
Humanitarian information exchange network: why do international humanitarian organisations collaborate?

Louis-Marie Tchouakeu Ngamassi*,
Kang Zhao, Edgar Maldonado,
Carleen Maitland and Andrea H. Tapia

College of Information Sciences and Technology,
The Pennsylvania State University,
332 Information Sciences and Technology Building,
University Park, PA 16802-6823, USA
Fax: 814-865-5604

E-mail: ltchouakeu@ist.psu.edu

E-mail: kxz134@psu.edu

E-mail: emaldonado@ist.psu.edu

E-mail: cmaitland@ist.psu.edu

E-mail: atapia@ist.psu.edu

*Corresponding author

Abstract: While in recent years research has highlighted the rise of inter-organisational collaboration among organisations in the non-profit sector and has documented issues related to forming and maintaining of these relationships, there is little known about inter-organisational humanitarian information exchange and especially the motives of collaboration. In this paper, we examine collaboration relationships among organisations member of a community of interest in humanitarian information exchange. We use the social network block-model method to analyse collaboration network data collected from 35 international organisations. Six strongly connected clusters are identified in the community. Evaluating reported reasons for these collaborations, we find that the two main motivations are related to relational characteristics of organisations, which interestingly are the most and least reported reasons in two of the most densely connected clusters of relationships. These findings are discussed through the lenses of resource dependency and network structural equivalence.

Keywords: inter-organisational network; humanitarian organisations; social network; collaboration; network clusters; humanitarian information.

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Biographical notes: Louis-Marie Tchouakeu Ngamassi is a PhD student in the College of Information Sciences and Technology at Penn State University. His research focuses on information and communication technology (ICT) use for inter-organisational coordination and social networks among humanitarian organisations.

Kang Zhao is a PhD student in the College of Information Sciences and Technology, the Pennsylvania State University. His current research interests include complex networks, computational social and organisational simulations, social computing, and agent-based systems.

Edgar Maldonado received his PhD from the Pennsylvania State University. His research interests are national-level information and telecommunication policies specifically directed at how the development and use of open source technologies can positively impact the public, private, and voluntary sectors.

Carleen Maitland is an Associate Professor in the College of Information Sciences and Technology at Penn State University. Her research focuses on inter-organisational coordination across multiple forms of organisations, both non-profit and for-profit, focusing on the technologies that support and hinder such coordination.

Andrea Tapia is an Associate Professor in the College of Information Sciences and Technology at Penn State University. Her research focuses on the functional and structural elements of organisations engaging in technological change and coordination across boundaries.

1 Introduction

International response to humanitarian disasters such as the 2010 Haiti earthquake depends highly on information. In humanitarian relief operations, organisations deal with information that is multi-sector, multi-dimensional, multi-source, and usually non-standardised. In recent years as the number and complexity of man-made and natural disasters has risen, so has the need for resources including information. This rise in the number of disaster has also led to more inter-organisational collaboration especially in information management (IM) and exchange. Inter-organisational information sharing has become increasingly important to the humanitarian relief sector (Wentz, 2006; Comfort, 1993). Though humanitarian IM has improved in recent years, some constraints continue to handicap inter-organisational humanitarian IM and exchange (Wentz, 2006; Maiers et al., 2005; Bharosa et al., 2010).

Researchers have identified numerous humanitarian IM 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., 2010), and mismatch in location, information overload, misinterpretation of information (Bui et al., 2000; Saab et al., 2008). In their investigation of the challenges and obstacles in sharing and coordinating information during multi-agency disaster response, Bharosa et al. (2010) identified three different levels of obstacles that challenge information sharing. They include community, organisational and individual levels. According to Galbraith (1977), the information issues in inter-organisational collaboration are closely related to the issue of uncertainty, with higher levels of uncertainty requiring greater amounts of information to be processed by decision makers. In addition to the challenges specific to humanitarian IM and exchange related problems, humanitarian organisations are also challenged by what are recognised as problems facing most organisations (see Galbraith, 1977; Ngamassi et al., 2010).

In an attempt to mitigate these challenges, humanitarian organisations are increasingly collaborating through coalitions, alliances, partnerships, and networks, both within and across the sector (Guo and Acar, 2005; Stephenson, 2005, 2006; Arya and Lin, 2007). Though an accurate census of these humanitarian collaborative entities does not exist in the literature, several studies offer some insight into their growing presence (Saidel and Harlan, 1998; Stone, 2000; Moore et al., 2003; Guo and Acar, 2005; Stephenson, 2005, 2006; Feiock and Andrew, 2006; Jang and Feiock, 2007; Arya and Lin, 2007).

Only a small number of these studies focus specially on inter-organisational collaboration in the special conditions that exist in the humanitarian field (Stephenson, 2005, 2006). In addition, in the existing literature on humanitarian inter-organisational collaboration research, little is known about inter-organisational humanitarian information exchange and especially the motives of collaboration. Moreover, the literature on inter-organisational collaboration shows that resource dependence theory (Pfeffer and Salancik, 1978) and transaction cost theory (Williamson, 1991) has been the most widely used theories to explain collaborative relationships. Resource dependence theory deals with, among other aspects, resource scarcity as a motivator for meeting these needs through collaboration, but with an accompanying concern about the potential loss of autonomy and power to the resource provider (Pfeffer and Salancik, 1978). According to the resource dependence theory, inter-organisational relationships are formed as a consequence of efforts made by organisations to manage external dependencies on resources. The transaction cost theory looks at inter-organisational collaboration as a way to reduce transaction costs and maximise gains. Despite their popularity in inter-organisational research, these theoretical perspectives have weaknesses that have been documented in the literature. They have for example been criticised for not paying sufficient attention to environmental constraints as well as other contextual and organisational process factors (Galaskiewicz, 1985; Oliver, 1990; Cigler, 1999). Such oversight is even more problematic in the humanitarian collaboration context where the environment can be very dynamic.

Drawing upon two main theoretical concepts including exchange relationship (Levine and White, 1961) and social network structural equivalence (Burt, 1976, 2008; Wasserman and Faust, 1994; Kilduff and Tsai, 2003), this study aims at providing some insights on inter-organisational collaboration in humanitarian information sharing. To this end, we explore collaboration relationships among organisations/agencies member of a community of interest in humanitarian information exchange. Especially, we investigate the patterns of interconnections among organisations/agencies in the community and seek to understand the reasons that explain these collaboration patterns. We collected data through interview and a survey among organisations/agencies member of the GlobalSympoNet¹, a United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA) sponsored community of interest on humanitarian IM. We used the network block-model method (Lorrain and White, 1971; Breiger et al., 1975; White et al., 1976) to analyse the data collected. This study is part of a larger research agenda that seeks to understand how humanitarian organisation/agencies can organise themselves to promote higher levels of collaboration and coordination particularly in the domain of information and communication technologies.

