

## Mapping the Structural Patterns of Intergovernmental Emergency Networks: An Exploratory Study

Yujin Choi<sup>1</sup>

### Abstract

---

This paper describes the structural patterns of intergovernmental emergency preparedness and then explored the impact of network centrality in collaborative networks on a county government's preparedness for emergencies. Through the first analysis using a social network analysis technique, this paper identified influential actors in each type of collaborative network. These results might provide initial insight into how county governments and other levels of government organizations interact with each other in terms of emergency management. Although the findings in the second analysis did not fully support the argument that network position affects organizational performance (i.e., emergency preparedness), the results showed that at least in the formal mutual aid network, a positive relationship exists between network centrality and emergency preparedness.

---

**Keywords:** Intergovernmental network, Emergencymanagement, social network analysis

### 1. Introduction

Public management of emergency situations is no longer the domain of single, self-contained agencies, but rather inter-reliant networks of actors across multiple government agencies (Kapucu, 2005; 2009). Increasingly complex and uncertain environments force the rise of "government by network" (Goldsmith & Eggers, 2004). In response, public management scholars are devoting increasing attention to collaborative networks to implement public values and services (Alter & Hage, 1993; Agranoff, 2007; Agranoff & McGuire, 2003; Gray et al., 2003; Drabek, 2004). The literature provides theoretical and empirical insights into the dynamics of collaborative networks and motives for using them (Austin, 2000). Among various policy areas, emergency management in the context of collaboration has been addressed by a considerable number of studies. The nature of emergency management demands interorganizational collaboration for effective responses to disasters (Kapucu, 2006; Lord, 2003; Mushkatel & Weschler, 1985). Regardless of whether a disaster is natural or man-made, governments should make decisions and share information in a reliable and timely manner to protect people and property. To accomplish this mission, Waugh and Streib (2006) argued that "the critical tasks leading up to, during, and following a disaster involve coordinating multiorganizational, intergovernmental, and intersectoral response and recovery operations" (p.134). The September 11 attacks, Hurricane Katrina, and their aftermaths were wake-up calls to develop effective interorganizational networks for emergency management.

A growing body of research explores these dynamics of collaboration, but the public administration literature has contributed relatively little to these efforts for understanding the structure of collaborative networks. To fill this gap, the current study is interested in the structure of intergovernmental emergency networks among county, state, and federal governments in the US. Specifically, this paper explores 1) the structural patterns of intergovernmental relationships in terms of collaborative activities and 2) the effects of network structure on county governments' emergency preparedness, using a survey of county-level emergency planning agencies. This article first reviews the literature of emergency management (EM) and the relationship between network position and performance.

---

<sup>1</sup> PhD, Assistant Professor, Department of Public Administration, Ewha Womans University, Seoul, South Korea.  
E-Mail: [yujinchoi@ewha.ac.kr](mailto:yujinchoi@ewha.ac.kr)

Then, this study's data and methods, including social network analysis and key measurements, are explained. Finally, the results section is followed by a discussion of this study.

## 2. Literature Review

### 2.1 Intergovernmental System in Emergency Management

The prior literature has shown that EM requires multi-organizational collaboration (Kapucu, 2006; Wise & Streib, 2006). Collaboration among different organizations within or across sectors to deal with disasters reduces liabilities and raises capabilities (McEntire, 2004). With regard to the different types of collaboration, the focus of this paper is on intergovernmental systems where multiple levels of government agencies join together to pursue shared goals and respond to a major emergency. Examining intergovernmental networks that enable government agencies to share information better and communicate is especially important for understanding emergency management operations (Mushkatel & Weschler, 1985). Since the creation of the Federal Emergency Management Agency (FEMA) in 1979, intergovernmental arrangements are considered essential in responding to both natural disasters and man-made emergencies (Mushkatel & Weschler, 1985). Under the notion of "shared governance," the different layers of government, including federal, state, and local, became involved in emergency management and collaborated to "protect people and property through a program of mitigation, preparedness, response, and recovery" (May, 1985; McLoughlin, 1985). The term "shared governance" refers to "situations where noteworthy decision-making power about program design and/or operations is exercised both by those in the federal government and those in state and/or local governments" (May, 1985, p. 41).

