Exploratory analyses of humanitarian operations through social networks

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Abstract
We collected data from two humanitarian relief responses and 757 development projects to investigate how actors' attributes and network features affect organizations' performance in humanitarian operations. Findings revealed that project's performance increases with its centrality and the amount of money awarded; and deceases with project's duration and number of implementers.

Keywords: Humanitarian Programs, Performance, Social Networks

Introduction

Natural and man-made disasters have increased in frequency and in impact during the last decades (IFRC, 2004). During the last 10 years, for example, we have faced large disasters such as typhoon Haiyan (2013), Haiti earthquake (2010), hurricane Katrina (2005), and many smaller disasters that have required the need for humanitarian organizations assistance. For instance, while an average of 470 disasters per year were faced in the 1990's; since 2000, these numbers have increased to an average of more than 700 disasters per year, leading to a 4% yearly increase of the affected population (IFRC, 2004; Strömberg, 2007). Given this increase in humanitarian needs, different humanitarian organizations, governments, academics and the wider community have been working on developing reliable programs to reduce human loss and suffering by guaranteeing acceptable living conditions to the populations in need and at risk (Samii, 2008).

To respond accurately to the humanitarian needs, humanitarian organizations work on three distinct types of programs: development, emergency and recovery. Development programs aim to improve the medium to long-term self-sufficiency and sustainability of life (Beamon and Balcik, 2008). Relief programs are short-term activities addressing the immediate damages caused by disasters; and the recovery programs address the post-emergency needs of an afflicted population (Beamon and Balcik, 2008; Samii, 2008).

In order to manage an emergency situation in humanitarian operations, disaster management replaced the profit maximization objective (which is followed by for-profit organizations) by the objective of timely and appropriate provision of the right goods, at the right

place, at the right time to the right people (Chomilier et al., 2003; Samii, 2008; Tomasini and Van Wassenhove, 2009). However, this is not an easy task for any actor in the system, in part because society calls for greater accountability when bringing attention to marginalized people (Slim 2002; Brown 2008). As a result, many accountability mechanisms and processes have been implemented to deal with the typical characteristics of humanitarian operations: high amount of actors, time pressures, delays, feedback loops and uncertainty (Besiou et al., 2011; Dolinskaya et al., 2011; Ergun et al., 2010; George, 2003; Tomasini, 2012). Difficulties in managing the limited resources, providing a good performance and making the right decisions create misunderstandings or can be interpreted as inefficiencies or abuse of power by the organization. Hence, actors are required to show that they do the right things –accountability–, assuring the best use for money and resources –good performance– (Halachmi, 2002). Perceived inefficiencies have an effect in further donations, which will definitely pose important challenges in planning and implementing further logistics operations (Van Wassenhove, 2006).

Concerns about good performance have also increased over the past twenty years (Ebrahim, 2005; Unerman and O'Dwyer, 2006), and this has shifted the attention to the creation of better coordination and accountability frameworks. On the one hand, initiatives created to face the incessant coordination issues have been grouped based on operational, tactical and strategic dimensions (Kovács and Spens, 2007; Pettit and Beresford, 2005). Based on these dimensions, different UN agencies, major organizations and NGOs have stablished different committees, offices and programs to improve humanitarian coordination (Balcik et al., 2010). For instance, the Office of UN disaster relief coordinator (UNDRO), the Office of the Coordinator for Humanitarian Affairs (OCHA), and the Emergency Capacity Building (ECB) developed ethical, trusty-based frameworks as key drivers of coordination and provided accessible systems for information sharing on the significant inhibitors of humanitarian operations.

The accountability policies, on the other hand, are currently used worldwide by many programs such as the Active Learning Network for Accountability and Performance (ALNAP), People in Aid, Management Accounting for Non-Governmental Organizations (MANGO), Humanitarian Accountability Partnership (HAP) and the Good Humanitarian Donorship (GHD) initiative (HAP International, 2013; Jagadananda and Brown, 2005; Jordan 2005). These programs seek to involve different actors at the global and local levels that are required to show a good performance (Chisolm, 1995; Fry, 1995). In this way, organizations have been trying not only to show that they can provide good policies and services that are more effective, but also that they can plan, coordinate with different humanitarian actors and deal properly with the uncertainties to carry out good relief and development programs (Samii, 2008).