The rest of the paper is organised as follow: in the following section (Section 2) we present a brief literature review on inter-organisational collaboration in the non-profit sector. In Section 3 we discuss our analytical framework. Method and data are described

in Section 4. The data analysis is presented in Section 6 followed in Section 7 by a discussion and the conclusions.

2 Inter-organisational collaboration in the non-profit sector: a brief literature review

According Wood and Gray (1991), inter-organisational collaboration takes place when organisations share authority and responsibility for planning and implementing an action to solve a problem. Stakeholders “engage in an interactive process, using shared rules, norms, and structures, to act or decide on issues related to that domain” [Wood and Gray, (1991), p.146]. In their discussion of inter-organisation collaboration, Guo and Acar (2005) define non-profit collaboration as what occurs when different non-profit organisations work together to address problems through joint effort, resources, and decision making and share ownership of the final product or service. The potential gains from inter-organisational collaborations, especially those occurring within inter-organisational networks, include economic efficiencies, more effective response to shared problems, improvements in the quality of services delivered to clients, the spreading of risks, and increased access to resources (Guo and Acar, 2005; Gazley, 2008). There is concurrently, an increasing number of research addressing issues involved in forming and maintaining these inter-organisational collaborations (e.g., Milne et al., 1996; Austin, 2000; O’Regan and Oster, 2000; Guo and Acar, 2005; Gazley and Brudney, 2007; Jang and Feiock, 2007).

Studies are also accumulating on the benefits and cost related to inter-organisation collaboration in the non-profit sector (e.g., Feiock and Andrew, 2006; Jang, 2006; McGuire, 2006; Gazley and Brudney, 2007; Jang and Feiock, 2007; Gazley, 2008). Inter-organisational collaboration benefits include benefits to the individual members of the network (e.g., the ability to address shared problems more effectively, the potential for cost savings and organisational learning), benefits to the clients of members of the network (e.g., the higher quality service or end product) and benefits to the community as a whole. According to Jang and Feiock (2007), inter-organisational collaboration among non-profit organisations has the potential to enhance service to clients. They argue that inter-organisational collaboration is beneficiary to non-profits because it allows them to share the risks associated with service production and delivery. Gazley (2008) identifies five potential gains that non-profit organisations could reap from collaborating. They include

- 1 economic efficiencies
- 2 more effective response to collective problems
- 3 improvements in the quality of services
- 4 the spreading of risks
- 5 increased access to resources.

According to Jang (2006) collaboration with governments, other non-profit or private organisations is an attractive option especially when non-profits face transaction cost.

The major constraints and costs involved in inter-organisational collaboration in the non-profit sector have also been intensively documented in the literature (Gazley and

Brudney, 2007; Ngamassi et al., 2010; Maitland et al., 2009). They include loss of autonomy, financial instability, difficulty in evaluating organisational results, and the opportunity costs from the time and resources devoted to collaborative activities. Non-profit inter-organisational collaboration must also contend with problems related to conflict of interests among organisations and coordination cost in terms of resource inputs, especially staff-time (Ngamassi et al., 2010). According to Jang and Feiock (2007), the costs of inter-organisational collaboration tend to be individual to organisations that participate in collaborative efforts while the benefits tend to be collective. They assert that non-profits are confronted with a collective action problem because the benefits of collaborative services are diffused and difficult to measure for individual organisations, but many of the costs are borne by individual organisations.

This vast and growing literature in the non-profit sector is however silent in investigating the motives of humanitarian inter-organisational collaboration especially with regards to humanitarian information exchange. The objective of this paper is to contribute to the literature by providing some insights on this aspect of collaboration among non-profit organisations in the humanitarian sector. Our research question is twofold. It is framed as follows:

- 1 What are the characteristics of interconnections among organisations/agencies which are members of a network of humanitarian information sharing?
- 2 What are the major reasons that can explain inter-organisational collaboration patterns observed in a network of humanitarian information sharing?

We discuss below the analytical framework used in the paper. We draw upon network analysis and exchange theory. Network analysis coupled with the theory of exchange provided the framework for our consideration of the relationships within the network. Network analysis captures the embedded nature of a network's organisational actors and structural element (Brass et al., 2004). It focuses on patterns of communication and information flows without placing value on the nature of the exchanges. The theory of exchange, meanwhile, assumes that the ties between organisations consist of exchange relations of valued items and that what matters is the value of the items (Levine and White, 1961; Provan and Milward, 1995). When combined, network analysis and exchange theory permit to understand more fully the relationships that exist and the nature of these links.

3 Analytical framework

3.1 Exchange theory of inter-organisational collaboration

One of the approaches that inter-organisational researchers have been using to study inter-organisational relationships is the exchange perspective (Levine and White, 1961; Provan and Milward, 1995). The exchange theory conceptualises inter-organisational collaboration more broadly, as to compare with the perspectives of resource dependency and transaction costs theories. This theory posits that organisations get involved in relationships when there is a perception of mutual benefit for interacting. According to Levine and White (1961), exchange among organisations does not necessarily involve elements of economic value. They assert that part of the exchange process is the

development of consensus among organisations. The issue of consensus is especially in humanitarian information sharing. For example, organisations need to agree on a set of information standards. In addition to explaining the motivations for inter-organisational relationships, the exchange approach also implies that the nature of the interactions between participants in these relationships is characterised by a high level of collaboration (Schmidt and Kochan, 1977).

3.2 Network structural equivalence

According to the concept of structural equivalence, organisations which have the same or similar ties to others tend to be equivalent in terms of their potential to act in the network (Burt, 1976; Lorrain and White, 1971; Wasserman and Faust, 1994; Kilduff and Tsai, 2003). Structural equivalence also takes into account the pattern of connections among all members of the network. Unlike the clique detection methods which are based on relations among members of the sub-group, this approach detects subgroups based on their similar patterns of relations with other members of the network (Wasserman and Faust, 1994; Kilduff and Tsai, 2003). Members of a network are put in a structurally equivalent group when they have comparable patterns of linkages with other members of the network, even if they do not maintain relations with one another (Lorrain and White, 1971).

Central to structural equivalence analysis is the concept of distance (Burt, 1976). Using the structural equivalence criterion, distance between network members is measured by the degree of similarity in their patterns of interaction: The greater the similarity, the shorter the distance. If two members have exactly identical patterns of relations with other members, their distance from each other is zero. The greater are the differences in their patterns of interaction, the greater is the distance between them. In a nutshell, the goal of structural equivalence analysis is to simplify the structure of relations in a network so that it is possible to understand the various kinds and patterns of interactions occurring in the network.

4 Research methodology

We used CONvergence of iterated CORrelation (CONCOR) a social network block-model method for our investigation. Network analysis is becoming increasingly popular for understanding complex patterns of relationships. The network perspective examines actors which are connected directly or indirectly by one or many different relationships. Regardless of unit level, network analysis describes structures and patterns of relationships and seeks to understand both their causes and consequences. We chose to use CONCOR because we believe that this network block-model method suits quite well with the purpose of our investigation. Moreover, in the literature, CONCOR is one of the earliest and most used approaches to partitioning actors into positions based on structural equivalence. This method was first used by Breiger and colleagues in the 1970s for analysing social network (Breiger et al., 1975; White et al., 1976). Since then, CONCOR has been used extensively in network research in many fields (Breiger and Ennis, 1979; Knoke and Rogers, 1979; Van de Ven et al., 1979; Friedkin, 1984; Anderson and Jay, 1985; Gerlach, 1992; Barnett and Danowski, 1992; Ashton, 2008).

