

Humanitarian Interorganizational Information Exchange Network: How Do Clique Structures Impact Network Effectiveness?

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Abstract Humanitarian information coordination and sharing continue to challenge the international community. Interorganizational networks are believed to be a way to improve coordination and collaboration among humanitarian organizations. Although researchers have devoted a considerable amount of time exploring the influence of network structure on network performance and effectiveness, little work has been done in the humanitarian relief field. We use the theoretical lens of social network to investigate the relationship between network cliques and network effectiveness. Data were collected through multiple sources among members of GlobalSymptoNet, a community of humanitarian organizations engaged in humanitarian information management and exchange. Our findings suggest that, similar to the public health service delivery sector, network effectiveness can be explained by network integration and network cliques in the humanitarian relief field. We discuss these findings and provide some implications of our research in designing interorganizational networks within the humanitarian relief field.

Résumé Dans un contexte où la coordination et le partage des informations humanitaires continuent de poser un problème à la communauté internationale, les réseaux interorganisationnels sont pressentis comme un moyen d'améliorer la coordination et la coopération entre organisations humanitaires. Bien que les chercheurs aient consacré un temps considérable à l'exploration de l'influence de la

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structure des réseaux sur leurs performances et leur efficacité, le domaine de l'aide humanitaire reste peu étudié. Le crible théorique du réseau social est ici utilisé pour examiner la relation entre les cliques dans les réseaux et l'efficacité desdits réseaux. Les données collectées proviennent de multiples sources parmi les membres de GlobalSympoNet, une communauté d'organisations humanitaires impliquée dans la gestion et l'échange d'informations humanitaires. Nos résultats suggèrent que, dans le domaine de l'aide humanitaire comme dans celui de la fourniture de services publics de santé, un lien peut être établi entre l'efficacité d'un réseau d'une part, et d'autre part son intégration et ses cliques. Nous examinons ces résultats et proposons des pistes issues de nos recherches pour la conception de réseaux inter-organisationnels dans le domaine de l'aide humanitaire.

Zusammenfassung Die Koordinierung und Weitergabe von humanitären Informationen stellen weiterhin ein Problem für die internationale Gemeinschaft dar. Man glaubt, dass organisationsübergreifende Netzwerke ein Mittel sind, um die Koordinierung und Zusammenarbeit zwischen humanitären Organisationen zu verbessern. Zwar haben Forscher sehr viel Zeit damit verbracht, den Einfluss der Netzwerkstruktur auf die Netzwerkleistung und -effektivität zu untersuchen, doch im Bereich der humanitären Hilfe wurde bislang nur wenig Forschung betrieben. Wir verwenden die theoretische Linse des sozialen Netzwerks, um die Beziehung zwischen Netzwerkgruppen und der Netzwerkeffektivität zu untersuchen. Die Daten wurden aus mehreren Quellen von Mitgliedern des GlobalSympoNet bezogen, einer Gemeinschaft humanitärer Organisationen, die sich mit dem Management und Austausch humanitärer Informationen beschäftigen. Unsere Ergebnisse weisen darauf hin, dass, ähnlich wie im Bereich öffentlicher Gesundheitsdienstleistungen, die Netzwerkeffektivität mittels der Netzwerkintegration und Netzwerkgruppen im Bereich der humanitären Hilfeleistung erklärt werden kann. Wir diskutieren diese Ergebnisse und erläutern einige Implikationen unserer Forschung für den Aufbau organisationsübergreifender Netzwerke im Bereich der humanitären Hilfe.

Resumen La información, la coordinación y el reparto humanitario continúan representando un reto para la comunidad internacional. Se cree que las redes interorganizativas son una forma de mejorar la coordinación y la colaboración entre organizaciones humanitarias. Aunque los investigadores han dedicado mucho tiempo a explorar la influencia de la estructura de red sobre el rendimiento y la efectividad de la red, poco trabajo se ha hecho en el campo de la ayuda humanitaria. Utilizamos la lente teórica de la red social para investigar la relación entre compadres de red y efectividad de red. Se recopilaron los datos mediante múltiples fuentes entre miembros de GlobalSympoNet, una comunidad de organizaciones humanitarias dedicada a la gestión e intercambio de información. Nuestros hallazgos sugieren que, de manera similar al sector de entrega de servicios sanitarios públicos, la efectividad de la red puede explicarse mediante la integración y los compadres de red en el campo de la ayuda humanitaria. Debatimos estos hallazgos y proporcionamos algunas implicaciones de nuestra investigación en el diseño de redes interorganizativas dentro del campo de la ayuda humanitaria.

Keywords Humanitarian interorganizational network · Humanitarian information exchange · Network clique · Multiplexity · Network effectiveness

Introduction

Although, in recent years, humanitarian information management and sharing has considerably improved because of significant development in humanitarian information management principles and systems (Van de Walle et al. 2009), humanitarian information sharing continues to challenge the international community (Maiers et al. 2005; Maitland et al. 2009; Bharosa et al. 2010). Humanitarian organizations require a wide variety of information, such as population displacement, relief expertise, disaster situation, availability and movement of relief supplies, and meteorological satellite images or maps (Zhang et al. 2002). The need for effective humanitarian information exchange is not just for supporting emergency response operations but, more importantly, it is for enhancing the capacity of the international community to respond to disasters before and after they occur.

Researchers have identified numerous humanitarian information management-related problems, including the quality and timeliness of information (e.g., De Bruijn 2006; Fisher and Kingma 2001), unpredictability of required information (Longstaff 2005), unwillingness to share (Ngamassi et al. 2011), mismatch in location, information overload, and misinterpretation of information (Bui et al. 2000; Saab et al. 2008). In addition to the challenges specific to information management, humanitarian organizations are also challenged by recognized problems facing most organizations (see Galbraith 1977; Ngamassi et al. 2011).

