# SOURCES OF ORGANIZATIONAL RESILIENCE
# DURING THE 2012 KOREAN TYPHOONS:
# AN INSTITUTIONAL COLLECTIVE ACTION FRAMEWORK

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A dissertation submitted in partial fulfillment of
the requirements for the degree of
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The objective of this proposed research is to test whether interorganizational collaboration contributes to the ability of an organization to bounce back swiftly from disasters. The research questions are examined from the Institutional Collective Action (ICA) perspective. The general argument of this dissertation is that organizational resilience can be explained by interorganizational collaboration. The ICA framework, specifically, identifies two general network structures to explain strategies that can be adopted to minimize collaboration risks: bonding and bridging structures.

This dissertation focuses on how governmental and nongovernmental organizations in South Korea collaborated. The data was collected from the southeastern tip of the Korean Peninsula in August of 2012, and January of 2013. The 2012 Typhoons devastated the area after the first data set was collected in August 2012, causing the loss of estimated US$ 730 million and 29 fatalities. Afterward, the second survey was administrated in January of 2013 to gauge respondents' views on how organizations responded to the disasters.

This dissertation consists of three essays. The first essay presents a brief overview and assessment of the current research on resilience. The second essay empirically tests the sources of organization resilience. The third essay examines the dynamic nature of interorganizational ties by employing stochastic actor-based models. The findings show how organizations prefer to not coordinate with other organizations even though this could reduce their strains during a disaster. The findings also suggest that organizations that operate in higher risk areas or participate in joint full-scale exercises before a disaster form interorganizational ties afterward.

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# CHAPTER 1

## INTRODUCTION

Since the adoption of the Hyogo Framework for Action 2005-2015 that called for research on organizational resilience (Manyena, 2006; Norris et al., 2008), there has been a growing interest among scholars and practitioners to examine and apply the concept of resilience in communities. The concept of resilience, however, is not new. For example, more than a decade ago, Ganor and Ben-Lavy (2003, p.105) suggested that organizational resilience is important because it is based on a community's self-determination and evolved as a "by-product of the investment in community development." More recently, Kapucu et al., (2013) noted that communities can reduce risk and improve resilience by focusing on development planning and mitigation strategies.

The concept of resilience is multidimensional depending on the level of research. At the community level, the term "resilience" is generally defined as "the capability of a community to face a threat, survive and bounce back or, perhaps more accurately, bounce forward into a normalcy" (Cox and Perry, 2011, p. 395). Others have described resilience at the organizational level (McManus et al., 2008; Crichton et al., 2009; Kapucu et al., 2013; Andrew et al., forthcoming). In particular, Andrew et al. (forthcoming, p. 2) note that organizational resilience captures "the ability of organizations to work together in minimizing operational disruptions and coordinate critical resources across administrative boundaries to aid local communities."

From the institutional collective action perspective, organizational resilience can be viewed as a paradox. Andrew et al. (forthcoming), for example, ask why an organization would

provide assistance to others if such efforts jeopardize the ability of the organization to perform its core functions during emergency and thus affecting their recovery. One of the problems is related to uncertainty, which often increases with the cost of building organizational resilience. For instance, the nature of tasks in building organizational resilience is multifaceted, suggesting that the costs of establishing trust and obtaining reliable information to perform the task will be high. The costs of negotiation will also increase as the number of interacting organizations increases, making it harder for each to achieve a consensus about designing and maintaining activities that are crucial for building organizational resilience (Andrew, 2010; Feiock and Scholz, 2010; Feiock, 2013).

Moreover, when effective monitoring and enforcement mechanisms are not present, the costs of maintaining and enhancing organizational resilience can be high for the local community. Since the nature of emergency does not exclude organizations from being affected by the disaster, it is difficult for individual organizations to agree on the most efficient way of distributing costs. Individual organizations have a strong incentive to free ride on the effort of others in order to reap the benefits of collaboration without making contributions to the collective. The rational choice perspective would suggest that during emergency situations where resources are limited and scarce, any rational actor would act in its own best interest by not cooperating and providing assistance to others.

Given the theoretical puzzle, the main objective of this research is to test whether interorganizational collaboration contributes to the ability of an organization to bounce back swiftly from disasters. While much has been written about the benefits and barriers to collaboration (Comfort, 1994; Perry and Lindell, 2003; Waugh and Streib, 2006; Robinson, 2012), few empirical studies have directly tested the tangible and intangible benefits that could

be generated through interorganizational collaboration. In the field of emergency management, with the exception of the work conducted in Thailand (Andrew et al., forthcoming), most studies tend to be descriptive (Tierney and Trainor, 2004; Harris and Clements, 2009; Moynihan, 2009; Vasavada, 2013), and thus, preventing us from having a broader understanding of the causal mechanisms driving organizations to provide assistance while dealing and continuing to perform their own core functions. The effect of collaboration on organizational resilience is also an important question to explore if organizations are to build capacities to withstand external shocks, such as coping and recovering swiftly from disasters. This research is then guided by three questions:

1. What are the sources of organizational resilience?
2. Given the evolutionary nature of organizational ties, how do organizations develop relations before and after a disaster?
3. What are the endogenous and exogenous factors explaining changes of organizational behaviors after a disaster?

Lacking from the literature calls an innovative and alternative approach to studying resilient communities. The concept is not well defined—making it difficult to develop reliable constructs applicable to different types of hazards and international settings. With one exception of a study in Thailand (Andrew et al., forthcoming), the literature has largely overlooked key dimensions of organizational resilience at the international level such as robustness, rapidity, resourcefulness, and redundancy (Bruneau et al., 2003; Norris et al., 2008; Jung, 2013). That is, whether theoretical dimensions developed in the US and Europe also hold true theoretically in

the newly industrialized and developing countries remains unknown. Thus, there is a need to develop an alternative approach to identify and test sources that contribute to resilience.

The research questions also highlight that the collective action dilemmas are the result of policies originating in higher level of government (i.e., not in line with the preferences of the local community) (Quarantelli, 1983; Drabek, 2004; Lindell and Perry, 2003; Kapucu, 2006; Cox and Perry, 2011). While some organizations are able and willing to provide resources and assistance to other organizations and communities in need, others are less able or willing to do so. The problems are particularly apparent in the area of emergency planning where the consensus developed at the local or regional level may not be in congruence with the national or central government policy. Local organizations and communities generally lack an incentive to invest their own resources in building capacity to cope with disasters, and thus, more likely to rely on resources and coordination of higher levels government to respond to disasters (NRC, 2011; Jung 2013).