The Integrated Emergency Management System (IEMS), initially implemented in 1984 in the United States, reflects the principle of shared governance (Mushkatel & Weschler, 1985). The framework of IEMS emphasizes the efforts of various levels of government agencies to prepare for, mitigate, respond to, and recover from all types of natural and man-made emergencies and disasters (Lord, 2003; McLoughlin, 1985). The IEMS framework aims to foster federal, state, and local government collaboration to achieve common national goals, and it presumes that each level of government plays a unique role, with specific competencies (Lord, 2003). The main role of the federal government is to provide resources, expertise, and training for reacting to emergencies, beyond the competencies of local and state governments, at the sub-national level. FEMA is the key federal agency, "tasked with primary coordination responsibility for assistance to local authorities," and it places a priority on emergency management partnerships with other agencies (Lord, 2003). The state government plays a critical role in emergency management. Considering the federal tradition and law of the US, the state governments have priority when emergency situations occur within their borders (Lord, 2003). Because state governments have more resources than local ones, they are expected to increase the quality of county emergency management programs and strengthen communication and coordination networks before, during, and after disasters. A State Emergency Response Plan, which each state government ought to make, should describe the distribution of state assets to local governments and provide linkages among federal, state, and local government authorities (Lord, 2003; McLoughlin, 1985; Waugh, 1994).

Generally, a local government has the main responsibility for managing a response to an emergency. O'Leary (2004) emphasized the local government's critical role: "Virtually all disasters are experienced at the local level, where many communities can expect to be 'on their own' for the first 72 hours after disaster impact" (p1). Waugh (1994) maintained that county governments are more effective entities for emergency management functions than other levels of government. He offered seven reasons supporting the important role of county government in handling emergency functions: county governments (1) are geographically close to an environmental problem, (2) have larger resource bases than municipalities, (3) have ambiguous administrative structures that encourage cooperation, (4) are local agents of state administration, (5) have close administrative ties with state governments, (6) provide forums for local-local cooperation, and (7) already serve roles as "general purpose" local governments representing broad constituencies and having strong local identification (Waugh 1994, p.258). In most cases, county governments take the first reactions to hazards and disasters and have "legal jurisdiction until they ask for outside assistance," but the needed resources are centralized at the state and federal levels (Waugh, 1994). This might make county government difficult, because emergency management demands resources beyond what a local government typically possesses (Waugh, 1994). To overcome these obstacles and mount effective emergency responses, county governments have established various collaborative network relationships with other levels of government.

## 2.2 Network Position and Organizational Performance

A considerable number of network studies have discussed the relationship between an organization's position in a network and its performance (Mowery et al., 1996; Zaheer & Bell, 2005). Many studies have argued that network prominence or superior network position allows an organization to gain benefits, stemming from both quantity and quality of access. An organization that occupies a superior position in a network can access key information and information diversity from multiple sources in the network. This enables the organization to increase its innovation and performance (Koka & Prescott, 2008). The idea of multiple accesses is associated with the concept of centrality. Central organizations in a network have more opportunities to approach critical information because they have direct contact with multiple partners that may decrease search costs (Koka & Prescott, 2008). Multiple ties with different partners in a network also may result in more frequent interaction among them. High levels of interaction increase the transfer of valuable knowledge and resources, improving organizational performance (Koka & Prescott, 2008). However, empirical findings on the link between network position and performance are mixed. For example, while Powell and colleagues (1996) showed empirical evidence in the context of the biotech industry, suggesting that being central in a network was more likely to produce innovation, others found a negative relationship between superior network position and performance. Because of the disparity in resource availability between county governments and higher levels of government, it is expected that a county government's network alliance with higher-level governments plays a significant role in a county government's performance in emergency management. Thus, this paper develops the following hypothesis: a county government that shows a superior network position in a network shows a higher level of organizational emergency management performance.