In an attempt to mitigate these challenges, organizations in the nonprofit sector, including the humanitarian field, are increasingly forming interorganizational collaborative networks (Guo and Acar 2005; Stephenson 2005, 2006; Arya and Lin 2007). Isett et al. (2011) define collaborative networks as “collections of governmental agencies, nonprofits and for-profits that work together to provide a public good or service when a single public agency is unable to create the good or service on its own and/or the private sector is unable or unwilling to provide the goods or services in the desired quantities” (p. 158). Massive international response to humanitarian crises, such as the South Asian Tsunami in 2004, Hurricane Katrina in 2005, and the Haiti earthquake in 2010, also highlights the importance of collaborative networks, especially in information management and exchange. Although an accurate census of these networks does not exist in the literature, several studies offer some insight into their growing presence (Guo and Acar 2005; Feiock and Andrew 2006; Jang and Feiock 2007; Arya and Lin 2007). Interorganizational collaborative networks are perceived to improve coordination and collaboration among organizations. Despite more than a decade-old call (O’Toole 1997; Provan and Milward 1995) to better understand the effectiveness of interorganizational networks in a nonprofit context, to date, limited research has been done (Provan et al. 2007).

The appeal for assessing the effectiveness of collaborative networks in a nonprofit context, specifically in the humanitarian relief field, appears to stem from several perspectives. First, apart from establishing the value of networking for a network member, evaluating the entire network has become increasingly important for all stakeholders who share a mutual interest in systematic efforts of the network (Sydow and Milward 2003). Second, evaluating the effectiveness of humanitarian interorganizational collaborative networks is critical for understanding whether networks are effective in meeting network goals as a whole, whether goals of individual network members or, more importantly, goals of the humanitarian relief field, and the extent to which the needs of the affected people have been met. Third, establishing the level of network effectiveness is also important for member organizations and those whose policies and funding support the network. Ideally, an effective interorganizational collaborative network would enhance the quality of service provided to its clients and optimize resource use by reducing redundancies. Finally, given the high failure rates reported by network researchers in both for-profit and the nonprofit sectors, organizations are often overly optimistic about the benefits of network participation (Barringer and Harrison 2000, p. 368). A thorough evaluation of networks could contribute to a more realistic attitude toward interorganizational networking (Sydow and Milward 2003).

In the existing literature on nonprofit interorganizational collaborative network research, only a few studies have investigated the effectiveness of these organizational forms (O'Toole 1997; Provan and Milward 1995; Provan et al. 2007; Lemieux-Charles et al. 2005; Arya and Lin 2007). Moreover, these few studies that have investigated the effectiveness of interorganizational collaborative networks in the nonprofit sector have been carried out in the health sector and concern health service delivery (Provan et al. 2007). In addition, almost all of these previous studies focused on networks of collocated organizations. Studies on the effectiveness of interorganizational collaborative networks in the domain of humanitarian relief are virtually nonexistent. Recent research in this domain provides a new context for the study of interorganizational effectiveness (Maitland and Tapia 2008; Maitland et al. 2008, 2009). These networks are formed and maintained with support from foundations and multilateral donors that provide funding for meetings, administration, report generation, and even research to define the barriers to coordination. Despite the recognized need for and support of such entities by the humanitarian relief community, there is little systematic analysis of their effectiveness, or, in other words, the extent to which they meet goals the network and its donors set out to achieve. This study is conducted in this new context.

We explore two-dimensional interorganizational collaborative networks in the humanitarian relief field using the theoretical lens of social network to investigate the relationships between network cliques and network effectiveness. Specifically, we use Provan and Sebastian (1998) clique analysis model. Data were collected through multiple sources among members of GlobalSymptoNet, a community of interest consisting of humanitarian organizations engaged in humanitarian information management and exchange. Network effectiveness was assessed using the

level of activity, measured as the number of funded projects. We used UCINET (Borgatti et al. 1999), a social network software, to analyze network data.

The rest of the paper is organized as follows: in the following section, we present a brief literature review on interorganizational network effectiveness in the nonprofit sector and delineate our theoretical framework. We then discuss our research method followed by our data analysis. The article ends with a discussion and conclusion section, followed by limitations and directions for future research.

Theory and Literature

Challenges Defining Network Effectiveness

The issue of the effectiveness of interorganizational networks is discussed at length in the literature. Much of these discussions highlight the difficulties of defining and assessing network effectiveness (Alter and Hage 1993; Provan and Milward 1995; Sydow and Windeler 1998). For example, Sydow and Windeler (1998) argue that, since establishing a shared understanding of effectiveness is already difficult for a single organization with a clearly identifiable center and a rather stable boundary, it is even more likely to be puzzling for interorganizational networks with several centers and more blurred boundaries. Researchers claim that what exactly counts as effective and which particular evaluating practices are really used depends on these stakeholders and their diverse interests.

For Provan and Milward (1995), assessing interorganizational network effectiveness is more complex than organizational effectiveness because of the involvement of multiple organizations in a network. Given that networks use multiple organizations to produce one or more pieces of a single service, making their evaluation to assess their effectiveness becomes more complex than that of a single organization.

Alter and Hage (1993) identify two other reasons why it is difficult to conceptualize the effectiveness of network systems. According to the paper, interorganizational networks go through phases. Each phase possesses a set of developmental tasks that must be accomplished before the next phase can be successfully entered. Evaluation of the network must be phase specific, or expectations will be inappropriately high. The second area of concern identified by Alter and Hage (1993) when assessing interorganizational effectiveness is the level of analysis. In network systems, even if it is possible to specify system level goals and objectives, one is faced with deciding the level at which the data will be collected. This is difficult because the production process is a hierarchy of cause and effect in a cybernetic process with changes occurring at different levels and the outcomes at each level acting as determinants for the next set of outcomes.

With all these difficulties in conceptualizing effectiveness in interorganizational networks, researchers provide a wide range of definitions for the concept. For instance, according to Goodman et al. (1977), interorganizational effectiveness should be conceptualized as an outcome but measured relative to the constraints that exist within the system. According to those authors, the expectation of what is a

reasonable outcome, given the context and barriers to goal achievement, is the best measure of effectiveness. Alter and Hage (1993) define effectiveness in interorganizational network as the perception among administrators and workers that their collective effort is achieving what it was intended to achieve, working smoothly and being reasonably productive. According to Sydow and Windeler (1998), interorganizational network effectiveness is an outcome and a medium of interorganizational practices. They claim that “network effectiveness can be defined as the viability and acceptability of inter-organizational practices and outcomes in the light of system requirements and powerful stakeholders, both of which are, of course, subject to change in the course of time” (p. 274).