This chapter is organized in the following ways. The next section will briefly explain the ICA theoretical framework in the context of emergency response. Two general network structures are advanced to explain sources of organizational resilience: bonding and bridging hypotheses (Andrew et al., forthcoming; Feiock, 2013; Andrew, 2009; 2010). While the bonding structure has been argued to have the advantage of generating shared resources and cohesiveness, the bridging structure allows the central organization to transmit information and coordinate joint activities effectively. To understand interorganizational ties, the complex nature of collaboration is further explored based on the interdependent risk and independent risk hypotheses. While the interdependent risk hypothesis suggests an organization with a strong preference to forge ties in order to share risks associated with emergency response, the independent risk hypothesis

highlights the tendency for an organization to spread risks by establishing ties with those outside their close-knitted circle. Before summarizing the general findings of the research, the research design, data collection, and methods of analysis are briefly discussed.

## Theoretical Framework: Institutional Collective Action (ICA) Perspective

Scholars in the field of emergency management often argue that the purpose of establishing and maintaining interorganizational collaboration is to overcome internal limitations of organizations and to strengthen organizational capacity (Waugh, 1994; Waugh and Streib, 2006; Kapucu et al., 2012). It is assumed that by working together, organizations build joint capacity and minimize the effect of disasters, which in turn increases their ability to bounce-back and return to normalcy (Jung, 2013; Andrew et al., forthcoming). Quarantelli, Lagadec, and Boin (2006), for example, highlight that interorganizational collaboration has become an indispensable part of emergency management due to the nature of disasters. Drabek and McEntire (2002) also indicate that, because resource coordination for response operations is often problematic, multi-organizational collaboration across sectors provides clues to coping with organizational capacity. According to Phillips, Neal, and Webb (2012), developing interorganizational partnerships among sectors under all aspects of emergency management should be a top priority for building resilient communities.

To examine the effect of organizational collaboration on the ability of an organization to cope with disasters, this research employs the ICA framework that allows us to analyze the collective action problem at the organizational level (Feiock 2013, Feiock and Scholz, 2010; Andrew and Carr 2013; Andrew 2009; 2010). The ICA framework is based on an actor-centered

preference (Scharpf, 1997) and the Institutional Analysis and Development (IAD) framework introduced by Ostrom. However, the IAD framework considers joint agreements or composite action grounded on individuals' rationality, which has limitations when applied to collective action dilemmas at the organizational level. The ICA framework employs similar logic when examining fragmented authority among multiple government units and the collective action dilemmas at the local or institutional level (Feiock, 2013). In the institutional collective action dilemma, each organization is assumed to make a risk assessment. Organizations may have incentives to participate in response and planning as well as high transaction costs that exacerbate ICA dilemmas (Feiock, 2013).

The framework provides 4 general guidelines to understand collective action dilemmas: (1) the nature of the dilemma, (2) the authorities directly or indirectly involved in the policy arena, (3) the potential risks associated with action and inaction, and (4) the incentives explaining the motivation of the actors (Feiock, 2013). First, the nature of the dilemma refers to a collective action problem embedded in interorganizational collaboration in which individual incentives of organizations may lead to inappropriate collective outcomes not desired by any of the individuals (Ostrom, 2005; Feiock, 2013). Second, the authorities directly or indirectly involved in the policy arena focus on established tools and goals created through collective decisions of participants involved in ICA dilemmas (Williamson, 1985; Feiock, 2013). Third, the potential risks and uncertainty derived from action and inaction is closely connected to transaction costs involved in the spillover effect among control, efficiency, political representations, and self-determination of organizations (McGinnis, 1999; Feiock, 2009). Lastly, the incentives for the motivation of organizations indicate a systematic means (i.e., regulations and monitoring mechanisms) to resolve ICA dilemmas by considering the barriers that prevent

authorities from achieving coordinated decisions (Brown and Potoski, 2005; Feiock and Scholz, 2010; Feiock, 2013).

The basic argument is as follows: In the presence of collective action dilemmas, organizations often make decisions strategically in order to reap the relative advantages of working collaboratively with others (Feiock, 2013). The strategic decision depends on the level of risks of collaboration, which is determined by the nature of interorganizational activities, frequency of interactions, and prior experiences with existing or potential collaborators. The decision to collaborate is also determined by uncertainties of organizational behaviors (Feiock and Scholz, 2010). Given the limited cognitive ability of organizations and information asymmetry, the threat of free riding problems or opportunistic behaviors also prevents collaboration. While monitoring and enforcement systems can be purposely designed to minimize uncertainties, the transaction costs in developing and maintaining them often prompt potential collaborators to seek alternative mechanisms to safeguard their joint activities (see Feiock, 2013; Carr and Hawkins, 2013). Otherwise, the organization will not contribute to the efforts of the collective.

In the context of emergency management, the collaboration and ability to cope with disasters also depends on the willingness of individual organizations to internalize coordination costs contributing to organizational cohesiveness in emergency response (Jung, 2013; Andrew and Carr, 2013). That is, organizational cohesiveness demands individual organizations to prepare for disasters as a collective in order to minimize operational disruptions. While collaboration in emergency management is often perceived as a "good thing," equally puzzling is the motivation of organizations to collaborate despite potential hardship in acquiring resources during disasters and functioning effectively after disasters. One important question, however,

remains unanswered: with whom do organizations collaborate in order to improve their likelihood to bounce back from devastations caused by disasters? To enhance the level of resilience, an organization can position itself to collaborate with a central actor in order to gain access to information and resources not available locally (bridging) or the organization can work closely with other organizations that are themselves closely connected with each other in order to pool and share redundant resources (bonding). Whether or not such a strategy would generate tangible outcomes is not well understood.

**Bonding and Bridging Hypotheses**

The general argument of this dissertation is that the sources of organizational resilience can be partly explained by interorganizational collaboration. Extending the ICA framework, two general network structures are advanced to explain strategies that can be adopted to minimize collaboration risks: bonding and bridging structures (Feiock, 2013; Andrew, 2009; 2010). A bonding structure, for example, provides actors with shared resources and cohesiveness in response and may thus contribute to resilience during disaster recovery. Public organizations situated in a bonding structure are assumed to have the ability to exchange resources directly with those that are also in close social proximity.

