality)
- Connects Agencies (high betweenness and low degree)

Figure 2 presents the percent or measures for each organization in the figure that measured in the top ten organizations for each centrality measure. The acronyms used to identify each organization are included in Appendix 3, in a complete organization list. Under the cluster system's official organization, the lead organizations are UNOCHA and the Logistics Cluster. The data show that the most central organizations during the response were the WASH Cluster and UNICEF, closely followed by the World Food Program. UNOCHA only reaches a position where it is tied with several other organizations that are in the top ten of only 15% of the centrality measures.

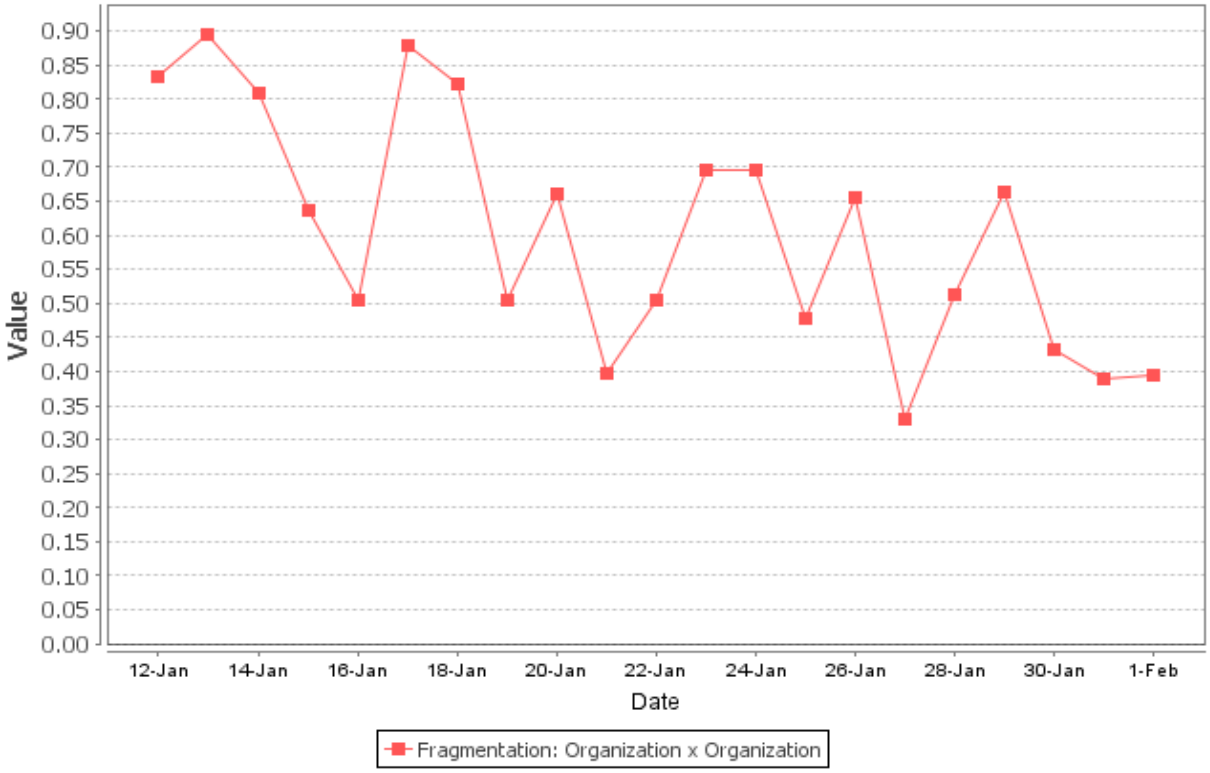
Dynamic Networks



The dynamic networks deepen the analysis just presented. A static network will look more thoroughly connected, and so have a higher network density than will the separate dynamic networks. All the connections that appear in any time slice of the dynamic network will appear in the single static map. This can give a false impression of the degree of connectedness by

showing connections between organizations that may only have occurred briefly and at widely separated time frames, limiting the amount of actual interaction. Figure 3 presents the basic node counts for each time slice, including the total number of nodes in each time slice, the number of isolates, and the number of new organizations that enter the system each day. The network maps for each time slice for the dynamic network analysis are contained in Appendix 2. These maps contain the same pattern of highly disconnected networks and a large number of isolates that are observed in the static map, and indeed, the separated network sections show even more clearly in the dynamic maps than the static map. Though using news reports from the Caribbean News Online, Figure 3 confirms the pattern of organizational entry into the system that Comfort, Siciliano, and Okada observed (2011), that is, an initial rush of organizations followed by a steady decrease in new organizations, representing a steady decrease in additional personnel, knowledge, and skills.