All these definitions highlight, as mentioned earlier, the complexity of the concept of interorganizational network effectiveness, as it encompasses many different perspectives. In this article, we conceptualized network effectiveness as the level of activities. The most effective network is the one that displays the highest level of humanitarian activities.

Network Effectiveness in the Nonprofit Sector

Previous research has identified important antecedents of interorganizational network effectiveness (Provan and Milward 1995; Moscovice et al. 1995; Provan and Sebastian 1998; Schumaker 2003; Lemieux-Charles et al. 2005). For example, several authors (e.g., Provan and Milward 1995; Moscovice et al. 1995; Wright et al. 1995; Provan and Sebastian 1998) highlight the importance of the integration of network members to achieve network effectiveness. Provan and Sebastian (1998) argued that achieving integration across an entire network of organizations is difficult. Their findings also suggest that to be the most effective, clique integration must be intensive, involving multiple and overlapping relationships both within and across organizations that compose the network core. Similarly, network membership diversity is also deemed relevant by several authors (e.g., Moscovice et al. 1995; Schumaker 2003). Schumaker (2003), for example, found that effectiveness is influenced by external and internal factors that are operationalized through external control, technology, structure, and operational process variables. Other important effectiveness predictors include the degree of multiplexity in the network, revenue sources, and network duration. In Table 1, we present a summary of these studies.

Most studies in the literature on network effectiveness in the nonprofit sector pertain to health and human services. To our knowledge, only two studies in the specific field of humanitarian assistance—Stephenson (2005, 2006)—investigate humanitarian interorganizational network effectiveness. Stephenson (2005) identifies some of the reasons for interorganization coordination problems faced by humanitarian organizations and suggests ways to address these problems to achieve more effective humanitarian interorganizational networks. Stephenson (2006) contributes to the debate in the humanitarian community regarding how to make humanitarian assistance more effective. Overall, the two studies explore issues on how to make interorganizational humanitarian networks more effective. Our study differs from these two in that we empirically investigate the relationship between network structural properties and network effectiveness.

Table 1 Interorganizational network effectiveness in the nonprofit sector

Authors	Issues	Measures of effectiveness	Findings/outcomes
Provan and Milward (1995)	Develop a theory to assess network effectiveness	<ul style="list-style-type: none"> Perception of solving problems Building social capital Decrease service duplication Improve coordination Goal commitment 	<p>Networks are more effective when network integration is centralized, external fiscal control by the state is nonfragmented and direct, resources are sufficient, and the overall system is secure</p>
Moscovice et al. (1995)	Develop an approach to study vertically integrated rural health networks	<ul style="list-style-type: none"> Benefits and costs of health care provision to network's clients 	<p>Questions for further research</p>
Grusky (1995)	Assess networks' effectiveness of mental health care delivery networks	<ul style="list-style-type: none"> Service quality Coverage Comprehensiveness Coordination 	<p>The longer key interorganizational network agency directors have served, the more likely the care system was perceived as effective.</p> <p>The more powerful the lead agency relative to other organizations in the network, the more likely the system was perceived as effective</p>
Provan and Sebastian (1998)	Explore the use of clique analysis for explaining network effectiveness.	<ul style="list-style-type: none"> Client outcomes 	<p>Effectiveness was negatively related to the integration of full networks. In contrast, effectiveness was positively related to integration among small cliques of agencies when these cliques had overlapping links through both reciprocated referrals and case coordination</p>
Provan and Milward (2001)	Develop a framework to assess network effectiveness at three levels of analysis (community, network, and organization/participant)	<ul style="list-style-type: none"> Network membership growth Range of service provided Absence of service duplication Relationship strength (multiplexity) Creation and maintenance of network administrative organization (NAO) Integration/coordination of services Cost of network maintenance Member commitment to network goals 	<p>A framework with different effectiveness criteria depending on the level of analysis</p>

Table 1 continued

Authors	Issues	Measures of effectiveness	Findings/outcomes
Schumaker (2003)	Assess networks' outcomes of rural health care delivery networks	Gap between best possible and actual practice	Effectiveness increased with network connectivity, decision making methods, and pattern of service delivery. Centrality and network size decrease together where there is little reliance on vertical sources of funds Use the approach to evaluate the effectiveness of community health partnerships
Weech-Maldonado et al. (2003)	Develop an approach to assess network effectiveness (stakeholder accountability approach)	Perceived benefit to the various stakeholders of the network	
Lemieux-Charles et al. (2005)	Assess the effectiveness of community-based networks	Facilitate sharing Provide opportunity for share program Facilitate administrative information exchange	Perceived effectiveness increased with multiplexed ties among members of different groups within the network Perceived effectiveness related to the centralization of network structure
Lerch et al. (2006)	Study the emergence and overlap of organizational cliques in an optics/ photonics cluster in Berlin-Brandenburg		The paper applies a multi-level analysis that distinguishes the cluster level from network and clique levels and accounts for the recursive interplay between structural properties of these levels and how agents refer to them in interorganizational interactions. The paper used longitudinal data which allow for studying network dynamics
Arya and Lin (2007)	Assess the impact of organization characteristics and network structure characteristics on collaboration outcomes	Ability to obtain funding Ability to enhance reputation Ability to meet clients' needs	High-status organizations are able to derive critical resources from network involvement
Morehead (2008)	Assess networks' effectiveness of rural health care delivery networks	Perceived benefit Number of organizations added Number of service provided Existence of NAO	Financing was found to be the most important predictor of network effectiveness

Theoretical Framework

In this study, we use the theoretical lens of social network. Social network theories investigate relationship patterns among network members and structural network attributes (Wasserman and Faust 1994). The strength of a network can be measured through the commitment of network members to one another as reflected in their engagement in multiple types of links and exchanges (Provan and Milward 2001).

Social network research criticizes theories that seek to explain performance and effectiveness solely on the basis of unilateral profit-seeking behavior in a resource-based or competition-oriented environment (Granovetter 1985; Gulati 1995; Nohria 1992). Instead, social network researchers analyze interorganizational relationship structures and examine the impact of network-level structural and relational characteristics on organizational performance and effectiveness. A large body of literature applies social network theories to the study of interorganizational networks and effectiveness. Network structural characteristics (density, centrality, clique, and clique overlap) have been found to have implications on performance and effectiveness (Ahuja and Carley 1999; Tsai and Ghoshal 1998; Tsai 2000; Nohria and Garcia-Pont 1991; Provan et al. 2007).