A bridging structure, on the other hand, presents the position of an actor with resources that connects other actors that would otherwise be disconnected. An organization positioned as a central actor that plays the bridging role in a network structure can coordinate joint activities and distribute resources effectively such as key personnel and equipment (Andrew and Carr, 2013; Andrew et al., forthcoming). Moreover, from the ICA perspective, the central organization is

assumed to have better access to reliable information in order to coordinate join activities (Freeman, 1980; Lin, 2001; Kapucu, 2006; Andrew and Carr, 2013) as well as the ability to minimize the possibility of organizational failure (see Andrew, 2010).

While the bonding and bridging network structures have been tested in other fields (Berardo and Scholz, 2010; Lee et al., 2012; Burt, 2005), the extent to which individual positions can provide tangible and intangible resources is not well understood. In examining the effect of joint activities during emergency response, only one study recently employed the social network analysis (Andrew et al., forthcoming). While this approach highlights the importance of social positions in influencing organizational resilience, it only captures the effect of interorganizational collaboration at one point in time; thus, ignoring the dynamic nature of interorganizational collaboration. Employing an advanced social network analysis (i.e., SIENA and SABM) provides better insights on sources of community and organizational resilience over time. This method of analysis also provides an alternative way of understanding the dynamic and motivation behind local government behaviors.


**Interdependent Risk and Independent Risk Hypotheses**

Given the evolutionary nature of organizational ties, organizations tend to develop and change their relations before and after a disaster. Previous studies have not examined this phenomena. Based on the ICA framework, two additional hypotheses are advanced: Interdependent-risk and independent-risk hypotheses. The interdependent risk hypothesis suggests that organizations have a strong preference to forge ties with those that are connected closely together in order to share risks resulted from disasters. That is, an organization that is closely connected to other

organizations may be more resilient than another organization because of the following reasons:
(1) forging a direct tie can broaden the range of collaborators leading to risk-sharing with
adjacent communities and enables people to respond quickly (Andrew, 2010); (2) holding a
close-knit structure provides informal structural power to directly access and mobilize
indispensable resources that an organization urgently needs during a disaster (Burt, 2005); and
(3) the importance of associational benefits resulting from close-knitted structures to share
resources through formal and informal arrangements after a disaster (Vasavada, 2013).

The independent risk hypothesis, on the other hand, posits that an organization will
spread risks by establishing ties with those outside their close-knitted circle. The hypothesis
highlights the importance of entrepreneurial behaviors of organizations to spread risks. The risk-
spreading strategy is important for organizations to minimize potential losses from the disaster
(Kreimer, Arnold, and Carlin, 2003). The reasons motivating organizations to spread risks and
establish ties with a central organization are that by establishing organizational ties with a central
actor, the organization can reduce additional costs of coordination (Andrew, 2010). That is,
organizations in the peripheral of a network prefer to directly link to core actors because they
cannot bear the costs of crafting and monitoring other collaborators independently (Kapucu,
2006).


**Exogenous Factors**

While the interdependent and independent hypotheses captured by the endogenous factors
explain the change of interorganizational ties, the tendency for organizations to change the nature
of collaboration is also influenced by exogenous factors such as social and environmental
vulnerability and the joint full-sized exercise capture "the average frequency at which an actor

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gets the opportunity to change their outgoing ties" (Snijders et al., 2010, 53). For instance, organizations with environmental vulnerability may change their network ties more frequently than others that are not located in the coastal line. Depending on such actors' attributes, the hypotheses allow us to examine whether the exogenous factors have an effect on organizational behaviors to change their interorganizational ties after a disaster.

**Homophily Hypothesis**

Previous research on intergovernmental collaboration also suggests the importance of organizational attributes (Lubell, 2007; Goodreau et al., 2009; Andrew, 2009). For instance, the homophily hypothesis allows us to investigate the similarity of organizational attributes in the field of emergency management. This hypothesis suggests that similarities of organizations will predispose the actors to have comparable policy preferences and strategic behaviors to reduce transaction costs (Goodreau et al., 2009). According to Lubell (2007), intrinsic similarities between organizations are crucial for selecting potential collaborative partners. This is important because it helps reduce transaction costs (Feiock and Scholz, 2010) and/or minimize risks derived from collaboration (Gulati and Gargiulo, 1999).

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**Emergency Management in South Korea**

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This dissertation focuses on interorganizational collaboration in the field of emergency management, South Korea. The patterns of interorganizational collaboration activities in the field are appropriate to test the general propositions that collaboration has an effect on organizational resilience. The nation's emergency management system has typically been

criticized as being highly centralized and hierarchical. Few studies have examined the patterns of interorganizational collaboration; most tend to be based on theoretical arguments and metaphors rather than empirically tests the nature of collaboration that exist at the local and regional levels.

Historically, the nation's emergency management system has been based on a three-tier structure (Ha, 2009; Ha and Ahn, 2009; Kim, Tachikawa, and Takara, 2007; Seo, 2008; Lee 2012; Jung, 2013). For instance, the National Emergency Management Agency (NEMA) [1] and the Ministry of Safety and Public Administration (MOSPA) played an important role in establishing the nation's emergency management system , which was primarily managed as a part of the civil defense by the National Council of Civil Defense before the 2000s (Ha, 2009). Since 2004, under the Basic Act (2004), three main bureaus under NEMA played the central coordinating role: the Prevention and Safety Bureau (man-made disasters and civil defense), the Emergency Management Bureau (disasters), and the Fire Policy Bureau (fire institutions and infrastructure). The Central Emergency and Safety Operations Headquarters (CESOH) under MOSPA, on the other hand, is responsible for designing all phases of comprehensive emergency management. It also directed all national agencies related to emergency management, including the Meteorological Agency, the National Police Agency, and the National Forestry Service. Provincial governments act as an intermediary between national agencies and local governments. They also certify local emergency management plans as per the guideline specified in the provincial governments' emergency management plan. The local governments---as the frontline

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[1] The emergency management system in South Korea is currently managed under the Ministry of Public Safety and Security (MPSS), which was established in December 2014 (Kim and Jung, 2015). Specifically, the functions of emergency management in the Ministry of Safety and Public Administration (i.e., the Ministry of Government Administration and Home Affairs after the 2014 government structure reform) were transferred to MPSS in December 2014, and the National Emergency Management Agency was attached to MPSS at that time.

responders--have the responsibility of coordinating activities of fire and police stations, nongovernmental organizations, and private firms.