However, although it is known that when organizations are willing to coordinate their efforts with others, they can reduce operational costs, cope with new threats, seize new opportunities and gain flexibility to improve faster; coordination is not an easy task (Kaatrud et al., 2003; Leiras et al., 2014). This occurs especially when organizations have little incentive to work with others, because in the end they all are competing for donations. By focusing on their own benefits, organizations do not rely on external partners, preferring to avoid the risk and gain access to new resources by themselves. This behavior leads to a clear duplication of efforts and to a lack of information and resources sharing (Leiras et al., 2014; Samii and Van Wassenhove, 2003). Given the lack of information available and the complexity of humanitarian operations, planning and evaluation have a direct effect on performance and the allocation of losses and gains within the coordination initiatives (Thomas and Kopczak, 2007).

Performance measurement for emergency chains is not only critical to secure NGO accountability and improve the program success (Beamon, 2004; Beamon and Balcik, 2008), but

also to evaluate the contribution of partnerships to performance (Binder and Witte, 2007). Similarly, humanitarian actors should measure performance in development projects, first, to assure donors that the organization use properly the funds (Fama and Jensen, 1983), and second, because lack of agreement among the actors in one project affects the project processes, resources and performance (Cohen and Zhou, 1991).

Despite its importance, performance measures are not completely developed and implemented in the humanitarian sector due to the own specificities and unique characteristics of each disaster, recovery and development program (Kanter and Summers, 1987; Micheli and Kennerly, 2005). In fact, one of the distinctive characteristics of nonprofit organizations is performance criteria ambiguity (O'Neill and Young, 1988). Therefore, in order to appraise the success of nonprofits, it is necessary to consider their ability to respond to a changing environment, and how effectively and efficiently they meet on time and on budget the needs of their stakeholders (Kaplan, 2001; Beamon and Balcik, 2008; Samii, 2008)

The purpose of this paper is to examine how the partnerships and interactions among different humanitarian actors can be a key factor for determining performance during humanitarian operations. We focus both on relief activities of multiple organizations responding to large-scale emergencies caused by quick disasters, and on development activities focusing on community self-sufficiency and sustainability. In order to study qualitatively these emerging structures produced by interconnected organizations, it is better to use a network approach than a simple linear chain analysis (Kim Y. et al., 2011). A network consists of nodes (e.g. organizations, projects) and ties (relationships) that connect the nodes providing support to those in need (Lamming et al. 2000; Harland et al. 2001). Although the social networks approach, which has its foundation in graph theory (Kircherr, 1992), has been widely used to study communities, communication flow and social structures (Granovetter, 1973; Bearman et. al, 2004), it has not been systematically used to characterize and understand humanitarian operations structures and their influence on potential performance. This paper tries to close that gap by doing two exploratory studies, where we analyze the characteristics of the networks that are created during relief and development operations.

In a first study, we describe the interactions among organizations during two of the most recent and large-scale natural disasters (Haiti earthquake and typhoon Haiyan). In a second study, we analyze the interaction among different actors (donors, implementers and beneficiaries) within different development projects, and their effect on project performance. Finally, in the last section, we conclude.

Study 1: Structural Analysis of Humanitarian Relief Operations

In this first exploratory study, we focus on horizontal accountability exercised mainly by partner organizations (implementers of relief) and local governments. We try to understand how different interactions between these actors can lead to different performances in the responses. We choose two contrasting scenarios to make our analyses: the 2010 Haiti Earthquake and the 2013 Philippines Haiyan Typhoon.

Haiti Earthquake: On January 12 2010, an earthquake of 7.0 points in the Richter scale struck Port-au-Prince (PaP), the capital of Haiti. This earthquake caused around 230000 deaths (BBC, 2010) destroying roads, the only airport, multiple houses and buildings, including government and humanitarian organizations offices. The humanitarian response started as soon as it was possible, and suddenly hundreds of different organizations arrived to PaP. This congestion

generated many coordination and leadership issues, mostly because the government had been largely affected and they were not prepared to cope with the magnitude of the situation.

Philippines Haiyan Typhoon: On November 8 2013, typhoon Haiyan struck the Philippines. It caused more than 7000 deaths and more than four million people displaced (BBC, 2014). The Philippine government act quickly and allowed humanitarian relief assistance from the following day. This helped to reduce coordination problems and to have a timely response, despite the logistics issues, and to assist vulnerable groups in an adequate manner. Nevertheless, there were some coverage problems, because many agencies focused on areas where the media was present (Sanderson and Willison, 2014).