Provan and Sebastian (1998) argued that network effectiveness may depend less on integration across a network (density) than to ties among a few organizations that provide the bulk of relationships and services. These ties are measured through cliques, which are groups of tightly connected organizations that form the microstructure of a given network boundary.

Because networks are seen as a valuable way to promote collaboration but are much more complex than a single organization, linking their structure to their effectiveness poses many challenges. Provan and Milward (2001) proposed a framework for evaluating network effectiveness criteria at three level of analysis: community, network, and organization or participant. For our study, we used the framework of Provan and Milward at the network level.

Research Design and Data

Research Site

The study was conducted among members of GlobalSympoNet, a community of interest in humanitarian information management and exchange (UNOCHA 2002, 2007a, b). GlobalSympoNet is spearheaded by the United Nations Office (UNO) for the Coordination of Humanitarian Affairs (UNOCHA). It began its activities in 2002 as a meeting of humanitarian information management professionals. This community of interest is made up of about 300 information technology (IT) and information management (IM) professionals from roughly 120 international and national organizations in the humanitarian assistance field. The goals of GlobalSympoNet include (i) fostering collaboration among members on humanitarian information management-related projects, (ii) disseminating best practices of information exchange, (iii) sensitizing its members on the critical aspect of

humanitarian information management preparedness, and (iv) facilitating head-quarter–field partnerships and advocating for more funding from donors for humanitarian information management-related projects. The research participants were representative of organization members of GlobalSympoNet who attended to at least one GlobalSympoNet meeting. UNOCHA provided us with the list of all the attendees of the various Global Symposium meetings. The members were almost all high ranked senior staff (e.g., CEO, CIO, IT Director) in their organizations.

Data Collection

We collected data through multiple sources, including surveys, interviews, and online database search. However, a survey instrument containing network-related questions was our main data collection source.

Surveys

We conducted a series of three surveys during October 2007, May 2008, and July 2009. Survey questions included the following four categories: (i) respondent's organization information; (ii) the GlobalSympoNet on Humanitarian Information Management community issues; (iii) GlobalSympoNet collaborative benefits and effectiveness; and (iv) community interorganizational networks. For questions concerning the interorganizational network, survey participants were provided with a list of GlobalSympoNet community members and were asked to identify (i) those with which they had collaborated on humanitarian projects and (ii) those with which they had advice relationships. We used the answers to this question to generate the GlobalSympoNet collaboration networks. Overall, representatives from 56 organizations answered the survey questions.

Interviews

From September 2009 to December 2009, we conducted 19 personal phone-based, semistructured interviews with organization representative members of GlobalSympoNet. Our intent was to supplement the quantitative survey data with a more detailed description and explanation of activities in the GlobalSympoNet community. Interview participants were asked to state the factors that influence their organization's decision to engage in collaboration with other organizations on humanitarian information management projects. A subsequent question focused on the participant's perception of GlobalSympoNet's effectiveness in meeting its goals. Each interview lasted between 45 and 90 min. The interviews were transcribed manually and coded both deductively and inductively (Epstein and Martin 2005).

Database Search

Our third data source was the ReliefWeb Financial Tracking Service (FTS). FTS is an online database which records all reported international humanitarian financial assistance (OCHA 2010). We collected data related to the funding amount raised

and the number of funded projects of organization members of the GlobalSympoNet community. In the humanitarian relief literature, data from the FTS database have been used in a number of academic work and reports to donors (e.g., Walker et al. 2005; Tomaszewski and Czárán 2009).

Network Structure Measures

Density

Kilduff and Tsai (2006) define density as the number of links between network members compared to the maximum possible number of links that could exist in the network. Researchers have used the concept of density in a number of interorganizational network studies and in various contexts (e.g., Brown and Ashman 1996; Provan and Sebastian 1998; Krackhardt 1999; Sparrowe et al. 2001; Reagans and Zuckerman 2001). For instance, findings from Brown and Ashman (1996) suggest that dense networks of local organizations indicate high levels of social capital. As it is the case in this study, the density of a network has also been used as a measure of network integration (Provan and Sebastian 1998).

Clique

A network clique consists of actors who all are interconnected but have no common links with anyone else in the network (Wasserman and Faust 1994; Kilduff and Tsai 2006). In an interorganizational network, cliques may form on the basis of shared demographic characteristics (Mehra et al. 1998). Cliques can also be created based on the provision of a certain set of services (Morrissey et al. 1994; Provan and Sebastian 1998). Studies on cliques in interorganizational networks have found that they can play important roles in the creation of positive outcomes (Provan and Sebastian 1998; Lerch et al. 2006).

Provan and Sebastian (1998), for example, found that network performance can be explained through the intensive integration via network cliques. Cliques facilitate learning and information sharing, which increases the performance of clique members as compared with non-clique members. Other benefits linked to clique membership relate to the faster pace at which information is exchanged within cliques (Pieters et al. 2009).

Multiplexity

Overlapping links or multiplexity refers to the extent in which clique members interact with members of other cliques through two or more different types of relationships (Kenis and Knoke 2002; Kilduff and Tsai 2006). Established research has shown that multiplex relationships impact network member behavior and performance through (i) a higher quantity and quality of information exchange (e.g., Galaskiewicz and Wasserman 1993; Uzzi 1997), (ii) a better coordination for joint problem solving (e.g., Uzzi 1997, 1999) and (iii) a greater reciprocity in relationships (e.g., Lazega and Pattison 1999).

In this article, we measured multiplexity as the extent to which organizations belonged to cliques in more than one relational dimension. We computed multiplexity as the percentage of organizations that were members in cliques in both advice and project collaboration dimensions. We also explored clique identical overlap. We calculated the degree of identical overlap as the percentage of cliques in the advice dimensions exactly matching (or completely embedded in) cliques in the projects collaboration dimension.

Network Effectiveness Measures

We assess network effectiveness using the level of activity measured as the number of funded projects. We consider that, the greater the number of funded projects in a network, the higher the level of activity and network effectiveness. We considered research subjects' opinions in our decision to choose this criteria for network effectiveness. For instance, during interviews, we asked research subjects about an appropriate measure of network effectiveness in their community. Below, we present some quotes from their answers.