However, the emergency management system in South Korea has been heavily criticized by scholars as being too hierarchical-- influenced much by the country's bureaucratic norms and structure. According to Ha and Park (2012), public agencies at the national level are assumed to play the leading role and provide directives to lower level governments without paying heed to local preferences. According to Kim and Lee (1998), the national government is only ready to act when disasters are caused by human errors or technological hazards rather than natural disasters. The national legislations and public programs also tend to focus on vertical networks rather than horizontal relations. Thus, little is done to encourage interorganizational collaboration across non-governmental, business, and local community-based organizations (Ryu and Ahn 2007; Yang 2010). Others called for a "spider-web approach" to emergency management system (Ha and Ahn, 2009), reflecting the need to take into account localized response activities instead of relying heavily on a higher level government during the initial stage of emergency response. Although there were values to an abstract conceptualization of the system, less attention has been paid on the nature of collaboration and relationships established at the provincial and local levels.

Despite the hierarchical structure of emergency management system in South Korea, NEMA and MOSPA have encouraged collaboration among public agencies across all levels, nongovernmental organizations, and private firms (Kim, Tachikawa, Takara, 2007; Seo, 2008; Lee 2012). According to Seo (2008), in the "Interim national progress report on the implementation of the Hyogo Framework for Action, national emergency management policy and legal framework aim to facilitate government agencies and local organizations in South

Korea to collaborate each other and to decentralized responsibilities at all levels."  In particular, the National Safety Management Basic Plan, first established in 2005, has provided the basic framework for mid- and long-term emergency management through active interorganizational collaboration (Lee, 2012).  Recently, local branches of national agencies such as the Rural Development Agency and the Ministry of Environment are encouraging more interorganizational agreements at the local level to resolve local matters (Younhab News Agency, 2013; Newsis, 2014). Other forms of collaboration have also been documented through mutual aid agreements between local governments. There have also been reports that local organizations are establishing agreements with organizations in the private sector (i.e., Joint Disaster Prevention Center established through public-private partnerships) (Environmental Broadcasting Network, 2014).

However, the national government has underestimated the barriers of interorganizational collaboration (Ha and Ahn, 2009; Lee 2012; Jung, 2013).  Ha and Ahn (2009), for instance, suggest that one of the challenges in emergency planning in South Korea is related to the ability of organization to share the responsibility in risk communication.  For example, public agencies have separate directives operating under different national agency mandates. The failure of first response during the 2012 Gumi chemical spill highlight the ineffectiveness of the City of Gumi evacuating local residents from the affected area. Inability to coordinate joint efforts and failure of risk communication channels among local organizations had hindered the ability of local fire and police stations to collaborate (Yonhap News Agency, 2012).  In addition, Jung (2013), in his quick response report to the Natural Hazards Center, pointed out that government agencies and local organizations rarely collaborate on disasters affecting local jurisdiction if emergency response operations were to be coordinated by the upper-level government agencies.

**Data Collection**

The data collection was conducted in the southeastern tip of the Korean peninsula at two different time periods (i.e., July 2012 and January 2013).  The region, which is also known as the Southeastern Economic Region (SER), consists of Busan Metropolitan City, Ulsan Metropolitan City, and the South Kyeongsang Province. There are 45 municipal governments with an estimated population of 7.94 million people (i.e., approximate 15% of total population), and the Gross Region Domestic Product (GRDP) reaches to about US$ 200 billion (MOPAS 2012). Economically, the region is one of the most important industrial regions in the country, where Korean global enterprises' manufacturing plants are located such as Samsung, LG, Hyundai, and Kia (Jung and Jeong, 2010). The region has also been recognized as being the most strategic location for the country's export market (i.e., Busan and Masan shipping ports).  For example, the region has a Gross Regional Domestic Product (GRDP) of about US$160 billion (i.e., 17.6% of the Korean economy).

The Southeastern Economic Region is vulnerable to natural disasters such as typhoons, floods, and severe winters, which makes it a suitable location to observe the way local organizations operate during disasters.  This research was conducted before and after the 2012 Typhoons, which devastated the region with an estimated US$ 730 million of economic loss and 29 fatalities.

The first survey was administered among 159 organizations in July 2012 using a snowballing technique followed by a second round of surveys in August 2012. The second survey was administered in January 2013 to gauge views on organizations' response to the disaster (see Jung, 2013).  During the first stage of the data collection, 130 organizations responded (i.e., local governments, fire and police stations, and nongovernmental organizations).

During the second stage of the data collection, a total of 112 organizations responded to the survey.

## Methods of Analysis

Two general approaches are used to analyze the data. In the first analysis, a social networks analysis approach is employed to determine the structural patterns of interorganizational collaboration. To test the bonding and bridging hypotheses, a Heckman's two-stage approach is used to correct for potential selection bias. The first analysis tests the bonding and bridging hypotheses on organizational resilience and then introduces the creditable commitment effect that has been overlooked in that previous study.

To determine the formation of interorganizational ties, the actor-action oriented model is employed as per Snijders et al. (2010). This method estimates the tendency for organizations to forge, sustain, or break organizational ties over two different time periods by utilizing a specialized network analysis—"Stochastic Actor-Based Model (SABM)" as suggested by Snijders (2005) and Snijders et al. (2010). This method of analysis – also referred to as SINEA – focuses the analysis on changes of interorganizational ties during an emergency. Two datasets of similar organizations are utilized: (1) dataset collected in July 2012 before the region was affected by the three major typhoons (e.g., Bolaven, Tembin, and Sanva), (2) dataset collected in January 2013 after the region was affected by three major typhoons. The analysis adopts an innovative approach by focusing our attention on how a diverse sets of organizations transformed their intangible resources and devised alternative means to overcome unexpected challenges and thereby enabling them to build an organizational resilience.

The third analysis examines endogenous and exogenous factors that explain the formation of interorganizational ties by applying the SABMs to uncover the dynamic structure of interorganizational ties. The endogenous factors include a set of network effects as specified in SIENA including: reciprocity, distance-2, betweenness, transitive triplets, and 3-cycles effects. The exogenous factors include social and environmental vulnerability indicators, geographical proximity, and a dyadic covariate indicating joint full-sized exercises that encompass professional training and comprehensive education. As proposed by Snijders et al. (2010), this method of analysis is based on a forward model selection strategy where the endogenous network structural effects are considered first before including the exogenous effects in the final model. The tendency for organizations with similar characteristics to establish interorganizational ties are also tested.


**Outline of Dissertation**

In Chapter 2, a brief overview and assessment of the current state of research on disaster resilience are presented. The conceptual framework employed by scholars in various disciplines are examined together with factors explaining the ability of a community to rebound from disasters. The key dimensions of resilience are also discussed in relations to disaster recovery. The final section of the essay outlines several topics for future research. This essay highlights the importance of studying organizational resilience as a way to understand the motivation and incentive for organizations to work jointly during emergency response. The study of organizational resilience also draws attention for the importance of various forms of interorganizational collaboration such as formal and informal relations. It also highlights how

local organizations can utilize their relations to seek resources without necessarily jeopardizing their ability to perform their core organizational functions.