## 3. Data and Method

This study uses data from the 2006 National Survey of Local Emergency in County Government, which was conducted by the National Association of Counties and the Center for the Study of Counties at the University of Georgia's Carl Vinson Institute of Government. The survey was designed to examine key aspects of county emergency management, including organizational structures, financial and human resources, and county governments' collaborations with other government entities (Clarke, 2006). Although the original survey was sent to 3,066 U.S. counties, representing 46 of the 50 states, the current study analyzed data from counties in the state of Georgia. Because the "state-local relationships differ considerably from state to state" (Vaughn, 1994, p.256), this article focuses on the State of Georgia, as a geographical boundary.

### 3.1 Network Analysis

A large body of public management studies to date has discussed the collaborative networks of emergency management organizations, but their methodology has relied primarily on traditional methods, such as case studies and regression analysis (Austin, 2000). Social network analysis is well-developed, but it is not yet often used in the public sector (Berry et al., 2004; Luke & Harris, 2007; Valente et al., 2008). A growing body of studies uses social network analysis to investigate the patterns of collaborative networks in emergency management (Choi & Brower, 2006; Kapucu, 2006). As Granovetter (1985) argued, it is important to consider organizations as embedded in social networks. Figuring out how an organization is embedded in a network leads to a better understanding of the behavior of the organization. While some network actors may actively interact with other organizations in the network and be closer to a broker organization, others may be fully isolated (Kapucu, 2006). Network analysis is designed to analyze relational data. Whereas attribute data relates characteristics that belong to individual agents, relational data consist of ties and connections that relate one individual agent to another (Scott, 2000; Wasserman & Faust, 1994). The focus of network analysis is the connections or relationships among network actors (e.g., information sharing and resource exchanges), and it is useful for understanding patterns of relations (Thomas et al., 2007). Using various measures, network analysis finds the location of central actors and describes overall network properties (Valente et al., 2008). This provides valuable information with respect to the structural characteristics of collaborative networks. This article reports on a social network analysis, using UCINET 6, a network analysis software program (Borgatti et al., 2002), to describe the network relationships between county governments and other levels of government agencies in emergency management systems in the state of Georgia.

Specifically, through measuring four types of intergovernmental collaborative networks, this study identifies structural patterns in the intergovernmental relationships between county government and federal and state emergency agencies (i.e., FEMA, EPA, the state's EM, and the state's EPA) that may help in our understanding of collaborative efforts in emergency management systems.

### 3.2 Patterns of Intergovernmental Emergency Networks

This study describes the structural patterns of intergovernmental relationships in collaborative activities in the state of Georgia. The literature provides a plethora of concepts of collaboration, but many studies seem to agree that collaboration involves a continuum of means of cooperation rather than a set of fixed relationships (Austin, 2000). Consistent with this argument, the present paper uses four types of collaboration: (1) informal cooperation, (2) formal mutual aid agreement, (3) memorandums of understanding, and (4) joint planning. Depending on the types of collaboration involved, the structures of intergovernmental relationships might vary. The presence of network ties was coded as '1,' whereas the absence of a relationship was coded as '0.' Two-mode network analysis, developed by Borgatti and Everett (1997), was used to explore the question of how county governments interact with other levels of government. The network data used in this study are county governments and a set of other levels of government (i.e., FEMA, EPA, the state EM, and the state EPA), and these are arranged as a two-mode county-by-state/federal government matrix. While a typical network analysis examines the interrelations among the same set of persons or entities (one-mode analysis), two-mode analysis looks at the relations between two equally interesting sets of persons or entities (Borgatti & Everett, 1997). Two-mode network data cannot be analyzed like a one-mode network data in UCINET because "the matrix is not square and the rows and columns are different modes" (Parker 2006). Borgatti and Everett (1997) suggested an alternative approach by "treating the data as a bipartite graph, computing geodesic distances, and submitting this matrix to multi-dimensional scaling" (Mote, 2005). Following their suggestion, this paper runs abipartite function, then shows the graphs through sociograms and specific network measure for the four types of collaboration.