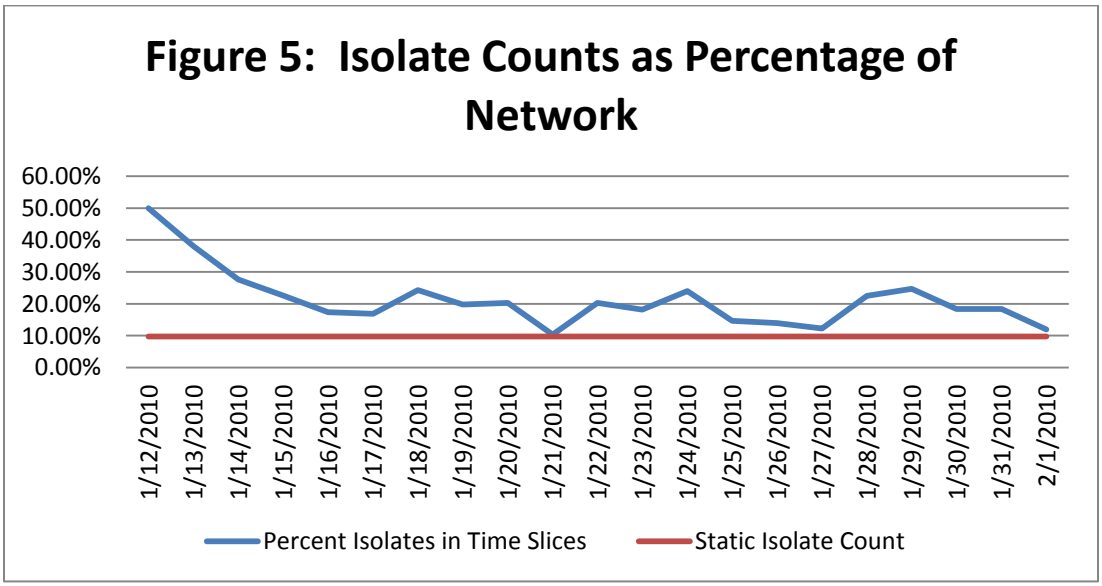
Figure 4 Network Fragmentation (*ORA)



Nevertheless, a continual measure of new organizations entering represents an expanding response system. Taken together, the network graphs and Figure 3 show that the total number of nodes in the main components of the networks remains roughly constant. The spikes tend to match rises in both new organizations and isolates in the first half of the response and large donor meetings in the second. The valleys in the number of nodes match to periods of few new organizations and smaller numbers of isolates. This suggests a pattern of organizational exit from the official coordination structures, even as the data shows that few organizations

completed their goals, when those actions included more than making statements of sympathy and support. The network interactions were coded by status of the task. A code of 7 indicated completion. Of 3088 organizational actions and interactions, only 650 entries recorded a completed action or interaction. Of those, the few that do not represent damage assessments or the initiating of a cluster primarily refer to opening refugee camps or the delivery of food, fuel, or medicine, and so represent the completion of the tasks necessary to perform other tasks.

Figure 4 shows the network fragmentation, the percent of nodes that are disconnected from the main portion of the network, for each time slice of the dynamic network, while Figure 5 provides the percentage of isolates for each time slice. In comparison, the fragmentation of the static network is 0.24, well below the lowest fragmentation of any time slice in the dynamic network. The static network has 52 isolates. Figure 5 shows that while this may be higher in absolute count than any time slice, the far greater number of organizations in the static network produces a smaller percentage of isolates, often much smaller, than are found in all of the time slices.



The time slices of the dynamic networks also show a similar pattern to the static networks in which organizations were most central, while showing the change across the time period of the response. Figure 6 presents the eigenvector centralities from the time slices of the dynamic network. This measure of centrality includes two parts: how many connections the given organization has to other organizations (degree centrality) and the degree centrality of the organizations to which that organization is connected. This allows for greater accounting for hierarchical network structures that commonly develop. Using a selection of the organizations that emerged in Figure 2, Figure 6 shows both the initial and continuing prominence of the WFP as a central organization, but also the emergence of PAHO and the UN WASH Cluster later in the response, and the episodic, but inconsistent centrality of UNOCHA.