4.1 *Research site*

We analyse data drawn from the GlobalSympoNet inter-organisational project collaboration network (Maitland and Tapia, 2007a, 2007b, 2008). The GlobalSympoNet is a UNOCHA sponsored inter-organisational community for humanitarian IM. The GlobalSympoNet began its activities in 2002 as a meeting of humanitarian IM professionals. This community of interest is made up of about 300 information technology (IT) and IM professionals from roughly 120 international and national organisations in the field of humanitarian assistance. Most of these professionals occupy high ranked position (e.g., Chief Executive Officer, Chief Information Officer) in their organisation. The goals of the GlobalSympoNet include

- 1 to foster collaboration among members on humanitarian information management related projects
- 2 to disseminate best practices of information exchange
- 3 to sensitise its members on the critical aspect of humanitarian information management preparedness
- 4 to facilitate headquarter-field partnerships and to advocate for more funding from donors for humanitarian information management related projects.

Organisations member of the GlobalSympoNet are for their vast majority, large international organisations. They could broadly be grouped into the following categories: non-governmental organisations (NGOs), United Nations organisations, Academia, Intergovernmental Organisation, and Media.

4.2 *Data collection*

A total of 61 responses were registered from an online survey conducted among 267 attendees of the 2007 GlobalSympoNet meeting. Respondents represented 47 different organisations out of the 119 organisational members of the GlobalSympoNet network that were surveyed; making a response rate of nearly 40% (39.50%). They were asked to identify organisations/agencies with which they had collaborated on humanitarian projects and to indicate their reasons for collaboration. The survey was the second in a series of three. It was developed with insights gained from survey results obtained at the time of the Symposium itself as well as those gained from an historical analysis of Symposium. Both the first and this second survey were reviewed by leaders of the Symposium.

The survey data was supplemented by data collected through nine (9) personal semi-structured interviews with representative of organisations members of the GlobalSympoNet. These interviews were conducted at the end of the first surveys. Each interview lasted between three quarter and one and half hours. Our intent was to have a more detailed description and explanation of activities in the GlobalSympoNet community and especial to gather the motives for collaboration among the members of the community.

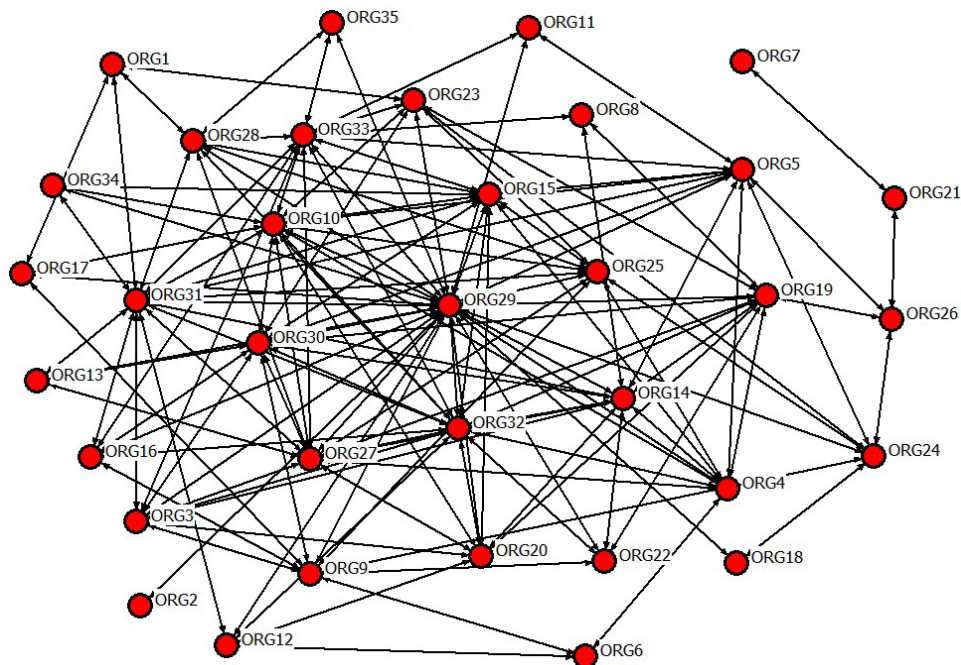
Social network analyses were conducted to explore the data collected in order to assess inter-organisational collaboration patterns in the network. The UCINET software (Borgatti et al., 1999) was used to computerise the data. Social network features used in the paper include network density (Freeman, 1979; Wasserman and Faust, 1994), degree centrality (Freeman, 1979; Wasserman and Faust, 1994), network position (Burt, 1976, 2008; Wasserman and Faust, 1994) and a block model (Lorrain and White, 1971; Breiger et al., 1975; White et al., 1976; Wasserman and Faust, 1994).

5 Research data

5.1 Project collaboration network data

As said earlier, through survey, we collected data from 47 organisations/agencies members of the GlobalSympoNet. Respondents were asked among other questions, to indicate organisations/agencies with which their organisation/agency had collaborated on humanitarian projects. In order to increase the reliability of this network data, we provided respondents with the complete list of organisations/agencies, rather than relying on their memory. Thirty five (35) organisations answered this question. Among these organisations, ten (10) were NGOs; nine (9) from the United Nations systems; six (6) from the academia and four (4) from the private sector. The rest (6) were from a variety of other categories including governmental organisations, intergovernmental organisations and media.

Figure 1 Network diagram (see online version for colours)



During the coding of data, we took in consideration all reported project collaboration relationships from multiple informants of the same organisation. For example, let say survey participants SP1 and SP2 work for the same organisation ORG1. If participant SP1 reports collaboration between organisation ORG1 and organisation ORG2, and participant SP2 reports collaboration between organisation ORG1 and organisation ORG3, we consider in our analysis that organisation ORG1 collaborates with organisation ORG2 and organisation ORG3. There were five (5) cases of multiple informants. Figure 1 depicts the relationship structure while Table 1 presents the 35 * 35 directed network matrix generated from the data collected. To protect confidentiality, we identify organisations/agencies by assigning codes for example ORG1. The collaboration relationships represented in the matrix are those reported by organisations on the rows. In this study, we considered both the reciprocated and non-reciprocated reported collaboration ties. A reciprocated collaboration tie is one in which both organisations/agencies report the collaboration relationship. Many researchers report reciprocated ties, with the premise that this strategy increases the reliability of network data and provide a more conservative estimate of inter-organisational relationships (e.g., Morrissey et al., 1994). However, non-reciprocated ties are also often reported (Bolland and Wilson, 1994), suggesting that an over reliance on confirmed ties may under represent relationships in the network.