Among the various network measures, the focus here is on centrality, density, and centralization, the most common measures of network structure. Freeman (1977, 1979) developed the centrality measure, which refers to how central a focal actor's position is, relative to others in the network. Degree-based centrality is the degree of the nodes (Wasserman & Faust, 1994). Through centrality measures assessing the location and importance of actors in the network, we can identify powerful key organizations in each network (Kapucu, 2005). This approach describes how close each county government is to the key emergency agencies as well. Density, referring to "the number of lines in a graph, expressed as a proportion of the maximum possible number of lines" (Scott, 2000 p.71), and centralization are both calculated to explain the structural patterns of each network. Density measures the overall connectedness of a network as a general level of cohesion, while centralization measures the degree to which the network is focused around particular actors (Scott, 2000).

### 3.3 The Impact of Network Position on Emergency Preparedness

In addition to the structural patterns, this paper also examines how network position impacts a county government's emergency preparedness. To test a hypothesis, this paper uses an ordinary least squares (OLS) regression model. The following section explains the measures used in this article.

$Y$  (*Emergency preparedness*)

$$\begin{aligned}
 &= \beta_0 + \beta_1 X_1 (\text{centrality in formal mutual aid network}) \\
 &+ \beta_2 X_2 (\text{centrality in joint planning network}) + \beta_3 X_3 (\text{centrality in informal network}) \\
 &+ \beta_4 X_4 (\text{centrality in MOU}) \\
 &+ \beta_5 X_5 (\text{county's EM characteristics}) + \beta_6 X_6 (\text{emergency risk level}) \\
 &+ \beta_7 X_7 (\text{per capita}) + \varepsilon
 \end{aligned}$$

#### 3.3.1 County Preparedness for Emergencies

The dependent variable, county preparedness for emergencies, was measured with a composite index, based on respondents' answers to the following question: "To what extent is each of the following prepared for the types of disasters that have hit your county in the past or are likely to affect the county in the future?"

This perceived emergency preparedness was measured for the following components of the county government: the majority of people in your county, most government departments, agencies, and offices in your county, most private corporations and businesses in your county, most hospitals and health care facilities in your county, most voluntary groups and organizations in your county, most churches and religious organizations in your county, the police department in your county, the fire department in your county, and schools in your county.

3.3.2 Network Centrality Measure

The questionnaire used in this survey provided a list of organizations to representatives of each county government and asked the respondents to identify all of the organizations that they work with through their county government. Respondents were presented with the following prompt: *Please indicate the agencies and organizations that you have worked with over the past two years in your emergency planning, mitigation, response, or recovery. Check all that apply.* The same prompt was given for all four types of collaborations. Among network structure variables, this paper uses the degree centrality measure because “it best reflects the extent of direct links of the focal organization in the network” (Arya & Lin, 2007). As stated in the hypothesis, this paper expects that *a county government that has a high centrality in the intergovernmental network will be positively associated with its emergency preparedness.*

3.3.3 Control Variables

This paper considers several variables as control variables that could affect emergency preparedness. They are the emergency management (EM) related characteristics of county governments, emergency risk level, and county characteristics. First, the EM characteristics of county governments are measured with a natural log of the budget for the EM office or department in the current fiscal year, the number of employees in EM office or department, training of emergency managers in different fields, and the percentage of the chief emergency management official’s time spent on emergency management. Second, the emergency risk level was rated with the following question: “What emergencies or natural disasters are the greatest concerns for your county?” 24 categories of emergencies were scored on a seven-point scale: hurricanes, earthquakes, volcanic eruptions, floods, winter/ice storms, tornados/severe winds, lighting, fires, hazardous materials spills (transportation), hazardous materials threat (fixed site), hail, civil disturbance, terrorist attack (nuclear), terrorist attack (biological), terrorist attack (chemical), landslide, subsidence, tsunamis, drought, heat waves, computer/tech failure, air transportation, and land and sea. Finally, a county’s per capita income is also included as a control variable.

4. Results

Table 1 shows the descriptive statistics (isolated counties were deleted). It seems that whether collaboration was formal or informal is not related to the number of actors or ties. Of 40 county governments in Georgia, 22 joined in formal mutual aid agreements, whereas only seven counties chose memorandums of understanding as a type of collaboration.