Subject #10: I think you need to look at the level of coordination and funding. How much of funding have organizations successfully secured to work in this area? The extent to which there are working with other partners or coordinating.

Subject #11: It is probably easier to use the money which has been given because that will at least express a certain level of satisfaction of what we are doing. Because we are funded by volunteering contribution from donors.

Subject #18: I think for me, I would look at the number of implemented projects.

Analyses

For both theoretical and empirical reasons, we subdivided the GlobalSympoNet community into different subnetworks. Although members of the GlobalSympoNet are all interested in humanitarian relief and especially humanitarian information management and exchange, they theoretically differ on a number of characteristics, including their missions and goals, their sources of funding, and their mode of governance.

We identified in both network dimensions (project collaboration and advice), three subnetworks, including the non-governmental organizations (NGOs) subnet, the United Nations agencies (UNA) subnet, and the governmental organizations (GO) subnet. Separating network members into subnets and analyzing how they overlap can be an important means for understanding how the network as a whole is likely to facilitate or constrain certain actions of these members (Sydow and Windeler 1998). The three subnets were also identified based on UNOCHA categories of organization in the humanitarian relief field. We briefly describe below the general characteristics each organization's three subnetworks.

Non-governmental Organizations

NGOs are “private organizations that pursue activities to relieve suffering, promote the interests of the poor, protect the environment, provide basic social services, or undertake community development” (World Bank 2000). One of the long-established activities of these organizations is to provide humanitarian assistance. NGOs engage in two broad types of activities, including relief activities and development activities.

United Nations Agencies

The United Nations (UN) plays a vital role in humanitarian assistance. For this endeavor, the institution operates several major organizations. Five of these organizations are such visible players in the most complex humanitarian emergencies that describing their functions and mandates will describe most, if not all, of the operational work of the entire UN system in relief operations. They are the World Food Program, the Office of the United Nations High Commissioner for Refugees, the United Nations Children’s Fund (UNICEF), the United Nations Development Program (UNDP), and the UNOCHA.

Governmental Organization

GOs are owned by governments. GOs work to achieve the goals set by the government. These goals are often set for political reasons. The managers of these organizations are appointed by the government, and the government also provides the necessary resources to these organizations.

Network Effectiveness

Data on the number of funded projects were collected from the ReliefWeb FTS (ReliefWeb 2010). The ReliefWeb FTS is a UNOCHA web-based database which records all reported international humanitarian financial assistance (Table 2).

When using the number of humanitarian funded projects as measure for effectiveness, we found that the most effective network was UNA, followed by NGO and GO, respectively.

Table 2 Network effectiveness

Effectiveness measure	Networks			
	Governmental organizations ($n = 15$)	Non-governmental organizations ($n = 29$)	United Nations agencies ($n = 12$)	Total ($n = 56$)
Number of funded projects (from 1999 to 2009)				
<i>M</i>	141.47	166.48	601.58	253.02
<i>SD</i>	346.82	337.48	872.07	523.98
Ranking	3rd	2nd	1st	

Network Structural Characteristics and Network Effectiveness

Density and Network Effectiveness

Using the social network block model (Wasserman and Faust 1994), we found that these subnetworks presented diversified patterns of interorganizational relationships. The level of interorganizational relationships (measured as network density) ranged from 0.076 to 0.193 for project collaboration dimension and from 0.025 to 0.074 for the advice dimension. The UNA subnetwork displayed was the most strongly interconnected on both dimensions, followed by the NGOs subnetwork and, lastly, the GO subnetwork.

On the project collaboration dimension, for example, approximately twenty percent (19.30 %) of all possible project collaboration relationships between the organizations in the UNA subnetwork were actually found to exist. In contrast, only about eight percent (7.6 %) of all possible linkages between organizations in the GOs subnetwork were found to exist. On the advice dimension, these percentages were, respectively, 7.42 % for the UNA subnetwork, 2.92 % for the NGOs subnetwork, and 2.52 % for the GOs subnetwork. An examination of interaction level across the three subnetworks also showed a significant discrepancy for both project collaboration and advice dimensions of relationships. Figures 1 and 2 above depict these differences.

Clique and Network Effectiveness

Our first step in clique and clique overlap analyses was to determine the minimum set size of a clique. Apart from the study done by Provan and Sebastian (1998), there is no research in the literature that reports clique overlap analysis. Given this lack of information, we set the minimum clique size based on the data we had. Similar to

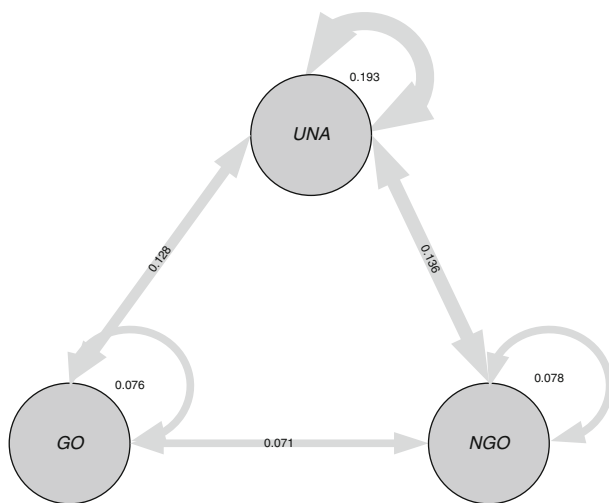


Fig. 1 Project collaboration relationship

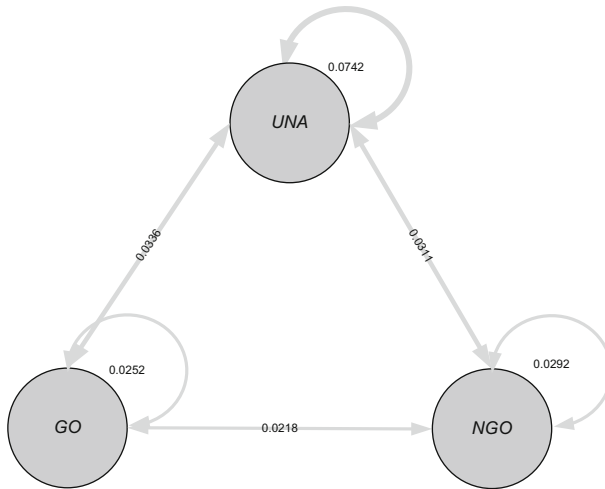


Fig. 2 Advice relationship

Table 3 Cliques characteristics for project relationship

Project network	Governmental organizations	Non-governmental organizations	United Nations agencies
Number of cliques	40	72	8
Min. size	3	3	3
Max. size	5	5	8
Average	3.825	4.014	5.375
SD	0.958	0.702	1.847
Clique members	35/53	55/72	14/25

Provan and Sebastian (1998), we assumed that the greater and more intensive integration within and across cliques would mean higher effectiveness levels. In a first step, we determined the clique size in all two dimensions that could be compared across the different networks. We began by generating lists of three, four, and so on actor cliques in all three networks. Tables 3 and 4 below present the general characteristics of cliques in the three networks and for the two dimensions we investigated.