In order to gain a better understanding of tightly and loosely connected members of the network, we used the CONCOR block modelling procedure. CONCOR block modelling method relies on structural equivalence. It aggregates network actors into positions based on similar patterns of interaction, regardless of whether or not they interact with each other. Table 2 shows the matrix resulting from this procedure. The content of this matrix is the same as that of the original network matrix represented by Table 1. The only difference is that the organisations/agencies in the rows and columns have been reorganised by CONCOR in a manner to group together those that are structurally equivalent. Four different network positions (P1, P2, P3, and P4) are identified. Each position comprises a set of organisations/agencies that collectively reported collaboration or no collaboration with other organisations/agencies in the network.

The CONCOR block modelling procedure also provides a density matrix (Table 3). A density matrix is a table that has positions instead of individual organisation/agency as its rows and columns and the values in the matrix are the proportion of ties that are present from the organisations/agencies in the row position to the organisations/agencies in the column position. This density can be used to measure the level of connectedness, which means collaborations in this network, among organisations in the position. In this paper, each cell of the density matrix is referred to as a cluster. For example, the cell at the intersection of position P1 and position P2 will be referred to as cluster P1P2. In order to define a tightly connected network block, we set the cut-off density value to the density of the whole network which is 0.15. In other words, a tightly connected cluster is a cluster in which at least 15% of all possible collaboration ties are effectively made. This method of determining the cut-off density value is frequently used in the literature (e.g., Wasserman and Faust, 1994). Based on this decision, six tightly connected clusters (set of relationships between two positions) were found in the network data. These clusters (P1P2, P2P1, P2P2, P3P1, P3P2 and P4P4) are represented in the image matrix by 1s (Table 4). The rest of the clusters are represented by 0s.

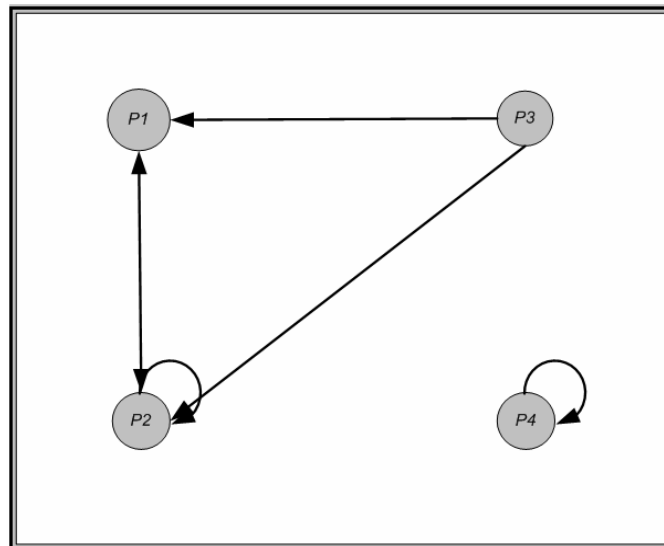
Table 3 Density matrix

| | <i>P1</i> | <i>P2</i> | <i>P3</i> | <i>P4</i> |
|-----------|-----------|-----------|-----------|-----------|
| <i>P1</i> | 0.100 | 0.400 | 0.147 | 0.050 |
| <i>P2</i> | 0.218 | 0.264 | 0.024 | 0.000 |
| <i>P3</i> | 0.240 | 0.297 | 0.110 | 0.033 |
| <i>P4</i> | 0.050 | 0.000 | 0.017 | 0.167 |

Table 4 Image matrix

| | <i>P1</i> | <i>P2</i> | <i>P3</i> | <i>P4</i> |
|-----------|-----------|-----------|-----------|-----------|
| <i>P1</i> | 0 | 1 | 0 | 0 |
| <i>P2</i> | 1 | 1 | 0 | 0 |
| <i>P3</i> | 1 | 1 | 0 | 0 |
| <i>P4</i> | 0 | 0 | 0 | 1 |

To better understand the collaboration relationship between and within positions, the inter-organisational collaboration network in Table 2 is transferred into the reduced graph in Figure 2. In this graph, positions are represented as nodes and ties between positions in the image matrix define the arcs between nodes. A '1' in an image matrix indicates that there is an arc from the node representing the row position to the node representing the column position in the reduced graph.

Figure 2 Network reduced graph

5.2 Data on reasons for collaboration

Respondents to the survey were also asked to indicate the reasons their organisations/agencies collaborate with other organisations/agencies member of the network. They were provided with a list of eight reasons from which they could choose

all that applied to their organisation (Table 5). These eight reasons were derived from the results of the first survey and the data collected through interview and from the literature review. The first survey included an open ended question asking survey participants to provide the reasons for which their organisation collaborates with other organisations.

Table 5 List of reasons for collaboration

| | |
|----|---|
| R1 | The goals of both organisations overlap. |
| R2 | The project was on my organisation's agenda already. |
| R3 | Both organisations are operating in the same geographical area. |
| R4 | My organisation is seeking a relationship with the project partner. |
| R5 | The other organisation has a successful track record of securing project funding. |
| R6 | The other organisation has data in which my organisation is interested. |
| R7 | The other organisation has information management policies or procedures in which that my organisation is interested. |
| R8 | The other organisation has technical tools in which that my organisation is interested. |

Table 6 shows the responses that were collected. These responses were aggregated for each of the six tightly connected network clusters identified through CONCOR. The aggregation was made based on the number of reported project collaboration relationships in each cluster. For example, if organisation/agency ORG1 collaborates for reason R1, this reason will be credited with the total number of collaborations report by ORG1. After calculating the total frequency of occurrence of each reason, we computed the mean frequency per cluster (Table 7) and ranked them from the most important (high mean frequency) to the least important (low mean frequency). Table 8 presents the result of the ranking.

Table 6 Organisations' reasons for collaboration

| | | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 |
|----|-------|----|----|----|----|----|----|----|----|
| P1 | ORG1 | √ | | | | | | | |
| | ORG19 | √ | | | | | √ | √ | √ |
| | ORG29 | √ | √ | √ | √ | √ | √ | √ | √ |
| | ORG6 | √ | √ | | √ | √ | | | |
| | ORG8 | √ | | √ | | | √ | | √ |
| P2 | ORG20 | | | √ | | | √ | √ | √ |
| | ORG22 | √ | √ | √ | √ | | √ | √ | |
| | ORG32 | √ | √ | √ | √ | | √ | √ | √ |
| | ORG17 | √ | | | | | | | |
| | ORG27 | √ | | √ | √ | | √ | √ | √ |
| | ORG28 | √ | | | | | | | |
| | ORG4 | √ | √ | | | √ | | | √ |
| | ORG30 | √ | √ | √ | √ | √ | √ | √ | √ |
| | ORG14 | √ | √ | √ | √ | √ | √ | √ | √ |
| | ORG31 | √ | | | | | √ | | √ |
| | ORG33 | √ | √ | √ | | | | √ | √ |