**Table 1: Descriptive Statistics of Emergency Networks in the State of Georgia**

	Formal mutual aid agreement	Memorandum of understanding	Informal cooperation	Joint planning
Number of organizations	26	11	24	16
Number of ties	37	10	37	20
Tie per organization	1.42	0.91	1.54	1.25

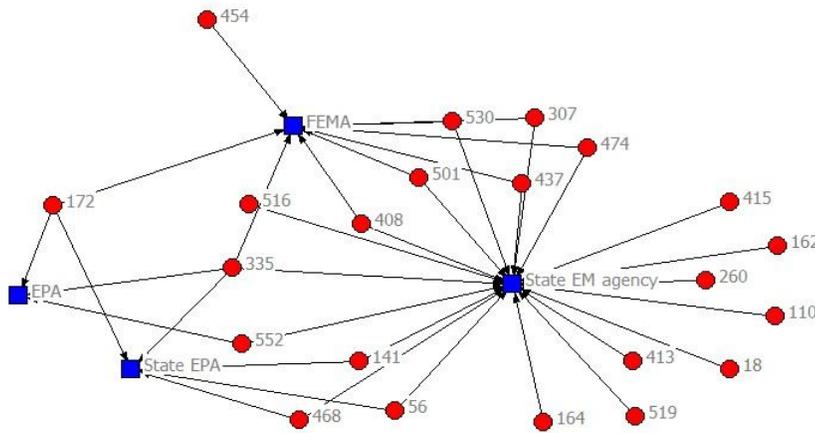
The next section explores the structural patterns of networks through sociograms and network structure measures such as degree centrality, density, and centralization.

4.1 Structural Patterns of Emergency Networks

4.1.1 Patterns of the Formal Mutual Aid Network

Figure 1 presents a multi-dimensional scaling of the network between county governments and other layers of governments (FEMA, EPA, the state EM, and the state EPA). This is the largest collaborative network, involving 26 organizations and 37 ties among agencies. According to degree centrality measures, the state EM agency is the most influential and central network actor in this mutual aid network. The results show that the EPA or the state EPA agency has not arrived at a formal mutual aid agreement with county governments. The overall density of the formal mutual aid network was 0.0330 and network centralization was 57.39%.

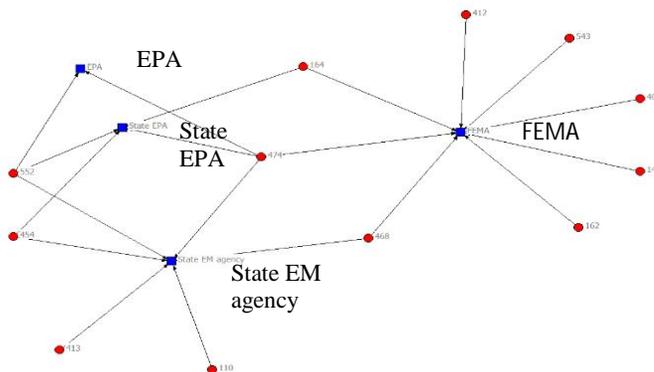
**Figure1. Formal Mutual Aid Network**



4.1.2 Patterns of Joint Planning Emergency Networks

The sociogram for the joint planning emergency network is presented in Figure 2. The figure shows a visual representation of the structure of relationships among county governments and four state/federal government agencies, as well as the major players in this network. In the graph, county governments are represented by red round nodes. Among 16 agencies, including federal and state government actors, there are 20 directional ties.