We also noted that the six actor cliques did not yield the possibility to compare cliques and clique overlap in all dimensions within the rest of the three networks. Consequently, we set the minimum clique set size at five, even though there are larger cliques present in the networks (especially in UNA). Table 5 presents the number of cliques and the number of organizations within cliques for each of the networks. These results were obtained by calculating the number of cliques with five or more organizations. We then calculated the total number of organizations in each network involved in one or more of these cliques. The number of cliques on the multidimensional row was generated for each network by summing the results of the

Table 4 Cliques characteristics for advice relationship

Advice network	Governmental organizations	Non-governmental organizations	United Nations agencies
Number of cliques	20	57	8
Min. size	3	3	3
Max. size	5	5	7
Average	3.4006	3.6667	5.1250
SD	0.6806	0.6362	1.6421
Clique members	23/53	40/72	12/25

Table 5 Clique characteristics: minimum set size of five

Clique characteristics	Governmental organizations	Non-governmental organizations	United Nations agencies
<i>Number of cliques</i>			
Project collaboration	15	18	5
Advice	2	5	5
Multidimensional	17	22	8
Ranking	2nd	1st	3rd
<i>Number of agencies in clique</i>			
Project collaboration	14	24	11
Advice	6	9	10
Multidimensional	15	26	11
Ranking	2nd	1st	3rd

two dimensions (projects collaboration and advice) and subtracting the total number of identical cliques. We used the same method to calculate the number of organizations on the multidimensional row.

When analyzing these results, we made two observations. First, we found that, across the different networks investigated, NGO was the most integrated as measured by the number of cliques and the number of organizations in cliques. This finding may indicate a sort of cluster environment in which organizations knew each another and interacted frequently through collaborative projects and/or advice.

The second observation was that, at the multidimensional level, there was a similar ranking pattern of the networks using the number of cliques or the number of organizations in cliques. For both ranking criteria, NGO was first (22 cliques and 26 organizations in cliques), followed, respectively, by GO (17 cliques and 19 organizations in cliques) and finally UNA (8 cliques and 12 organizations in cliques). Exploring individual dimensions, the same ranking pattern held for project collaboration relationships. The ranking was different with regard to advice relationships. On this dimension, UNA was first both in terms of number of cliques and the number of organizations in cliques, followed, respectively, by NGO and GO.

Clique overlap and Network Effectiveness

One-dimensional clique overlap analysis explores one single type of interorganizational relationship at a time. We calculated clique overlap in several ways using Provan and Sebastian's (1998) procedure. We counted the number of times organizations in a particular relational type of clique appeared in at least n (n being a cut off number) cliques of that type and divided the result by dividing by the total number of organizations in cliques. The few previous studies in the literature that used this procedure (e.g., Provan and Sebastian 1998; Lemieux-Charles et al. 2005) set the cut number at 50 %. Unlike these studies, we explored four different levels (low, medium, and high) of clique overlap using, respectively, 25, 40, 50, and 75 % as cut off numbers (See Table 6). Low overlap would indicate that the members of these cliques interact intensively among themselves but interact very little across different cliques. In contrast, in a network with high clique overlap, many clique members would also belong to other cliques. This would lead to a highly integrated core of organizations spanning multiple cliques.

After a preliminary analysis of the results, we chose to use the lower level (25 %) of clique overlap in this study. The reason for this choice was threefold. First, the lower level (25 %) of clique overlap presented, overall, the highest percentage of clique overlap across networks and across the two dimensions of interorganizational relationships investigated. Second, we observed that the different networks maintained the same ranking irrespective of the level of clique overlap. On the project collaboration dimension, UNA came first, followed by GO and then NGO. On the advice dimension, the order was GO, UNA, and NGO for three levels of overlap (40, 50 and 75 %). At 25 % clique overlap was similar (100 %) in all of the

Table 6 Clique overlap

Clique characteristics: one-dimensional clique overlap			
Clique characteristics	Governmental organizations	Non-governmental organizations	United Nations agencies
75 %			
Project collaboration	3/14 = 21.43 %	2/24 = 8.33 %	3/11 = 27.27 %
Advice	4/6 = 66.66 %	3/9 = 33.33 %	4/10 = 40.00 %
50 %			
Project collaboration	3/14 = 21.43 %	3/24 = 12.5 %	7/11 = 63.63 %
Advice	6/6 = 100 %	4/9 = 44.44 %	6/10 = 60.00 %
40 %			
Project collaboration	5/14 = 35.71 %	4/24 = 16.66 %	10/11 = 90.90 %
Advice	6/6 = 100 %	7/9 = 77.77 %	9/10 = 90.00 %
25 %			
Project collaboration	8/14 = 55.14 %	5/24 = 20.83 %	11/11 = 100 %
Advice	6/6 = 100 %	9/9 = 100 %	10/10 = 100 %
Ranking	2nd	3rd	1st

networks. This meant that, working at this level, the differences in clique overlap among the networks at a multidimensional level could be assessed just using the project collaboration relationships. Analyzing the project collaboration relationships results, we observed a very high discrepancy in clique overlap scores across networks. These scores ranged from roughly twenty-one percent (20.83 %) to one hundred percent (100.00 %). UNA displayed the highest score (100.00 %) followed by GO (55.14 %) and, finally, NGO (20.83 %).