A lot has been discussed about the contextual conditions that led to the differences in outcomes in these two crises. However, nothing has been said yet about how the interactions among humanitarian actors may have had a role. Hence, we aim to explore these interactions among humanitarian actors during emergency responses using social networks.

Data description

This study was conducted using an online survey in Qualtrics. We collected information from different humanitarian organizations that responded to each of the crises (Haiti earthquake 2010 and typhoon Haiyan 2013). We collected the respondents' email address from the 3W (Who does What Where) contact management directory provided by the UNOCHA, where the target respondent in each organization was the chief executive of the mission. For the Haiti earthquake, we sent the questionnaires to 288 organizations and we got responses from 42, and for the typhoon Haiyan we sent 198 questionnaires and we got 29 responses. These responses give a total 15% sample response rate.

Throughout the short survey, respondents was asked to choose their organization name and to select their main partners during the crisis. In the last part of the survey, we created a performance check, based on respondents' perception. This performance measurement is created following the existing performance measurement framework proposed by Beamon and Balcik (2008) and the theoretical concepts proposed by Samii (2008). In this case, three dimensions of performance were created and each dimension was evaluated with two measures. Then, following a typical five-level Likert scale, we asked respondents to evaluate their own organization and their partners' in each of the six measures.

Results and Analysis

Based on the data collected, we create a network for each of the crisis based on the partnerships identified through the survey. In this network, we consider each organization as a node and we create a link (representing partnership) between two organizations if at least one organization consider the other organization as partner. Hence, we create an undirected network characterized by organizations' partnerships.

Analyzing the perceived performance in each of the crisis responses, we compute the overall performance measure following the procedure explained in the previous section. Table 1 (row 6) presents the overall performance for each crisis as a result of the evaluation made by each of the respondents that completed the survey. Results show that on average the organizations' performance during the typhoon Haiyan was higher than in the Haiti earthquake, and this difference is significant ($t = 3.23$, $df = 141.1$, p-value = 0.0015).

Our analysis will focus now on how the specific characteristics to each type of network could have had a role in the difference in performance perception. The first two rows of Table 1 represent the number of organizations (vertexes) that were part of the responses, and the number of partnerships (edges) that those organizations held. It seems that the number of partnerships was higher during the Haiti earthquake than during the typhoon Haiyan. However, when analyzing the density index, we can observe that in the Haiti earthquake only 1.87% of the total possible partnerships were actually established, while during the Haiyan typhoon this index corresponds to 4.01%, which may be interpreted as a higher level of collaboration. The number of clusters formed during the disasters (row 5) helps us understand the level of cohesiveness. While during the Haiti earthquake, there were six different clusters, i.e. six different group of actors that were connected within them, but disconnected between one another; during the Haiyan typhoon there was only one big cluster composed of all 105 actors in the network. This means that in this last case the network was more cohesive, because all the actors were connected. This particular characteristic of the network might be very useful during disaster response, because it allows for a better communication and flow information in the network, which at the same time facilitates a higher degree of horizontal accountability and coordination among partner organizations.

Table 1 – Network characteristics of emergency responses

	Haiti Earthquake	**Typhoon Haiyan**
#Vertexes	205	105
#Edges	390	219
Diameter	6	6
Density	1.87%	4.01%
Cluster	6	1
Performance	3.644	3.977
	Centralization	
Eigenvector	90.29%	84.30%
Degree	29.02%	29.64%
Closeness	3.14%	41.08%
Betweenness	30.34%	32.14%

Finally, Table 1 (last 4 rows) shows the values for different types of centralization. The centralization index indicates to what degree the network is configured around few actors. Comparing the different results, the most important difference is found in closeness centralization. The high closeness centralization index found for typhoon Haiyan (41.1% vs. 3.14%) is representing a network that is highly centralized around few actors, who have high closeness centrality. We could explain this outcome based on the important role that the Philippine government had during the response. As the government was coordinating the main operations at a central level, it is not surprising to find high indicators of centralization in this response.

Now that we have seen what some characteristics of the interactions that lead to different performance levels are, we are interested in studying what happens in development projects.