**Figure 2: Joint Planning Emergency Network**

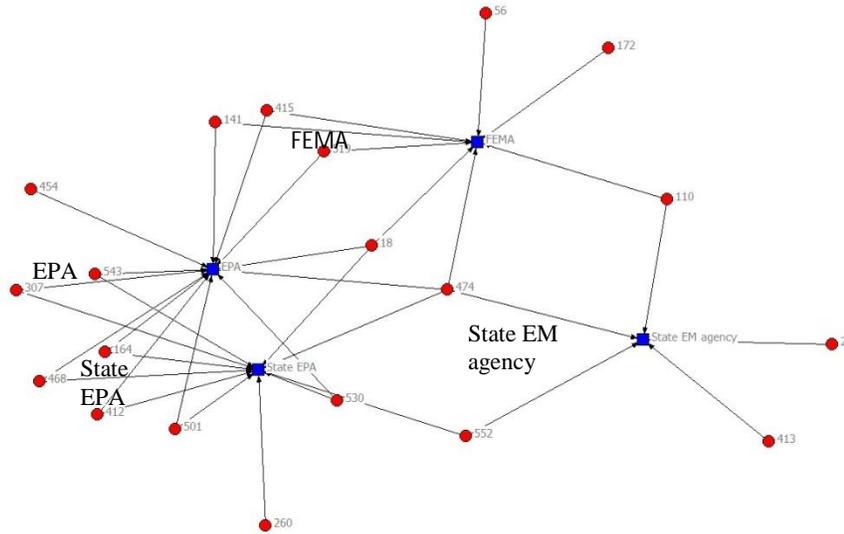


FEMA and the state EM agency register the highest degrees on the degree centrality measures and can be considered the most influential agencies in the joint planning emergency network. The state EPA and Banks County (actor #23) follow. The overall density of the joint planning emergency network was 0.0178 and network centralization was 21.97%.

4.1.3 Patterns of the Informal Cooperation Network

Twenty county governments are involved in this network. There appear to be some differences in how county governments are connected to the four agencies. The EPA and the state EPA are in the center of informal cooperative activities, but the state EM agency seems not to be very well connected with county governments. Unlike the formal mutual aid network, the EPA and the state EPA agencies play central roles in this network. The overall density was 0.0330 and network centralization was 34.85%.

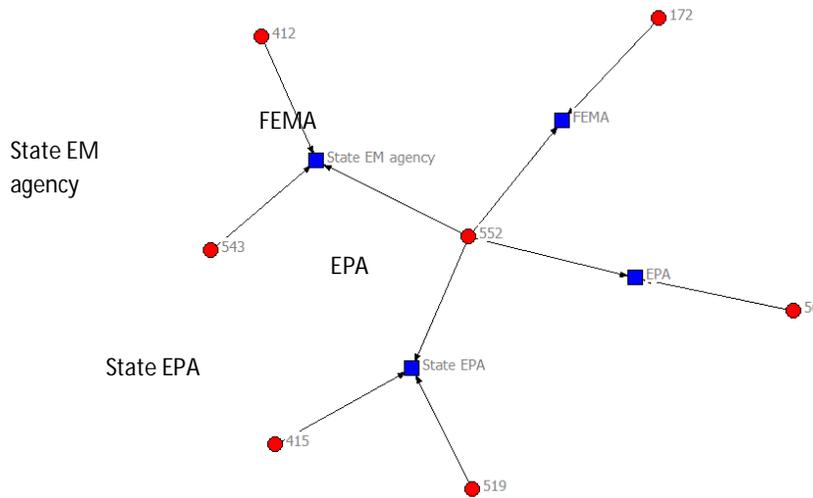
**Figure 3: Informal Cooperation Network**



4. 1. 4 Patterns of the Collaborative Network Involving Memorandums of Understanding

The least number of network actors joined in this network. Among the four types of collaborative networks, this is the smallest. This is very different tendency from formal mutual aid agreement previously stated, even though both formal mutual aid and MOU networks belong to the formal interactions of county governments with other levels of emergency agencies. The results indicate that Appling County (actor #552) established memorandums of understanding with all four state/federal government agencies. The overall density was 0.0089 and centralization was 10.98%.

**Figure 4: MOU Collaborative Network**



4.2 The Impact of Network Centrality on Emergency Preparedness

This study used an Ordinary Least Square (OLS) model to analyze the impact of network centrality on a county government's preparedness for emergencies in four types of collaborative networks. Table 6 shows the regression result. The finding shows that the network position (centrality) of county government in a formal mutual aid network is positively associated with the level of emergency preparedness. At the same time, centrality measures in other types of networks have not yielded statistically significant evidence and, thus, only partially support the hypothesis. Among control variables, the training of emergency managers and a county government's per capita income present significant relationships with the county government's emergency preparedness. The R<sup>2</sup> value was 0.4855.