Table 6 Organisations' reasons for collaboration (continued))

| | | <i>R1</i> | <i>R2</i> | <i>R3</i> | <i>R4</i> | <i>R5</i> | <i>R6</i> | <i>R7</i> | <i>R8</i> |
|----|-------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| P3 | ORG9 | √ | | | | √ | | | |
| | ORG35 | √ | √ | √ | | | √ | √ | √ |
| | ORG2 | | | | √ | √ | | | √ |
| | ORG3 | √ | | | | | | √ | |
| | ORG12 | √ | √ | √ | √ | √ | √ | √ | √ |
| | ORG5 | | | | √ | | √ | | √ |
| | ORG24 | √ | √ | | √ | √ | √ | √ | √ |
| | ORG15 | √ | √ | √ | √ | √ | √ | | |
| | ORG25 | √ | √ | | √ | √ | √ | √ | √ |
| | ORG34 | √ | √ | | | √ | | | |
| | ORG10 | √ | | | √ | √ | | | |
| | ORG11 | √ | | | | | √ | √ | √ |
| | ORG16 | √ | √ | | √ | √ | | | √ |
| | ORG13 | √ | | | | | | √ | √ |
| | ORG23 | √ | | | √ | √ | √ | | √ |
| P4 | ORG7 | √ | | | | | √ | √ | √ |
| | ORG21 | √ | √ | | √ | | √ | | |
| | ORG26 | | | | √ | √ | √ | | |
| | ORG18 | | √ | | | √ | √ | | √ |

Table 7 Mean frequency reported types of reasons for collaborations

| <i>Cluster</i> | <i>R1</i> | <i>R2</i> | <i>R3</i> | <i>R4</i> | <i>R5</i> | <i>R6</i> | <i>R7</i> | <i>R8</i> |
|----------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| NGO1 → UN | 1.07 | 1.03 | 1.37 | 0.78 | 0.93 | 1.19 | 1.32 | 1.23 |
| UN → NGO1 | 0.98 | 0.94 | 1.55 | 0.72 | 0.43 | 1.03 | 1.14 | 1.18 |
| UN → UN | 1.07 | 1.04 | 1.92 | 1.19 | 0.35 | 1.28 | 1.41 | 1.27 |
| OTHER → NGO1 | 0.95 | 0.84 | 0.52 | 0.95 | 1.23 | 0.84 | 0.76 | 1.03 |
| OTHER → UN | 0.96 | 0.85 | 0.55 | 0.98 | 1.10 | 0.70 | 0.74 | 0.72 |

Table 8 Ranking of types of reasons for collaboration in decreasing order of mean frequency

| <i>Rank</i> | <i>Cluster</i> | | | | |
|-------------|------------------|------------------|----------------|---------------------|-------------------|
| | <i>NGOs → UN</i> | <i>UN → NGOs</i> | <i>UN → UN</i> | <i>OTHER → NGOs</i> | <i>OTHER → UN</i> |
| 1 | R3 | R3 | R3 | R5 | R5 |
| 2 | R7 | R8 | R7 | R8 | R4 |
| 3 | R8 | R7 | R6 | R4 | R1 |
| 4 | R6 | R6 | R8 | R1 | R2 |
| 5 | R1 | R1 | R4 | R2 | R7 |
| 6 | R2 | R2 | R1 | R6 | R8 |
| 7 | R5 | R4 | R2 | R7 | R6 |
| 8 | R4 | R5 | R5 | R3 | R3 |

6 Data analysis

6.1 *Characterising network positions and network clusters*

As shown in Table 3, applying the CONCOR procedure to the network data produced four structurally equivalent positions in the network. The number of organisations/agencies in each the network positions varies significantly ranging from 4 (four) to 15 (fifteen). Positions P1 and P4 have the smallest number of organisations/agencies, 5 (five) and 4 (four) respectively. These two positions could also be characterised as NGOs positions since 4 (four) out of the 5 (five) organisations/agencies in position P1 and 2 (two) out of the 4 (four) in position P4 are NGOs. We refer to these two positions in the rest of the paper as NGO1 and NGO2. Position P2 is made up of 11 (eleven) organisations/agencies mainly from the UN System (six out of eleven). The only Donor organisation in the 35 surveyed belongs to this position. This position could be characterised as the UN position. Position P3 has the greatest number of organisations/agencies (fifteen) and is the most diversified in terms of different categories represented (eight). With six organisations/agencies, academia is the category with the highest number of organisations/agencies. The only Media organisation surveyed belongs to this position. Position P3 could be characterised as the 'other agencies' position. In the rest of the analysis, we will refer to positions P1 and P4 as NGOs positions; position P2 as United Nations (UN) agencies position and position P3 as other position. Similarly, the cluster P2P2 for example will be referred to as the UN agencies cluster. This examination of the GlobalSymptoNet collaboration network positions sheds some light on the grouping of the members of the network.

6.2 *Patterns of collaboration*

After the network is partitioned into structurally equivalent positions, patterns of relationships between and within the positions are examined using the density matrix and the image matrix [see Wasserman and Faust, (1994), pp.389–391]. As said earlier, a density matrix shows the proportion of potential linkages that are actually sent from a row position to a column position. It is possible for a position to send many linkages to other positions and not to receive linkages in return. Another possibility is for a position to be internally linked, with members of the block sending links to one another.

Six tightly connected clusters of collaboration were identified in the GlobalSymptoNet network data. With regards to the density of interactions, these clusters present diversified patterns of project collaboration between and within the four structurally equivalent network positions. Scores in the density matrix range from 0.40 to 0.167. The cluster formed by NGO1 and UN is the most strongly interconnected. 40% of all the possible project collaboration relationships between the organisations in this cluster were actually found to exist. In contrast, only about 17% of all possible linkages between organisations/agencies in the cluster NGO2 were found to exist.

6.2.1 *Patterns of collaboration within clusters*

Among the six tightly connected clusters that were identified in the network data, two were concerned with inter-organisational collaboration relationships within cluster. They include the UN agencies cluster (P2P2) and one of the two NGOs clusters (P4P4). The

level of collaboration among organisations/agencies in each of these two clusters was higher than the average in the whole network. However, these two clusters differed significantly in term of density of collaboration. With approximately 27% (26.4%) of connections, the UN agencies cluster has one of the highest densities among the tightly connected clusters while one of the NGOs cluster (P4P4) has the lowest density (less than 17%). The reduced graph (Figure 2) shows that the NGOs cluster P4P4 is an isolate in the network. That means that organisations/agencies in this cluster collaborate only among themselves.

6.2.2 *Patterns of collaboration between clusters*

As depicted in the reduced graph (Figure 2) the following between clusters collaboration relationships were found to exist in the network;

- 1 NGOs, UN agencies
- 2 NGOs, other
- 3 UN agencies, other.