Study 2: Structural Analysis of Humanitarian Development Projects

In this study, we expand our analysis including different actors' roles as an important factor to explain performance in humanitarian development projects. This means, not only accounting for implementers and local governments, but also for donors and beneficiaries. We will undertake this

second study using two different approaches: first, we explain actors' performance in terms of actors' interaction across different projects; and second, we describe projects' performance in terms of the projects' interactions generated by the overlapping of actors during the projects implementation.

Actors' Approach: In humanitarian development operations, actors can be grouped in three basic classes: donors, implementers and beneficiaries. In this actors' approach, we created a directed network where the nodes are the stakeholders of the project; and we define the interactions among these actors taking into account how the donations move through the projects.

Projects' Approach: In order to understand how best practices move through different projects and how multiple actors' working on a same project could lead to coordination issues, we create a network considering the projects as nodes, and where the ties among the projects are established if they have at least one actor in common.

Data description

In order to analyze actors' performance during different humanitarian development projects, we collected data from the United Nations Office for Project Services (UNOPS). Our database is composed of 757 ongoing humanitarian development projects (taking place since 2004), involving 241 different actors among donors, implementers and beneficiaries. For each project, we have data about ID, description, start date and finish date, money awarded, money expended to date, donors, implementers and beneficiaries (countries). Moreover, for the actors we have information about the number of projects in which they are involved and their classification as donor, implementer or beneficiary. From this dataset, we were able to build two different matrices, according to the corresponding approach: *actors'* approach and *projects'* approach.

In order to build the relations among *actors*, we consider donors, implementers and beneficiaries as nodes, and we create a directed tie among the actors that were working in the same project, considering the flow of donations in the chain. In the simplest case of a project, a donor will give money to an implementer, which will deliver aid to a beneficiary on behalf of the donor. Therefore, in this example, a directed tie will be created from donor to implementer, from implementer to beneficiary, but also from donor to beneficiary.

On the other hand, for the *projects* matrix, we considered the projects as nodes and we created an undirected tie among the projects which have at least one actor in common, i.e. if two projects have a tie, this means that there is at least one actor which is participating in the two projects at the same time.

We designed a performance measure, drawing on the theory of Earned Value Management (EVM), which is used for project performance monitoring and uses concepts such as the planned value (budgeted cost of work scheduled, BCWS), earned value (budgeted cost of work performed, BCWP) and the actual cost (actual cost of work performed, ACWP) (De Weck, 2010). The EVM metrics help analyze the current state of the project (both in schedule and costs), using the budget that was planned, the work that has been performed, and the actual cost for each activity. In addition to the performance indicator, we define attributes for each project such as number of donors, number of implementers, number of beneficiaries, project duration and money awarded. Similarly, for each actor we specify attributes like type of actor (donor, implementer or beneficiary), amount of projects, money awarded and performance. The performance of the actor as donor, as implementer and as a beneficiary is computed as an average performance of all the projects that the actor is involved as donor, as implementer and as beneficiary, respectively.

Results and Analysis

We used R-studio to run different econometrical models using ordinary least squares embedded in network analysis. Table 2 presents five different models that allow us to get some general insights about donors', implementers' and beneficiaries' performance using the actors' approach. We analyze the effect of the indegree and outdegree centrality, as well as the money awarded in actors' performance. Models 1 and 2 show a positive and significant effect of the outdegree centrality in donors' performance. This effect on performance could be interpreted in terms of donors' learning. Donors' relationships with the implementers give information to the donor about how implementers behave and make use of their money. Hence, the higher the number of implementers a donor is supporting, the more learning and experience will be generated, so that the donor is better prepared to push project performance (Lubatking, 1983). Model 4 presents a positive and significant effect of the money awarded on implementers' performance. However, the causality is not clear: implementers perform better because they have more money awarded, or implementers with high performance are the ones receiving the higher amounts of money.