On-Site Observations and Network Results

On-site observation took place during May, 2010. It involved attending cluster meetings at Logbase, and visiting and interviewing officials in the Haitian government and at Logbase to gain their insights and understandings of the response and reconstruction effort. Earlier publication documented the primary conclusions from this trip (Comfort *et al*, 2011a). Some of the observations bear repeating here. Two of the primary observations of this effort were the extremely rapid turnover in cluster leads and the separation between international responders, the Haitian government, and the Haitian population. In the network maps for both the static and dynamic networks, this pattern continues to hold. While few groups in the network map are completely homogenous, they do tend towards a being primarily from one jurisdiction or another. This is based on inspection of the patterns of the shape of the nodes (See Appendices 1 and 2.). At the same time, those organizations which are not public tend to group together and enter the network through only one or two public organizations. Similar to jurisdiction, this is based on pattern of color locations in the network maps (See Appendices 1 and 2.).

Figure 6: Eigenvector Centralities in the Dynamic Time Slices (*ORA)

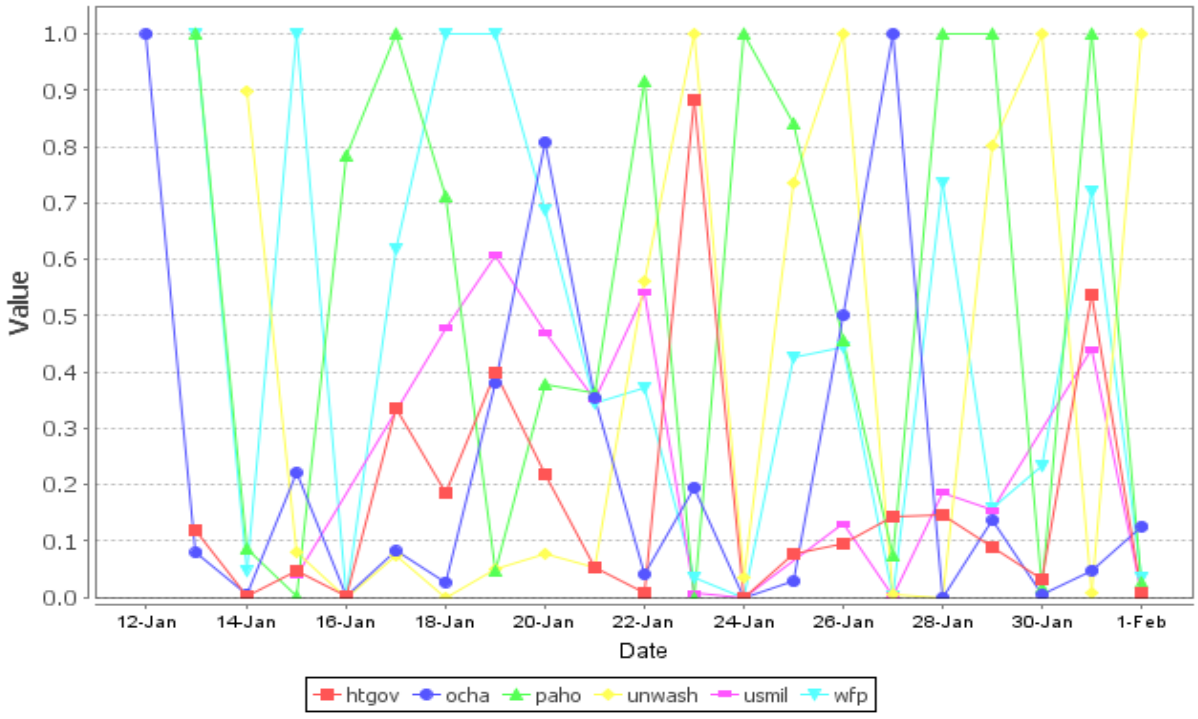


Figure 4 shows more than just the large proportion of isolates in the network. It shows the early pattern of a development of coordination. Through the first three weeks, the percentage of isolates first dropped towards the static percentage of isolates, and would approach that level three more times over the course of the response, even though it never reached it. This shows intervals of coordination, where organizations would coordinate every few days. This fits the pattern of cluster meetings at Logbase. Each cluster would meet once per week, providing for a

venue of mass coordination. Some clusters would take advantage of this, with organizational representatives making requests or announcing projects at the meetings. Others, however, spent the meeting discussing policies, often the most general of terms, such as agreeing to pay attention to issues of gender while mentioning no specifics.[5] Nevertheless, much of the content of cluster meetings was determined with documents that aid workers edited in advance and passed between each other using email and GoogleGroups. Even then, the aid workers, who quickly came to resemble "bureaucrats for hire," often took a surprisingly long amount of time to fill out documents and respond to email requests.