In Chapter 3, an empirical analysis to test the sources of organizational resilience is offered. The results, based on the Heckman selection model, present evidence for the general argument that organizations holding a central position between two other actors tend to perceive a higher level of organizational resilience, thus supporting the bridging hypothesis.  The finding implies that organizations with a bridging strategy can enhance their capacity to bounce back from a catastrophic event by securing access to critical resources and information. It is also argued that the sources of organizational resilience can be gained through emergency preparedness and hazards mitigation processes such as joint response and recovery planning.

In Chapter 4, the dynamics nature of interorganizational ties is examined. The results of the SABMs found support for the interdependent risk hypothesis, which suggests interorganizational collaboration tends to be based on the notion of "shared risk" as suggested by Comfort (1999). That is, organizations generally established a closely-knitted collaborative arrangements with other organizations over time.  On the other hand, the independent risk hypothesis is negative and statistically significant, indicating that organizations' tendency to collaborate independently across different organizations in order to spread risk are less likely to occur over time. The findings provide insights on the importance of coordinating preferences across various organizations in order to share the risk associated with the consequences of disasters.

Chapter 4 also examines the exogenous factors influencing the formation of interorganizational ties (i.e., social and environmental factors and joint full-sized exercises). The analysis tests for the probability that an organization will collaborate with other organizations

after a disaster.  The results suggest that organizations located on the coastline and/or that participated in the joint full-sized exercise before a disaster are more likely to form interorganizational ties after a disaster. The findings imply that an organization experiencing a higher level of environmental vulnerability prefer to collaborate with other organizations in order to respond to disasters. The result also suggest that by organizing joint exercise activities in emergency planning and hazard mitigation before a disaster, an organization will have the opportunity to collaborate with other organizations and thus mobilize critical resources and information during an unexpected condition.

# CHAPTER 2

## RECENT DEVELOPMENT IN THE STUDY OF DISASTER RESILIENCE: OVERVIEW AND ASSESSMENT

Local governments' ability to design strategies that improve their overall capacities to prepare and abilities to respond to disasters has several implications for the study of regional governance. Scholars in the fields of disaster research, urban politics, and public administration have published various articles on the topic (Paton, Millar, and Johnson, 2001; Carpenter, 2003; Comfort, 2007; Scheffer and Nes, 2007; Scheffer, 2004; Cox and Perry, 2011; Foster, 2012; Chandra et al., 2011; Rivera and Settembrino, 2012; Andrew et al., forthcoming). From a theoretical standpoint, there is a need to examine factors explaining the ability of local communities and governments to bounce back after a disaster; and how individual localities contribute to the overall ability of a region to return to normalcy. According to Tierney (2012: p.9), "research has increasingly focused on the conditions for and characteristics of resilience, on strategies for improving resilience, and on outcomes resulting from resilience-enhancing activities." For instance, in 2010, under the 2010 National Security Strategy, the concept of resilience has been strongly emphasized as a national goal. Under the Presidential Policy Directive 8 (National Preparedness), a new emphasis was placed in the need "for collaboration among governmental, private sector, and civil society institutions and organizations in achieving societal resilience" (Tierney, 2012: p.10).

The concept of community resilience not only captures the ability of a group of individuals (as well as organizations within that community) to effectively organize themselves, but also their capacity to minimize the consequences of disasters through joint preparedness

planning.  The topic also holds a tremendous promise for understanding a community's capacities---as a set of strategies---for enhancing disaster readiness and response. The Community and Regional Resilience Institute (CARRI) –which "believes that a community's resilience is measured by its sustained ability to prepare for, respond to, and fully bounce back from a variety of crises"—highlights the importance of identifying, assessing, and taking proactive actions in order to minimize the consequences of disasters and improve resilience in vulnerable communities. There have also been various measurements to identify the strengths and weaknesses of communities' resilience including the Coastal Resilience Index (CRI) and Community Assessment of Resilience Tool (CART).

While much of the current research tends to focus on vulnerability and resilience in communities located in major metropolitan areas (Campanella, 2006; Berke and Campanella, 2006; Cutter et al., 2003; Tobin and Whiteford, 2002; Pfefferbaum et al., 2007; Norris et al., 2008), few have examined how organizations from various sectors within urban and rural communities respond to natural disasters. There has also been a limited number of empirical studies addressing the factors that explain the ability and capacity of organizations to minimize the consequences of natural and man-made disasters (Somers, 2009; Sherrieb et al., 2010; Norris et al., 2009; Rivera and Settembrino, 2012; Andrew et al., forthcoming). As noted by Kapucu et al (2012), one of the "challenge[s] in developing resilient communities is not only recognizing and anticipating the scope of damages, but integrating multiple agencies, jurisdictions and stakeholder groups in a response to a disaster (Ronan and Johnson, 2005; Pelling, 2003)." The ability of organization to respond and recover from disasters depends on their ability to coordinate joint activities and share resources across administrative and political boundaries (Ainuddin and Routray, 2012; Crichton et al., 2009; Andrew et al., forthcoming). In other words,

interorganizational collaboration is an essential part of assessing resilience-related characteristics of a community.

This essay provides a brief overview and assessment of the current state of research on community resilience. The conceptual frameworks employed by scholars in the various disciplines are examined together with factors explaining the ability of a community to rebound from disasters. The key dimensions of resilience are also discussed in relation to disaster recovery.  The final section of the essay outlines several topics for future research. This essay highlights the importance of studying organizational resilience as a way to understand the motivation and incentive for organizations to work jointly during emergency response. The study of organizational resilience also draws attention for the importance of various forms of interorganizational collaboration such as formal and informal relations. It also highlights how local organizations can utilize their relations to seek resources without necessarily jeopardizing their ability to perform their core organizational functions.

## What is Resilience?

In the field of emergency management, resilience is a concept employed by scholars to understand the degree to which an individual, organization, and the community bounce back and return to normalcy after disasters. At the community level, the term "resilience" has been broadly defined as "the capability of a community to face a threat, survive and bounce back or, perhaps more accurately, bounce forward into a normalcy newly defined by the disaster related to losses and changes" (Cox and Perry, 2011, p.395). The National Research Council (NRC) provides a common sense definition, which emphasizes "the continued ability of a community to function

during and following stress" (NRC 2010, p.3).