Table 2 – Results for the actors' approach

	Donors' Performance		**Implementers' Performance**		**Beneficiaries' Performance**
Independent Variable	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Indegree			-0.003	-0.004	0.023**
			(0.005)	(0.005)	(0.007)
Outdegree	0.006**	0.005*	0.003.	0.002	
	(0.002)	(0.002)	(0.002)	(0.002)	
Money		0.001.		0.001*	0.0003
		(0.0004)		(0.0003)	(0.0004)
Intercept	0.131***	0.123***	0.061*	0.065*	0.264***
	(0.031)	(0.031)	(0.031)	(0.030)	(0.042)
p-Value	1.94E-03	1.82E-03	1.95E-01	4.62E-02	1.92E-03
Degrees of freedom	239	238	238	237	238

Significance codes: '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1; in parenthesis Standard Errors

Finally, model 5 presents a positive and significant effect of the indegree centrality in beneficiaries' performance. Beneficiaries will definitely benefit when different organizations alleviate their needs, and they will try to cooperate with the intermediaries to guarantee a good use of the contributions. This accountability mechanism can foster a higher amount of interactions between beneficiaries and implementers, to the general benefit of both aid givers and recipients (George, 2003). Hence, the beneficiaries learn that their collaboration could create trust with donors and implementers, so that they will keep supporting their communities.

Table 3 presents four models that allow concluding about the projects' approach. Results show non-significant effects for number of donors and number of beneficiaries on project performance. However, we find that the higher the number of implementers in a project, the lower the project performance (there is a negative and significant effect in two out of the four models). This can happen because multiple implementers working on a same project could lead to coordination issues, especially because implementers have little incentive to work together, to share resources and information, because at the end they are competing for donors' attention (Leiras et al., 2014).

Table 3 – Results for the projects' approach

Independent Variable	Model 6	Model 7	Model 8	Model 9
N° Donors	-0.128*	-0.037	-0.057	-0.058
	(0.057)	(0.056)	(0.056)	(0.056)
N° Implementers	-0.266**	0.005	-0.184.	-0.209*
	(0.082)	(0.084)	(0.105)	(0.106)
N° Beneficiaries	0.011	0.032	0.032	0.028
	(0.037)	(0.036)	(0.036)	(0.036)
Duration		-0.022***	-0.024***	-0.026***
		(0.002)	(0.003)	(0.003)
Degree			0.001**	0.002***
			(0.001)	(0.001)
Money Awarded				0.004*
				(0.002)
Intercept	0.897***	1.262***	1.252***	1.249***
	(0.102)	(0.106)	(0.106)	(0.106)
p-Value	0.003	2.2E-16	2.2E-16	2.2E-16
Degrees of freedom	753	752	751	750

Significance codes: '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1; in parenthesis Standard Errors

In addition, in models 8 and 9, we observe a positive and significant relation between the degree centrality and project performance. This finding suggests that in order to reach better project performance, flow of information among projects through the actors should take place. Therefore, when projects are connected with actors that are participating in multiple projects at the same time, there is an exchange of best practices, experiences and lessons learned through those actors, leading to an increase in project performance. However, this increase in performance and in common knowledge probably requires an effective communication and a proper integration of effort (Child, 1972). Finally, models 7 to 9 show two additional factors that are related with performance: project duration and money awarded. Longer projects have a negative and significant relation with project performance. This is due to the difficulty in accurately planning and follow up with an initial plan. Lastly, we find that projects with higher amount of money awarded show a higher performance. This could be because projects that are more expensive may require a higher involvement of the actors, which will also increase the performance of the overall project.

Conclusions and future research

The objective of this paper was to understand how the networks' structures and the interactions that emerge among humanitarian actors in different relief and development programs could affect accountability, coordination, learning and, hence, performance. We develop two exploratory studies, collecting primary and secondary data, and using social networks as the methodology of analysis in order to account for the interaction between the different actors.

In the first study, we contrast the emergency response networks that develop during two different disasters: Haiti earthquake and typhoon Haiyan. We find out that a high network cohesiveness (represented by a high amount of partnerships) together with an active central actor (who is able to reach easily others) could be determinant in facilitating the communication and information flow, improving the overall perceived performance of the crisis response.

The second study focuses on the interactions that arise during development projects. Here, we use a cost performance index to compare the actors and the projects. We realize that donors and

beneficiaries who present a high performance are those who have high number of interactions with other organizations. These interactions could facilitate learning processes and increase experience. In the case of the implementers, those who were more cost efficient also had more money awarded. Furthermore, we find out that projects with a higher number of implementers are less cost efficient. From the donor standpoint, the more implementers the project has, the more difficult is to control the project with the same resources. However, projects with a high degree centrality, i.e. a high number of actors participating in other projects, show a high performance. We believe that when projects have actors who have experience in other initiatives, there is an increase in learning and spread of best practices, which can lead to an increase in performance. Finally, we realize that the amount of money awarded has a positive effect on project performance, while the project duration has a negative effect.

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