An examination of the directions of relationship flows between clusters in the reduced graph shows a unique directional relationship between other and NGOs (P1) and between other and UN agencies. This means that organisations/agencies that we characterised in this study as ‘other’ (position P3) reported a significant number of collaboration relationships with organisations/agencies in both NGO1 position and UN agencies position. Organisations/agencies in NGO1 and UN agencies positions did not report collaboration relationships with ‘other’ or the number of reported relationships were not important (less than the cut-off point in the density matrix). This finding may be a common characterisation of relationships between resources providers and resources seekers. The pattern of relationships is consistent with this notion. The reduced graph also shows a bi-directional relationship between NGOs (P1) and UN agencies, indicating organisations/agencies in both positions reported a significant number of collaboration relationships with organisations/agencies in the other position.

6.3 *Reasons for collaboration*

Table 7 shows for each of the six tightly connected clusters of interactions the mean frequency of occurrence of reasons for collaboration. The highest score cross cluster is for reason R3 (both organisations are operating in the same geographical area). This highest score is registered within the UN agencies cluster. The lowest score cross cluster is for reason R5 (the other organisation has a successful track record of securing project funding). This score is also registered within the UN agencies cluster. The appearance of these two extreme scores in the same cluster suggests a strong indication of the motivations of inter-organisational project collaboration relationships among the United Nations agencies.

An examination of Table 7 also shows that two different main reasons for collaboration (highest scores) are identified that could characterise two of the six clusters. As mentioned earlier, reason R3 would characterise the United Nations agencies cluster, while R5 (Successful track record of securing project funding) would characterise cluster P3P2. This finding suggests that the need for resources and especially the need for

funding would be the main motivation for organisations in the ‘other’ position to collaborate with the United Nations agencies.

Another interesting finding of our investigation is that the two main reported reasons for collaboration (both organisations are operating in the same geographical area; the other organisation has a successful track record of securing project funding) occupy respectively and inversely the top and the last positions in the two most densely connected clusters.

Table 9 Density of collaboration among organisations grouped per reasons

| | <i>Reasons for collaboration</i> | | | | | | | |
|-----------------------------|----------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| | <i>R1</i> | <i>R2</i> | <i>R3</i> | <i>R4</i> | <i>R5</i> | <i>R6</i> | <i>R7</i> | <i>R8</i> |
| Number of organisations | 30 | 17 | 12 | 18 | 17 | 22 | 17 | 23 |
| Max number of possible ties | 870 | 272 | 132 | 306 | 272 | 462 | 272 | 506 |
| Number of ties present | 166 | 93 | 77 | 124 | 103 | 128 | 103 | 124 |
| Density | 0.19 | 0.34 | 0.58 | 0.41 | 0.38 | 0.28 | 0.38 | 0.25 |

Table 9 presents the density of collaboration among organisations grouped per reported reasons of collaboration. As highlighted in this table, R3, R4, R5 and R7 register respectively the first, second and third highest density of collaboration. These findings are concordant with the result obtained from block modelling.

7 Discussion and conclusions

The objective of this research is to investigate inter-organisational collaboration behaviour/reasons among humanitarian organisations/agencies which are members of a community of interest in information exchange. We seek to understand the patterns of interconnections among organisations/agencies in the community. We also investigate the reasons that explain the collaboration patterns observed in the community. Although previous research highlight the popularity of inter-organisational collaboration in the non-profit sector and document issues involved in forming and maintaining these inter-organisational collaborations few studies examine the behaviour of humanitarian organisations/agencies members of a community of interest in information sharing.

The findings of this study can be grouped into two categories, one related to the structure of relationships in the GlobalSympoNet community and the other related to the motives of information exchange within the community. With regards to the structure of relationships, our study shows that the UNOCHA GlobalSympoNet community is fragmented into four groups described as network positions. The density of collaboration relationships within and between these groups varies significantly ranging from 0% (zero) to 40% (forty). Organisations/agencies of each group appear to be almost all in similar category (e.g., NGO, UN agencies, Academia). This may mean that organisations in similar categories hold similar structural positions in the inter-organisational humanitarian information exchange network. This finding is consistent with some previous inter-organisational network research that used the structural equivalence lens.

As mentioned earlier, structural equivalence measures the extent to which certain network members occupy similar positions and serve similar functions, or roles, within the network. Knoke (1983) and Galaskiewicz and Krohn (1984) describe inter-organisational structural equivalence as being based upon the function and activity of the organisation. In the case of humanitarian information exchange network, these groups are most likely to be defined by their categories.

Concerning the motivations for collaboration, the study shows that two main reasons predominantly characterise collaboration relationships among members of the GlobalSympoNet community. More importantly, we found that the two predominant reasons were inversely the most and least reported in two of the most densely connected clusters. The first reason is related to location of operation (i.e., both organisations/agencies are operating in the same geographical area). This finding suggests that similarly to people for who when they reside near one another, they have more opportunities to interact (Hoegl and Proserpio, 2004) proximity is one of the reasons for humanitarian information management among organisations. Humanitarian organisations that are collocated are more likely to interact thus to collaborate in information exchange than those that are geographically distant. The second reason identified in our study is related to resources (i.e., the other organisation has a successful track record of securing project funding). This finding suggests that resources play a significant role in information exchange among humanitarian organisations in the GlobalSympoNet community. This finding is consistent with that of Knoke and Rogers, (1979). In their analysis of multiple relationships among community development organisations, Knoke and Rogers found that organisations enter into relations with others to secure needed resources. Their findings also suggest that organisations that receive resources are expected to reciprocate by returning resources comparable in value. We believe the fact that the two predominant reasons were inversely the most and least reported in two of the most densely connected clusters is consistent with Bolland and Wilson (1994). According this paper every inter-organisational network is clustered into groups of agencies centred on specific needs. Our study extends their work in the humanitarian information exchange field.

As stated earlier, according to the exchange perspective of inter-organisational relationships, relations form when organisations perceive mutual benefits or gains from interacting (Levine and White, 1961; Hall et al., 1977). Our findings corroborate with this perspective as proximity and resources are found to be the major reasons for which organisations collaborate in humanitarian information exchange. Proximity provides opportunity for interaction and interaction would lead to mutual benefit. When looking at the findings from the structural equivalence perspective (Burt, 1976, 2008; Wasserman and Faust, 1994), the fact that the two predominant reasons for collaboration were inversely the most and the least reported in two different clusters would be consistent with this approach. Organisations in the same structurally equivalent network position would tend to have similar behaviour in the network. The results of this research contribute to the body of literature inter-organisational collaboration among humanitarian organisations/agencies by identifying and describing the patterns of collaboration as well as the motives that could explain these patterns.