Following Andrew et al. (forthcoming, p. 1), resilience can be examined at the organizational level, which is defined as "the ability of organizations to work together in minimizing operational disruptions and coordinate critical resources across administrative boundaries to aid local communities." This definition implies that interorganizational collaboration enables organizations to help others during disasters and, at the same time, perform core functions and cope with disasters. Consistent with the ICA framework, this conceptual definition also suggests that collaboration and the ability of organizations to cope with disasters depend on the willingness of individual organizations to internalize coordination costs contributing to organizational cohesiveness in emergency response (Jung, 2013, Andrew and Carr, 2013). It is assumed that organizational cohesiveness demands individual organizations to prepare for disasters as a collective in order to minimize their operational disruptions.

In New Zealand, a group of scholars under the Resilient Organizations Research Programme (RORP) from the University of Canterbury and University of Auckland, define the term organizational resilience as "the ability of an organization to survive a crisis and thrive in a world of uncertainty" (RORP, 2014). Foster (2012) also examines resilience at the organizational level with reference to economic shocks. By using the term High Reliable Organization (HRO) in the United Kingdom, Crichton et al. (2009, p.25) examine organizational resilience as the process to secure appropriate knowledge and resources available from both within its own organization and external actors and to incorporate critical resources into their emergency management system. McManus et al. (2008) assert that an effective disaster response operation can be enhanced by organizations with high levels of resilience in order to respond swiftly to victims and the affected community during catastrophic events.

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Other scholars have defined the concept of resilience in multidimensional form: robustness, rapidity, resourcefulness, and redundancy (Bruneau et al., 2003; Norris et al., 2008; Andrew et al., forthcoming). First, the dimension of robustness refers to the capacity of a community to deal with disaster situations. Second, rapidity captures the speed by which organizations in a community can respond and recover from disasters. Third, resourcefulness is a complicated source of resilience since it implies that organizations must have the ability to transform internal and external resources into something of value (Bruneau et al., 2003; Norris et al., 2008). Lastly, the dimension of redundancy implies that collaboration facilitates the process of organizations pooling resources during emergency planning.

Moreover, the literature in the field of emergency management seems to focus on the ability of organizations to enhance resilience (Paton, Millar, and Johnson, 2001). To improve the capacities of a community's response to disasters, Paton et al. (2001) argue that resilience should be conceptualized as a contingent planning strategy as opposed to a prescription for resilience. This is because the level of resilience varies considerably depending on the "all-hazards management" framework across sectors. In order to enhance resilience, Crichton, Ramsay, and Kelly (2009) provide key lessons from a range of emergencies that occurred in the United Kingdom and the United States. They highlight the importance of aligning shared vision throughout the emergency response system as well as ensuring capability and availability of resources within and beyond a single organization. Learning from and consulting with the public are also crucial components of capacity building (Crichton et al., 2009).

Chandra et al. (2011) in their technical report, illustrate that the main components of improving resilience are integration and involvement of various organizations such as public, private, and nongovernmental organizations in emergency planning, response, and recovery and

effective risk communication for information and resource exchange. Enhancing organizational resilience seems to be closely connected to interorganizational collaboration and the ability of organizations to coordinate resources and communicate risks.

## Theoretical Perspectives on Resilience

Currently, there are two dominant theoretical approaches to studying resilience. The first approach frames the issues as social-ecological systems (Carpenter, 2003; Carpenter et al., 1999; Scheffer and Nes, 2007; Scheffer, 2004; Meijer et al., 1999; Scheffer et al., 1993). The second approach, relies much on institutions and governance derived from social science disciplines (i.e., psychology, anthropology, political science, and urban politics), which generally view resilience in terms of rules permitting and constraining social interactions. Both approaches tend to view resilience as either a set of attributes assisting a community to cope with disaster or an outcome reflecting the ability of a community to recover from external shocks.

### Social-ecological Systems Approach

This approach reflects the various aspects of ecological systems. It is among the first perspectives to dismiss the idea that there is a pristine ecosystem and the goal of management should be to restore the systems in order for the ecosystem to return to its previous conditions (Martin-Breen and Anderies, 2011). Since the work of Berkes et al. (2003), they provided a shift in the perspective on resilience: from a pristine ecosystem approach to a social-ecological system (SESs) perspective.

The new approach extends the resilience research by focusing more on the social dimension of the ecosystem in order to understand the essential process that would lead to resilient organizations. Within the context of a social-economic configuration, the perspective provides insights on the different patterns of public and nonprofit organizations partnerships in the social-ecological system. It yields a rich description on the motivation and invectives for organizations to enhance their resilience within the eco-system. Nelson et al. (2010), utilizing the perspective, highlight the importance of cross-scale interactions between organizations and social context in three irrigation societies in the United States.

Most discussions based on the eco-system approach, according to Norris et al. (2008), tend to focus on three dimensions: First, resilience is conceptualized as the ability of a community to rebound rather than an outcome (Brown and Kulig, 1996; Pfefferbaum et al., 2005). Second, resilience is conceptualized as an adaptability process rather than a static or stable ecosystem (Handmer and Dovers, 1996; Waller, 2001). Third, the literature also tends to focus on the "stressor," including: characteristics or types of disasters (severity, duration, or/and level of surprise), individual's response to the stressor, level of exposure, and/or vulnerability of the organization or community to the stressor. In fact, Quarantelli (1986) suggest that resilience should be examined as the effect of a disaster in term of demand-induced response (i.e., whether demands exceed capacities of the community to response to disasters). As for the adaptability process, studies using longitudinal data are mostly interested on the difference between recovery and resilience trajectories (Bonanno 2004; Flynn 1994). The assumption in this studies is that dysfunctions of the system are transient and temporary. As pointed out by Norris et al. (2008, p.135), "resilience rests on both the resources themselves and the dynamic attributes of those resources (robustness, redundancy, rapidity)."

**Institutions and Governance Perspective**

A second approach adopts an institutions and governance perspective to capture various factors promoting resilience (Ostrom, 1990; Williams, 1998; North, 2009; Anderies et al. 2004; Janssen et al., 2007; Janssen and Anderies, 2007). In this approach, the concept of institutions is defined as the rules structuring interactions among organizations as a set of agents, and governance refers to the various forms of institutions and interorganizational structures that shape the process responsible for actions and inactions (i.e., processes facilitating decisions and actions that are taken by organizations) (Ostrom, 2006; Janssen and Anderies, 2007). Based on these perspectives, several lines of research can be identified (i.e., social vulnerability, social capital, social support and engagement, and grass-root participation in disaster planning).