**Table 6: Impact of Network Centrality on EM preparedness**

EM preparedness	Coef.	P>t	
Centrality in formal mutual aid network	0.271664	0.079	*
Centrality in joint planning network	0.03597	0.848	
Centrality in informal cooperation network	-0.05083	0.769	
Centrality in MOU	-0.09846	0.688	
Time spending on EM	0.001995	0.771	
Number of EM employees	-0.0065	0.596	
Training	1.546313	0.027	**
Risk level	0.127646	0.508	
County's per capita (log)	-1.42635	0.09	*
EM budget (log)	-0.15715	0.525	

(Obs.=40)

\* $p < 0.1$ \*\* $p < 0.05$ 

## 5. Discussion

This paper describes the structural patterns of intergovernmental emergency preparedness and then explored the impact of network centrality in collaborative networks on a county government's preparedness for emergencies. Through the first analysis using a social network analysis technique, this paper identified influential actors in each type of collaborative network. These results might provide initial insight into how county governments and other levels of government organizations interact with each other in terms of emergency management. Although the findings in the second analysis did not fully support the argument that network position affects organizational performance (i.e., emergency preparedness), the results showed that at least in the formal mutual aid network, a positive relationship exists between network centrality and emergency preparedness. Given the small number of observations, this result is exploratory. Because many studies dealing with the issue of network position and performance have been conducted in a business setting, however, this article, in the intergovernmental setting, might add useful results to existing knowledge. As Koka and Prescott (2008) noted, however, contingency factors, including environmental change and time, might affect the impact of particular network positions on performance. Thus, to obtain more precise results, future research should consider relevant contingency variables in an emergency management context.

According to Burt's (1995) argument, organizations in a network rich in structural holes gain advantages because they are able to access new information from network actors remote from them. However, due to the limitation of survey data, this paper could not identify the role of structural holes on performance. Although this study focused on vertical collaborations in government, future research should consider lateral collaborations between county governments and other government agencies such as fire departments, and private/nonprofit organizations, such as hospitals too. Furthermore, although this study was concerned with organizational performance, other scholars such as Provan and Milward (2001) stressed the need to examine network performance. Because analyzing network characteristics is important to the evaluation of network performance (Kapucu & Demiroz, 2008), the impact of network structure in network performance is an important consideration. Besides network performance, it might be interesting to test whether county governments perform better in an emergency situation as they increase their interactions with other organizations inside or outside government.