Multiplexity and Network Effectiveness

As discussed earlier, in this study, multiplexity indicates the level of overlap between the two different dimensions of networks. We measured multiplexity as the extent to which organizations belonged to cliques in more than one relational dimension. We computed multiplexity as the percentage of organizations that were members in cliques in both advice and project collaboration dimensions. We also explored clique identical overlap. We calculated the degree of identical overlap as the percentage of cliques in the advice dimensions exactly matching (or completely embedded in) cliques in the project collaboration dimension.

Table 7 below presents the results of these investigations. We found a high discrepancy in both the multiplexity and the identical clique overlap scores. With regard to multiplexity, scores ranged from approximately seventy percent (66.66 %) to ninety percent (100.00 %). UNA displayed the highest multiplexity scores (100.00 %), followed by NGO (77.77 %) and GO (66.66 %). Concerning identical cliques overlap, UNA was ranked first with a score of forty percent (40.00 %), followed by NGO (20.00 %) and GO (0 %).

As a final way of exploring the findings regarding clique structure and overlap, we generated a graphical representation of the clique structure for each of the three networks. Using the NetDraw function of UCINET (1991), we developed graphics of all clique members for each network. Figures 3, 4, and 5 represent these graphics. We used three different types of line, with each line representing one type of interorganizational relationship. Organizations that were members of a clique in the Project Collaboration relationship were linked by dotted lines. Members of a clique in an advice relationship were linked by dashed lines. Clique overlap, in which both relationship types occurred among clique members, was represented by a thick solid line. This line linked each pair of organizations for which overlap existed. Examining these graphics, it was clear that there were important differences in the overlap structures of cliques for each network.

Table 7 Multidimensional clique overlap

Clique characteristics: multidimensional clique overlap			
Relationship overlap	Governmental organizations	Non-governmental organizations	United Nations agencies
Multiplexity	4/6 = 66.66 %	7/9 = 77.77 %	10/10 = 100.00 %
Identical	0/2 = 0 %	1/5 = 20.00 %	2/5 = 40.00 %

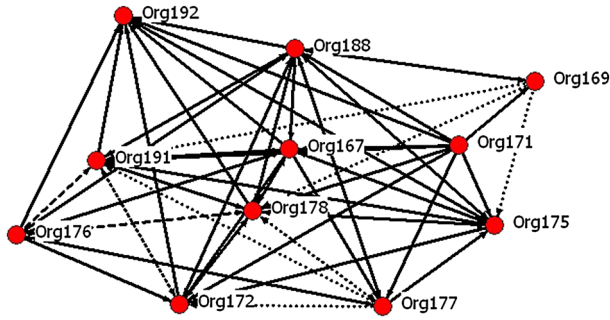


Fig. 3 United Nations agencies clique structure

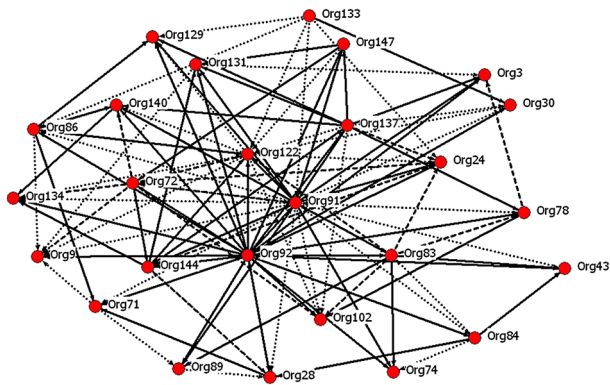


Fig. 4 Non-governmental organizations clique structure

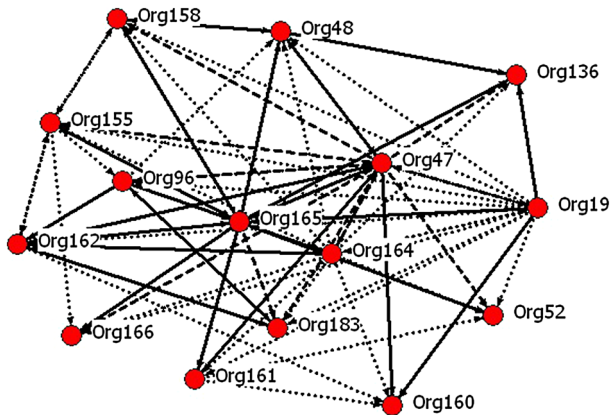


Fig. 5 Governmental organizations clique structure

Link overlap among clique members in UNA (Fig. 3) was substantial. All of the 11 clique-member organizations maintained at least one multiplex relationship (both project collaboration and advice) with another clique member. More than thirty-five percent (36.33 %) of organizations were connected exclusively through multiplex ties. Examining the effectiveness of these organizations, we found that they were among those that displayed the highest number of funded projects. For example, Org188 had 2,777 funded projects as compared with 601, the average number in the network. NGO (Fig. 4) had many more organizations (26) in cliques than the UNA. Similar to UNA organizations, organizations in NGO also maintained at least one multiplex relationship with another organization. In this network, only less than four percent (3.83 %) of the organizations had an exclusively multiplex relation. It was also found that these organizations were among the most effective in the network in term of number of funded projects. An examination of the last graphic (GO) depicted in Fig. 5, also revealed that many organizations were involved in cliques. In this network, however, the level of link overlap among clique members was lower than in the two previous networks. Approximately seven percent (6.66 %) of the organizations maintained only one type of relationship with other organizations.

In summary, we found that overlap in interorganizational relationships across cliques appeared to be important for explaining network effectiveness. Moreover, the specific composition of these overlapping cliques was also important, particularly when the cliques involved organizations, like the leading humanitarian organizations (e.g., Org188), that may be critical to overall network success.

Discussion and Conclusion

The purpose of our study was to provide some insights into the relationships between network clique structures and network effectiveness in the humanitarian relief field. We studied three humanitarian interorganizational networks of GlobalSymptoNet, a community of interest in humanitarian information management and exchange spearheaded by the UNOCHA. We explored three network structural properties, including network clique, clique overlap, and multiplexity.