An example of this pattern occurred shortly after the CDM's reconnaissance trip to Haiti that illustrates common patterns in the response community, including another issue, the language divide. One cluster, attempting to coordinate aid projects, generated a word document where each member of the cluster was to fill in boxes indicating details of the project. The document was published to the membership through the GoogleGroup[6] with the request to the membership to complete it. The cluster leadership would then compile the response and send out a completed document. This was in addition to the on-going Consolidated Appeals Process documents which UNOCHA published, and was not for use with donor agencies, but only for the use of the cluster and its membership. After requesting for several weeks that organizations fill out the document, only a small fraction of the cluster membership returned any data. A partially completed document was published for the group, in French. No English-language version was ever compiled. Haiti is a French-speaking country, and earlier works have critiqued the over-reliance on English in the international response (Comfort *et al*, 2011a). Excluding English, however, particularly in the primarily English-speaking aid community commits the same sin as excluding French while working in a French-speaking country. Indeed, it may even be worse in this case, since it alienates much of the aid and donor community while still not being accessible to the majority of Haitians, who actually speak Haitian Creole, and not French.

Performance of Coordination and Communication through the Cluster System Following the Haitian Earthquake

The UN Cluster System anticipates and calls for UNOCHA and the UN Logistics Cluster to be the primary actors at the center of the system, who coordination the response and facilitate direct action, respectively. In Haiti, actual practice saw the lead for coordination and logistics shift from UNOCHA and the Logistics Cluster to the World Food Program, with PAHO, UNICEF, and the UN Water, Sanitation, and Hygiene Cluster emerging later in the response. This required organizations to adapt to more than just the changing needs of the crisis, but to new patterns and policies for any coordination they might attempt. The fragmentation of both the static and dynamic networks and the high number of isolates suggests that many organizations were unable to adapt to new communication and coordination procedures.

[5] This occurred at one cluster meeting, directly observed by an author of this paper.

[6] An author of this paper had joined the group as part of observing and monitoring the response efforts and so received this document directly throughout its lifespan.

Many organizations did not take part in the cluster system. Some of their actions are recorded in the various sitreps published on ReliefWeb, or they would have been left out of this analysis. They emerged as the unusually high portion of isolates in both the static and dynamic networks. Despite the essentialness of communication and coordination to be effective (Hutchins, 1995, Comfort, 1999), these isolates took part in the coordination. Still other organizations, either unable or unwilling to pass through the security checks at Logbase, or simply too small to be noticed or too cutoff to reach internet-based communications, were completely overlooked by any part of the central international response and its efforts to register all the aid actors that were either already present in Haiti at the time of the earthquake or entered following the earthquake. The steady number of organizations in the system, despite a continual flow of newly-entering organizations, suggests that many others were unable to maintain communication and coordination in the field, indicating that the communication system did not meet the challenges which conditions in Haiti imposed on the response.

When coordination did occur, its content was often unproductive or untimely. Events change faster than weekly meetings can often accommodate. Wide-spread internet communication between meetings can mitigate that delay, but only if the communication carries the proper information, focusing on organizational activities and coordination, and can reach all the actors, including those in the field, who need the information. All too frequently this did not occur, leaving the clusters as slow to respond and all too often not responding effectively. At the same time, many organizations did not attempt to coordinate, leaving them operating without sufficient knowledge of their context to respond effectively, if at all, to changes in the environment, events, and needs. The data show that this information was available on ReliefWeb and OneResponse, while the data also show that few organizations made full utilization of that data, as shown by the gaps in the networks. As a result, the organizations involved in the response were unable to form any kind of common operating picture. Without a common operating picture, the organizations involved could not adapt properly and so were left on their own to face vast challenges posed by both the earthquake and the operating environment.

The data used represents the official record of communication and coordination. It does not include informal communication and coordination that can and does happen between organizations in the field and alongside formal meetings. This informal communication could still be bridging gaps in the formal record and improving communication and coordination (Comfort, Wukich, Scheinert, and Huggins, 2011). However, the data do not record this, so no assessment can be made. Often, this informal communication goes entirely unrecorded, making analysis of it nearly impossible. Some may be captured in newspaper reports, so that future research will combine the official record analyzed here with the news report data that Comfort, Siciliano, and Okada (2011) analyzed. It will then compare the analyses from both sitreps and news reports with the data from both sources to determine if informal communication filled gaps in the formal communication and coordination practices.

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