Ostrom's (2006) work on institutions, for instance, has a strong influence on this approach. The main argument focuses on the dynamics of interactions that could lead to the development of rules and principles purposefully designed for collective action. This perspective can also be used to explain organizational resilience over time. Approaching the topic of organizational resilience from this perspective brings attention to the important intangible values of formal and informal interactions such as trust, rights to organize, interorganizational arrangements, and rules governing decision-making. Scholars in the field of emergency management who are interested to capture the importance of citizen engagement in emergency planning and implementation have also adopted this approach (Berke and Campanella, 2006; Pfefferbaum et al., 2005).

The work presented by Pendall, Foster, and Cowell (2010) on regional resilience as a complex adaptive system essentially argues that a region goes through stages of recovery

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processes such as short and long terms recoveries that depend on the scale of disaster as well as the time, nature and magnitude of various challenges. They argue that a region should be viewed as being resiliant if "it maintains or improves its performance on outcomes regardless of effort, process or starting point" (Pendall, Foster, and Cowell, 2010, p.83). The basic assumption is that a region's capacity to return to normalcy depends on "coping mechanisms" – "region with low resilience cope poorly with system disturbance, filtering in the face of environmental, political, and economic blows" (Foster, unpublished, p.5).

Recently, Andrew et al. (forthcoming)—relying on the institutional collective action framework—examined organizations' ability to bound back after a major disaster in Thailand and found that the nature of collaboration influences their perceived organizational resilience. They argue that the social cohesion embedded in local communities influences the ability of organizations to coordinate emergency response efforts, which in turns affect a community's ability to bounce back faster after a major disaster. Their study also highlights policy implications that can help facilitate region administration to create disaster resilient communities and the need to develop social cohesiveness through synergistic inter-organizational activities carried out as disaster mitigation strategies.

<div align="center">**Determinants of Resilience**</div>

While much progress has been made in thinking about resilience, a broad consensus on key factors explaining resilience has yet to be reached. In terms of community resilience, for instance, most of the progress has been made in identifying the abilities of communities to recover from disasters. Based on the institutional and governance perspective, the next section

examines factors contributing to resilience, including: social vulnerability, social capital, social support and engagement, and grass-root participation in disaster planning.

The relationship between social vulnerability and resilience has received much attention in the disaster literature (Cutter et al., 2003; Tobin and Whiteford, 2002; Pfefferbaum et al., 2007; Norris et al., 2008). Flanagan and Gregory (2011) argue that during disaster events, socially vulnerable communities are more likely to be adversely affected by disasters, which lowers their level of community resilience. Norris et al. (2008) note that "differential risk is all the more striking from a global perspective because disasters are disproportionally likely to strike economically developing or poor countries (De Girolamo and McFarlane, 1996)." A longstanding presumption among scholars is that communities without adequate resources and/or with a higher level of social vulnerability are not only at greater risk for severe damages and victims but will also struggle to mobilize resources after disasters. Quarantelli (1994) also warned that industrialization and urbanization across communities and countries increase social vulnerability resulted from the devastated consequences of increasing disasters especially in developing countries.

Another important determinant of resilience is social capital. The relationship between resilience and social capital is based on the idea that communities make investments in social relations in order to gain access to information and resources. The interactions developed through a network of personal ties allow a community to gain social support and thus increases a community's ability to cope with disasters. The tangible benefits can be realized when social support derived from such interactions can establish a sense of belonging (Uphoff 2000). Social capital is also important for providing access to resources and allowing communities to reciprocate support as well as transmit reliable information (Norris et al. 2008; NRC 2009). The

information regarding actual or potential resources provided by communities offers significant advantages (Kapucu 2006; Kapucu et al., 2008). Norris et al. (2008) and Kapucu et al. (2010), for example, indicate that social capital based on credible information are preconditions that are crucial for community competence. It implies that competencies developed through interorganizational relationships can generate substantial benefits of joint efforts, articulateness, and participatory decision-making at the organization level.

Under the umbrella of social capital, network structures have been considered as sources of community resilience. Goodman et al. (1998) argued that the presence of interorganizational networks enables communities to build mutual interactions and new types of association for cooperative decision-making processes. Schoch-Spana (2008) note that the existence of interorganizational networks significantly enhance turst among actors for timely assistance. More specifically, Longstaff (2005) asserts that structural holes such as keystones or hubs within interorganizational networks play an important role in securing social capital. Despite structural benefits of clustered networks, there are conflicting views to social capital emerged from interorganizational networks. Allenby and Fink (2005) highlight the importance of redundancy for connective functions, suggesting that the efficiency of network structures may hinder community resilience if the structural holes disappear.

A third determinant is linked closely with the social capital argument—the importance of social support such as community engagement and citizen participation. Social support refers to voluntary interactions of individuals with actual assistance in "a web of social relationships perceived to be loving, caring, and readily available in times of need" (Norris et al., 2008, p. 138). Berke and Campanella (2006), for example, argued that resilience can be enhanced through the process of response and recovery planning where a more diverse population voicing their

preferences help rebuild their community. Pfefferbaum et al. (2007) indicate that social support is a meaningful, deliberate, and collective action to remedy the consequences of disasters. That is, social supports serve an important function when individuals help similar others to make decision about appropriate behaviors (i.e., emergent norms) (Fritz and Williams, 1957).

Another important determinant is the engagement of community members in providing the social support. Community involvement is important because the pattern of mobilizing intangible resources generally correlates positively with community resilience (Norris et al., 2006; Berke and Campanella, 2006; Pfefferbaum et al., 2005). Maton and Salem (1995) argue that an empowered and engaged community is related to the presence of strong leadership and provided opportunities for members to play meaningful roles in supporting similar others during disasters. Moreover, Goodman et al. (1998) and Pfefferbaum et al. (2005) note that citizen participation such as mutual interactions and shared values is widely believed to be a key for community resilience, which requires active grass-roots leadership and local mobilization.

**Empirical evidence**

The literature on resilience can be divided into qualitative and quantitative research. Qualitative studies involving the use of interviews and focus groups are extensively used in the social science disaster literature. One advantage of this type of research is that it provides detailed features about community preparedness (Ainuddin and Routray, 2012; Manyena, 2014), response and recovery (Crichton et al., 2009), and hazard mitigation (Joerin et al., 2012; Aldrich, 2012). These details can be useful to assess the effectiveness of factors that explain community resilience, and thus qualitative studies have been a good source of information to resilience

research. Despite the usefulness of qualitative research, the generalization is limited by the notion that such studies have very selective sample sets. This then results in studies that are not generally comparable, and so the ability to of researchers to conduct met-analyses across multiple cases is limited. The quantitative approach to resilience research has attempted to build direct measurements of factors to explain sources of resilience, which have been generally collected from surveys and demographical data sets.