Summarising, this paper responds to a call for researchers to further examine solutions to inter-organisational collaboration issues. It sheds some lights on collaboration behaviour in a community of interest in humanitarian information exchange. It also identifies some factors that explain the patterns of collaboration found

in the community. The results of this study should be considered in light of several limitations. Of particular concern, is the potential sampling bias due to the fact 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 organisational bias. Another limitation to the study concerns the source of information. The network data was constructed based on information provided by individuals. Although most of our survey participants were high ranked senior staff in their respective organisations, they might not always have complete information about the organisation's relationships and the motivations for these relationships. A third limitation concerns CONCOR, the social network block model that we use. CONCOR has been criticised as lacking validation. That is, there is no proof that convergence of the correlation matrix actually represents structurally equivalent positions. Lastly, two important assumptions are made in the study. First, we assume that inter-organisational collaboration relationships are of different kind. At any particular time, an organisation could be engaged collaboratively in different kind of projects with other organisations. The second assumption is that reasons for which an organisation collaborates with others were the same irrespective of projects or collaboration partner's characteristics.

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References

- Anderson, J.G. and Jay, S.J. (1985) 'The diffusion of medical technology: Social network analysis and policy research', *The Sociological Quarterly*, Vol. 26, pp.49–64.
- Arya, B. and Lin, Z. (2007) 'Understanding collaboration outcomes from an extended resource-based view perspective: the roles of organizational characteristics, partner attributes, and network structures', *Journal of Management*, Vol. 33, No. 5, pp.697–723.
- Ashton, W. (2008) 'Understanding the organization of industrial ecosystems: a social network approach', *Journal of Industrial Ecology*, Vol. 12, No. 1, pp.34–51.
- Austin, J.E. (2000) 'Strategic collaboration between non-profits and business', *Non-profit and Voluntary Sector Quarterly*, Vol. 29, No. 1, pp.69–97.
- Barnett, G.A. and Danowski, J.A. (1992) 'The structure of communication: a network analysis of the International Communication Association', *Human Communication Research*, Vol. 19, No. 2, pp.264–286.
- Bharosa, N., Lee, J. and Janssen, M. (2010) 'Challenges and obstacles in sharing and coordinating information during multi-agency disaster response: propositions from field exercises', *Information Systems Frontiers*, Vol. 12, No. 1, pp.49–65.
- Bolland, J.M. and Wilson, J.V. (1994) 'Three faces of integrative coordination: a model of interorganizational relations in community-based health and human services', *Human Services Research*, Vol. 29, No. 3, pp.341–365.
- Borgatti, S.P., Everett, M.G. and Freeman, L.C. (1999) *UCINET 6.0 Version 1.00*, Natick: Analytic Technologies.
- Brass, D.J., Galaskiewicz, J., Greve, H.R. and Tsai, W. (2004) 'Taking stock of networks and organizations: a multilevel perspective', *Academy of Management Journal*, Vol. 47, pp.795–817.

- Breiger, R.L. and Ennis, J.G. (1979) 'Personae and social roles: the network structure of personality types in small groups', *Social Psychology Quarterly*, Vol. 42, pp.262–270.
- Breiger, R.L., Boorman, S.A. and Arabie, P. (1975) 'An algorithm for clustering relational data, with application to social network analysis and comparison with multidimensional scaling', *Journal of Mathematical Psychology*, Vol. 12, pp.328–383.
- Bui, T., Cho, S., Sankaran, S. and Sovereign, M. (2000) 'A framework for designing a global information network for multinational humanitarian assistance/disaster relief', *Information Systems Frontiers*, Vol. 1, No. 4, pp.427–442.
- Burt, R.S. (1976) 'Positions in networks', *Social Forces*, Vol. 55, No. 1, pp.93–122.
- Burt, R.S. (2008) 'Information and structural holes: comment on Reagans and Zuckerman', *Industrial and Corporate Change*, Vol. 17, No. 5, pp.953–969.
- Cigler, B.A. (1999) 'Pre-conditions for the emergence of multicommunity collaborative organizations', *Policy Studies Review*, Vol. 16, No. 1, pp.87–102.
- Comfort, L.K. (1993) 'Integrating information technology into international crisis management and policy', *Journal of Contingencies and Crisis Management*, Vol. 1, No. 1, pp.15–26.
- De Bruijn, H. (2006) 'One fight, one team: the 9/11 commission report on intelligence, fragmentation and information', *Public Administration*, Vol. 84, No. 2, pp.267–287.
- Feiock, R.C. and Andrew, S. (2006) 'Introduction: understanding the relationships between non-profit organizations and local governments', *International Journal of Public Administration*, Vol. 29, Nos. 10–11, pp.759–767.
- Fisher, C.W. and Kingma, D.R. (2001) 'Criticality of data quality as exemplified in two disasters', *Information & Management*, Vol. 39, pp.109–116.
- Freeman, L.C. (1979) 'Centrality in social networks: conceptual clarification', *Social Networks*, Vol. 1, pp.215–239.
- Friedkin, N.E. (1984) 'Structural cohesion and equivalence explanations of social homogeneity', *Sociological Methods and Research*, Vol. 12, pp.235–261.
- Galaskiewicz, J. (1985) 'Interorganizational relations', *Annual Review of Sociology*, Vol. 11, pp.281–304.
- Galaskiewicz, J. and Krohn, K. (1984) 'Positions, roles, and dependencies in a community interorganization system', *Sociological Quarterly*, Vol. 25, pp.527–550.
- Galbraith, J.R. (1977) *Organization Design*, Addison-Wesley, Reading, MA.
- Gazley, B. (2008) 'Beyond the contract: the scope and nature of informal government non-profit partnerships', *Public Administration Review*, Vol. 68, No. 1, pp.141–154.
- Gazley, B. and Brudney, L. (2007) 'The purpose (and perils) of government-non-profit partnership', *Non-profit and Voluntary Sector Quarterly*, Vol. 36, No. 3, pp.389–415.
- Gerlach, M.L. (1992) 'The Japanese corporate network: a blockmodel analysis', *Administrative Science Quarterly*, Vol. 37, pp.105–139.
- Guo, C. and Acar, M. (2005) 'Understanding collaboration among non-profit organizations: combining resource dependency, institutional, and network perspectives', *Non-Profit and Voluntary Sector Quarterly*, Vol. 34, No. 3, pp.340–361.
- Hall, R., Clark, J., Giordano, P., Johnson, P. and Van Roekel, M. (1977) 'Patterns of interorganizational relationships', *Administrative Science Quarterly*, Vol. 22, No. 3, pp.457–474.
- Hoegl, M. and Proserpio, L. (2004) 'Team member proximity and teamwork in innovative projects', *Research Policy*, Vol. 33, pp.1153–1165.
- Jang, H. (2006) 'Contracting out parks and recreation services: correcting for selection bias using heckman selection model', *International Journal of Public Administration*, Vol. 29, Nos. 10–11, pp.799–818.
- Jang, H. and Feiock, R. (2007) 'Public and private funding reliance of non-profit organizations: implications for inter-organizational collaboration', *Forthcoming in Public Productivity and Management Review*.