## References

- Agranoff, R. (2007). *Managing within networks: Adding value to public organizations*. Georgetown University Press.
- Agranoff, R., & McGuire, M. (2004). *Collaborative public management: New strategies for local governments*. Georgetown University Press.
- Alter, C., & Hage, J. (1993). *Organizations working together*. Newbury Park, CA: Sage Publications.
- Arya, B., & 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*, 33(5), 697-723.
- Austin, J. E. (2000). Strategic collaboration between nonprofits and business. *Nonprofit and Voluntary Sector Quarterly*, 29 (suppl 1), 69-97.
- Berry, F. S., Brower, R. S., Choi, S. O., Goa, W. X., Jang, H., Kwon, M., & Word, J. (2004). Three traditions of network research: What the public management research agenda can learn from other research communities. *Public administration review*, 64(5), 539-552.
- Borgatti, S. P., & Everett, M. G. (1997). Network analysis of 2-mode data. *Social Networks*, 19(3), 243-269.
- Borgatti, S. P., Everett, M. G., & Freeman, L. C. (2002). *UCINET 6 for Windows*. Harvard: Analytic Technologies, 185.
- Burt, R. S. (1995). *Structural holes: The social structure of competition*. Harvard University Press.
- Choi, S. O., & Brower, R. S. (2006). When practice matters more than government plans a network analysis of local emergency management. *Administration & Society*, 37(6), 651-678.
- Clarke, W. (2006). *Emergency management in county government: A national survey*. University of Georgia. Carl Vinson Institute of Government.
- Drabek, T. E. (1985). Managing the emergency response. *Public Administration Review*, 85-92.
- Freeman, L. C. (1977). A set of measures of centrality based on betweenness. *Sociometry*, 35-41.
- Freeman, L. C. (1979). Centrality in social networks conceptual clarification. *Social networks*, 1(3), 215-239.
- Goldsmith, S., & Eggers, W. D. (2005). *Governing by network: The new shape of the public sector*. Brookings Institution Press.
- Gray, A. (Ed.). (2003). *Collaboration in public services: the challenge for evaluation* (Vol. 10). Transaction Publishers.
- Granovetter, M. (1985). Economic action and social structure: the problem of embeddedness. *American journal of sociology*, 481-510.
- Kapucu, N. (2005). Interorganizational coordination in dynamic context: Networks in emergency response management. *Connections*, 26(2), 33-48.
- Kapucu, N. (2006). Interagency communication networks during emergencies boundary spanners in multiagency coordination. *The American Review of Public Administration*, 36(2), 207-225.
- Kapucu, N. (2009). Performance under stress: Managing emergencies and disasters: Introduction *Public Performance & Management Review*, 32(3), 339-344.
- Kapucu, N., & Demiroz, F. (2011). Measuring performance for collaborative public management using network analysis methods and tools. *Public Performance & Management Review*, 34(4), 549-579.
- Lord, A. F. (2003). *Integrated Emergency Management: The Roles of Federal, State, and Local Government with Implications for Homeland Security*. Strategy Research Project.
- Luke, D. A., & Harris, J. K. (2007). Network analysis in public health: history, methods, and applications. *Annu. Rev. Public Health*, 28, 69-93.
- May, P. J. (1985). FEMA's role in emergency management: examining recent experience. *Public Administration Review*, 40-48.
- McEntire, D. A. (2004). The status of emergency management theory: Issues, barriers, and recommendations for improved scholarship. Paper presented at the FEMA higher education conference.
- McLoughlin, D. (1985). A framework for integrated emergency management. *Public Administration Review*, 165-172.
- Mote, J. E. (2005). R&D ecology: using 2-mode network analysis to explore complexity in R&D environments. *Journal of Engineering and Technology Management*, 22(1), 93-111.
- Mowery, D. C., Oxley, J. E., & Silverman, B. S. (1996). Strategic alliances and interfirm knowledge transfer. *Strategic management journal*, 17(S2), 77-91.
- Mushkatel, A. H., & Weschler, L. F. (1985). Emergency management and the intergovernmental system. *Public Administration Review*, 49-56.
- O'Leary, M. (Ed.). (2004). *The first 72 hours: A community approach to disaster preparedness*. iUniverse.

- Parker, Andrew. (2006). 2-mode networks (available at: [https://webapp.comm.virginia.edu/NetworkRoundtable/Portals/0/Tutorials/July\\_Workshop-2\\_mode\\_networks.pdf](https://webapp.comm.virginia.edu/NetworkRoundtable/Portals/0/Tutorials/July_Workshop-2_mode_networks.pdf))
- Scott, J. (2012). *Social network analysis*. Sage.
- Thomas, J. C., Isler, M. R., Carter, C., & Torrone, E. (2007). An interagency network perspective on HIV prevention. *Sexually transmitted diseases*, 34(2), 71-75.
- Wasserman, S. (1994). *Social network analysis: Methods and applications* (Vol. 8). Cambridge university press.
- Waugh Jr, W. L. (1994). Regionalizing emergency management: Counties as state and local government. *Public Administration Review*, 253-258.
- Waugh, W. L., & Streib, G. (2006). Collaboration and leadership for effective emergency management. *Public administration review*, 66(s1), 131-140.
- Valente, T. W., Coronges, K. A., Stevens, G. D., & Cousineau, M. R. (2008). Collaboration and competition in a children's health initiative coalition: A network analysis. *Evaluation and program planning*, 31(4), 392-402.
- Zaheer, A., & Bell, G. G. (2005). Benefiting from network position: firm capabilities, structural holes, and performance. *Strategic management journal*, 26(9), 809-825.