Though it would be risky to generalize about research results from a sample of only three networks in a single area of humanitarian information exchange, our study contributes to the literature on interorganizational humanitarian networks in a number of ways. Building on Provan and Sebastian (1998), our study further highlights the need to consider network analyses in smaller substructures than what has been done previously. Large scale integration across an entire network of organizations is difficult to achieve and is probably not a very efficient way of organizing (Provan and Sebastian 1998). For instance, in the humanitarian relief field, disaster response often involves heterogeneous organizations, both for-profit and nonprofit, with a wide range of different characteristics. In this field, achieving effective interorganizational collaboration is more challenging, especially in regard to information management and exchange (Ngamassi et al. 2011; Maitland et al. 2009). As our research findings suggest, it is more appropriate to assess network effectiveness in smaller substructures such as subnets or cliques. These findings

derived from quantitative analysis corroborated with results from qualitative data. For instance, some interview participants reported that the large size of the GlobalSympoNet community would more likely negatively impact its effectiveness. Below, we provide illustrative quotes from Subjects #5 and #11.

Subject #5: There should be smaller groups that held very specifically with mixed of media communication people and these organizations perhaps have small groups that meets for one day but in a highly intensive manner, and really look at the issues maybe to review what happened in the last symposium, but reviewed this in a very pragmatic manner and a very outspoken critical manner as well.

Subject #11: May be a smaller group, because it was rather a large event, so maybe if you could do it regionally, let say one in Latin America, and another one in Africa or central Africa, west Africa, maybe that would be more effective, because you would have fewer participants.

The findings of our research also suggest that, similar to the public health service delivery sector, network effectiveness can be explained by network cliques in the humanitarian relief field. Our data supported the idea that differences in effectiveness across networks could be better understood by focusing on cliques and the overlap among cliques of multiple relationships among humanitarian organizations. Our study would assist with clique analysis or in searching for closely connected and cohesive subgroups. Additionally, our work can help to design efficient interorganizational network structures in the humanitarian relief sector. For example, by increasing the level of clique overlap in interorganizational humanitarian networks, network designers should expect a higher level of interorganizational collaboration.

By empirically testing Provan and Sebastian's (1998) conceptual framework for assessing network effectiveness, our study contributes to further research in interorganizational collaboration within the humanitarian relief field. During our investigations, we realized the importance of understanding the different types of relationships that exist among humanitarian organizations. We found that the relationships were significantly complex, especially when considering motive. Disaster response often involves heterogeneous organizations with a broad range of different goals, and need to render collaboration is very challenging. In our study, for example, when asked about their reasons for establishing a relationship, study subjects provided a wide range of different reasons. Network designers need to examine more closely the nature of relationships in which humanitarian organizations are engaged and the self-reinforcing dynamic of overlapping groups.

Our research also highlights the need to explore network effectiveness using a set of different measures. The majority of existing work on network effectiveness, including that of Provan and Sebastian (1998), was conducted using one measure. Moreover, in most cases, the effectiveness measure was not selected with input from the various network members. In our study, we used input from network members to determine the three measures of effectiveness. Using a set of three different measures for network effectiveness allowed us to find a consistent ranking pattern for each of the six network structural characteristics studied. Our findings suggest

that the subjective and objective forms of network effectiveness are better explained by different network structural attributes. Whereas subjective network effectiveness is better explained by the number of cliques and clique membership, objective network effectiveness is better explained by the multifaceted nature of interorganizational relationships as measured by clique overlap and multiplexity. Our study serves as an example of effectiveness being measured with multiple criteria. Overall, our work extends in the humanitarian relief field and Provan and Sebastian (1998)'s model of interorganizational network effectiveness.

Finally, the results of our research also point to some important implications for the humanitarian relief field. The analysis of our interview data also helped to identify two important network characteristics we believe should be considered when designing interorganizational networks in the humanitarian relief field.

Sharing Spirit

Organization members of a network must possess a high level of sharing spirit. Members of a network need to be open, willing and able to learn from each other (Liebler and Ferri 2004). In our research, the lack of sharing spirit was consistently reported as one of the biggest problems that undermines network effectiveness.

Subject #13: I think the main challenge here is that the idea of sharing formation has always been said in many areas. It is usually always said yeah it is good to share but you do not sometime see concrete platforms or formalities on how to share this information. It is not formalize. It is always thought as an objective but never formalize.

Network members must feel confident enough about what they do and the information they possess that they are willing to share with others. Networks and partnerships are more likely to become effective when they are founded by members that share a history of working together, that know each other and have relationships characterized by mutual trust. This suggests that networks may have a longer incubation and startup period before they can reach the stage of maximum effectiveness.

Capacity to Contribute

Organization members of a network must have the capacity to contribute in the activities of the network. Members can contribute especially in terms of skill sets and/or money. In our study, the ability of a potential network partner to contribute was reported to be one of the main collaboration factors.

Subject #1: I think we have a fairly good rumor of what we do is useful is useful and it is good quality so in terms of being approached by the people that would like to collaborate with us, we seem to be of interest to quite a few entities.

Subject #2: Both [organizations] have to be able to bring to the table their competitive advantage. You can't have two organizations that do the same thing. So you need different skills set from any of the organizations.

Limitations and Further Research

The first limitation to our research networks relates to the survey sample. The survey participants were not selected through any scientific sampling technique. Rather, the survey was conducted on a sample defined by UNOCHA, thereby generating an organizational bias. Also, owing to the low response rate relative to the number of potential collaboration partners, connections in the network are not necessarily reciprocal. That is, if only one of the two organizations indicated a relationship, we counted this connection. Thus, the analysis favors inclusion over validity. The most obvious and probably the most serious shortcoming of the research is the small sample size, which is, unfortunately, a common problem when the unit of analysis is an organizational network. Our study involved only three networks, which can create an important problem with regard to generalizing our findings. Moreover, it is certainly possible that the network effectiveness measures used, which were tied to individual organizations, did not accurately reflect network effectiveness at each network.

The results of our research point to several suggestions for future research and theory development. First, further research is needed to determine (i) the conditions under which improving relationships among humanitarian organizations will lead to better network effectiveness and (ii) the extent to which a formal network structure facilitates interorganizational interactions, thus leading to better network effectiveness. Second, network researchers should consider the role of strongly connected and overlapping cliques of organizations rather than focusing solely on full network integration, particularly when attempting to explain network-level outcomes or effectiveness. Finally, it seems important to measure and analyze clique overlap using complementary linkage mechanisms, like the project collaboration and advice relationships that we studied. If clique overlap is to have an impact on effectiveness, it is likely to be through multiple links that build and reinforce competencies rather than through links that only contribute superficially to organizational outcomes.

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