- Kilduff, M. and Tsai, W. (2003) *Social Networks and Organizations*, Sage, London.
- Knoke, D. (1983) 'Organization sponsorship and influence reputation of social influence associations', *Social Forces*, Vol. 61, pp.1065–1087.
- Knoke, D. and Rogers, D.L. (1979) 'A blockmodel analysis of inter-organizational network', *Sociology and Social Research*, Vol. 64, pp.28–52.
- Levine, S. and White, P. (1961) 'Exchange as a conceptual framework for the study on inter-organizational relationships', *Administrative Science Quarterly*, Vol. 5, pp.583–601.
- Longstaff, P.H. (2005) *Security, Resilience, and Communication in Unpredictable Environments Such as Terrorism, Natural Disasters, and Complex Technology*, available at http://pirp.harvard.edu/pubs_pdf/longsta/longsta-p05-3.pdf (accessed on December 2008).
- Lorrain, F. and White, H.C. (1971) 'Structural equivalence of individuals in social networks', *Journal of Mathematical Sociology*, Vol. 1, pp.49–80.
- Maiers, C., Reynolds, M. and Haselkorn, M. (2005) 'Challenges to effective information and communication systems in humanitarian relief organizations', *2005 IEEE International Professional Communication Conference Proceedings*.
- Maitland, C. and Tapia, A. (2007a) *Global Symposium +5 Information for Humanitarian Action Survey Report*, 15 November, p.33, Prepared for United Nations Office for the Coordination of Humanitarian Affairs.
- Maitland, C. and Tapia, A. (2007b) *Outcomes from the UN OCHA 2002 Symposium & HIN Workshops on Best Practices in Humanitarian Information Management and Exchange*, 13th October, p.16, Prepared for United Nations Office for the Coordination of Humanitarian Affairs.
- Maitland, C. and Tapia, A. (2008) *Global Symposium +5 Information for Humanitarian Action First Follow-up Survey Report*, 3 November, p.33, Prepared for United Nations Office for the Coordination of Humanitarian Affairs.
- Maitland, C., Ngamassi, L. and Tapia, A. (2009) 'Information management and technology issues addressed by humanitarian relief coordination bodies', *Proceedings of the 6th International ISCRAM Conference*, May, Göteborg, Sweden.
- McGuire, M. (2006) 'Collaborative public management: assessing what we know and how we know it', *Public Administration Review*, Vol. 66, No. 1, pp.33–43.
- Milne, G.R., Iyer, E.S. and Gooding-Williams, S. (1996) 'Environmental organization alliance relationships within and across non-profit, business, and government sectors', *Journal of Public Policy & Marketing*, Vol. 15, No. 2, pp.203–215.
- Moore, S., Eng, E. and Daniel, M. (2003) 'International NGOs and the role of network centrality in humanitarian aid operations: a case study of coordination during the 2000 Mozambique floods', *Disasters*, Vol. 27, No. 4, pp.305–318.
- Morrissey, J.P., Calloway, M., Bartko, W.T., Ridgley, S., Goldman, H.H. and Paulson, R.I. (1994) 'Local mental health authorities and service system change: evidence from the Robert Wood Johnson program on chronic mental illness', *Milbank Quarterly*, Vol. 72, No. 1, pp.49–80.
- Ngamassi, L., Maldonado, E., Zhao, K., Robinson, H., Maitland, C. and Tapia, A. (2010) 'Exploring barriers to coordination between humanitarian NGOs: a comparative case study of two NGO's information technology coordination bodies', *Forthcoming the International Journal of Information Systems and Social Change (IJISSC)*, special issue on IS/IT in Non-profits.
- O'Regan, K.M. and Oster, S.M. (2000) 'Non-profit and for-profit partnerships: rationale and challenges of cross-sector contracting', *Non-profit and Voluntary Sector Quarterly*, Vol. 29, No. 1, pp.120–140.
- Oliver, C. (1990) 'Determinants of interorganizational relationships: integration and future directions', *Academy of Management Review*, Vol. 15, No. 2, pp.241–265.
- Pfeffer, J. and Salancik, G.R. (1978) 'The external control of organizations: a resource dependence perspective', Harper and Row, New York, NY.

- Provan, K.G. and Milward, H.B. (1995) 'A preliminary theory of inter-organizational network effectiveness: a comparative study of four community mental health systems', *Administrative Science Quarterly*, Vol. 40, No. 1, pp.1–33.
- Saab, D., Maldonado, E., Orendovici, R., Ngamassi, L., Gorp, A., Zhao, K., Maitland, C. and Tapia, A. (2008) 'Building global bridges: coordination bodies for improved information sharing among humanitarian relief agencies', Friedrich, F. and Van de Walle, B. (Eds.): *Proceedings of the 5th International ISCRAM Conference*, May, pp.471–483, Washington, DC, USA.
- Saidel, J.R. and Harlan, S.L. (1998) 'Contracting and patterns of non-profit governance', *Non-profit Management and Leadership*, Vol. 8, No. 3, pp.243–259.
- Schmidt, S. and Kochan, T. (1977) 'Interorganizational relationships: patterns and motivations', *Administrative Science Quarterly*, Vol. 22, No. 2, pp.220–234.
- Stephenson, M. (2006) 'Toward a descriptive model of humanitarian assistance coordination, voluntas', *International Journal of Voluntary and Non-profit Organizations*, Vol. 17, No. 1, pp.41–57.
- Stephenson, M., Jr. (2005) 'Making humanitarian relief networks more effective: operational coordination, trust and sense-making', *Disasters*, Vol. 29, No. 4, pp.337–350.
- Stone, M. (2000) 'Exploring the effects of collaborations on member organizations: Washington county's welfare-to-work partnership', *Non-profit and Voluntary Sector Quarterly*, Vol. 29, pp.98–119.
- Van de Ven, A.H., Walker, G. and Liston, J. (1979) 'Coordination patterns within an interorganizational network', *Human Relations*, Vol. 32, No. 1, pp.19–36.
- Wasserman, S. and Faust, K. (1994) *Social Network Analysis: Methods and Applications*, Cambridge University Press.
- Wentz, L. (2006) *An ICT Primer: Information and Communication Technologies for Civil-Military Coordination in Disaster Relief and Stabilization and Reconstruction*, available at <http://stinet.dtic.mil/cgi-bin/GetTRDoc?AD=ADA454071&Location=U2&doc=GetTRDoc.pdf> (accessed on 11 March 2009).
- White, C., Boorman, A. and Breiger, R. (1976) 'Social structure from multiple networks, blockmodels of roles and positions', *The American Journal of Sociology*, Vol. 81, No. 4, pp.730–780.
- Williamson, O.E. (1991) 'Comparative economic organization: the analysis of discrete structural alternatives', *Administrative Science Quarterly*, Vol. 36, No. 2, pp.269–296.
- Wood, D.J. and Gray, B. (1991) 'Toward a comprehensive theory of collaboration', *Journal of Applied Behavioral Science*, Vol. 27, pp.139–162.

Notes

- 1 GlobalSympoNet is a pseudonym we used to protect the confidentiality of the organisations.