**Qualitative research**

Crichton et al. (2009) identify recurring themes from lessons learned that can be widely applied to enhancing organizational resilience. By reviewing reports relating to seven disasters that have occurred in the United Kingdom, New Zealand, and the Netherlands, their research proposed eight recurring themes for enhancing resilience: (1) emphasizing the process of emergency preparedness; (2) understanding the reference accidents; (3) aligning the safety culture throughout emergency response systems; (4) understanding the purpose of command and control; (5) communicating with the public; (6) attending to welfare long term; (7) training responders in non-technical skills; and (8) assuring capability and availability of resources. These themes provide guidance to relevant parties within organizations such as emergency managers and technical assistants.

Ainuddin and Routray (2012) propose a framework to build the resilience of the communities prone to hazards and disasters by analyzing and reviewing the frameworks in the context of an earthquake prone area in Baluchistan. Based on the findings of an extensive research carried out on vulnerability and resilience assessment through a household

questionnaire survey from 200 residents of Quetta city, their study found that a new framework for identifying community resilience can improve the community preparedness, awareness, and finally leading to community resilience at the local levels.

Joerin et al. (2012) compares the resilience of two communities in Chennai, India, which have similar exposure to natural hazards such as cyclones and river-based floods due to their close proximity to the sea. The results from a household survey that assessed the physical, social and economic resilience of individuals through a Climate-related Disaster Community Resilience Framework (CDCRF) show that people living in the vicinity of rivers and canals are at higher risk from impacts of floods compared to others. In addition, the results indicated that two communities in the study were not able to enhance their coping capacity due to their limited adaptive capacity. In collaboration with other stakeholders, community-driven participatory solutions were recommended for beneficial effects in enhancing the resilience of communities to climate-related disasters.

Aldrich (2012) presents a qualitative analysis of the ways in which social capital influences the pace and trajectory of post-disaster community recovery, and argues that social capital at the neighborhood level is an important asset to build resilience from a large-scale disaster. This research highlights that resilience is not a static descriptor of a community at a single point in time but is a process of development that occurs through concatenations of bonding, bridging, and linking networks by reviewing recovery efforts that followed the 1923 Tokyo earthquake, the 1955 Kobe earthquake, the 2004 Indian Ocean tsunami, and the 2005 Hurricane Katrina disaster.

Manyena (2014) argues that the traditional institution of chieftaincy in many parts of

Africa could potentially offer lessons in the theory and practice of resilience to disasters, highlighting that the chieftaincy is the 'real' example of a resilient institution from which disaster resilience can learn. By using the case study material from Zimbabwe, this research illustrates how the chieftaincy in Zimbabwe is continuously re-making, replenishing and adapting to the neo-liberal and post-Marxist agendas in order to remain relevant to the ever-changing socio-economic environment.

**Quantitative research**

Somers (2009) suggests a new paradigm that focuses on creating organizational structures and processes to build organizational resilience potential by measuring latent resilience in organizations. Specifically, a questionnaire including six factors capturing organizational resilience potential was used for the survey responded by public works directors in the Region VI of the American Public Works Association (i.e., the states of Arizona, New Mexico, Oklahoma, and Texas). The results show that community planning activities and managerial information seeking can explain latent resilience.

Sherrieb et al. (2010) attempted to measure the sets of adaptive capacities for social capital in the Norris et al. (2008) community resilience model with publicly accessible demographic indicators. By using Mississippi county data, they found support for correlations among their measure of communities' capacities that may predict a community's ability to bounce back from disasters.

Norris et al. (2009) examine the notion that resilience may be best understood and

measured as one member of a set of trajectories that may follow exposure to trauma or severe stress by analyzing two large, population-based and longitudinal datasets collected after the 1999 floods in Mexico and the September 11, 2001 terrorist attacks in New York. The results in this research yield the strongest evidence for resistance, resilience, recovery, and chronic dysfunction, as these trajectories were prevalent in both samples.

Rivera and Settembrino (2012) propose a sociological framework of community resilience, which tests the effect of pre and post-disaster barriers and facilitators on resilience as a continuum of possible outcomes. By using social capital data from urban and rural communities in Central Florida, the study found that social trust as the source of community resilience are explained by race, gender, age, and income level and that overall most counties in both urban and rural areas reported similar high levels of social capital.

Andrew et al. (forthcoming), test the bonding and bridging hypotheses by using survey data collected during the 2011 Thailand floods. This research attempted to measure organizational resilience by using four dimensions: robustness, rapidity, resourcefulness, and redundancy, and found that the bonding strategy—which refers to organizations that closely collaborate with other organizations—has a positive effect on the perceived level of organizational resilience.

## Discussion and Conclusion

The conceptualized framework to studying resilience at the organizational level is still relatively new. Much of the current literature tends view resilience as either the capacities of a community

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or organization to prepare for disasters through joint planning, or as an outcome when responding to disasters or external shock. While the former reflects the importance of taking proactive actions in order to minimize the consequences of disasters, the later points to resilience as the performance of an organization or community to withstand external shocks. While both conceptualizations of resilience present views that resilience can be studied through interorganizational and intergovernmental collaboration, they each have the following limitations.

First, on the issue of measurement, few empirical studies have been conducted at the organizational level to understand resilience, which makes it difficult to assess capacities of individual organizations and interactions among them. Even though organizational capacity (e.g., personnel and financial resource) can be objectively measured, organizational resilience cannot be captured solely by objectives measures or attributes. This is because resilience, within the social-ecological systems, contains multiple feedback loops that interact in complex ways (Carpenter, 2003; Scheffer, 2004; Scheffer and Nes, 2007). While subjective assessments of resilience have been proposed and applied in field research, the reliability of the instrument is still not well tested.

Future research should explore the various ways to measure resilience such as quantitatively through primary data collection procedures as well as secondary data sources to best capture the concept of resilience. This line of work can contribute to the study of resilience and the performance of a community or organization.  For example, it can reveal why certain organizations or communities are more resilience than others and thus, allow us to identify, assess, and weigh the strengths and weaknesses of a community's ability to respond to disasters.

Another limitation is on the issue of causality. In the social-ecological contexts of resilience, it is uncertain as to which factor is establishing an effect. For instance, in conducting research on resilience, it is difficult to separate the influence of institutions on the ability of organization to rebound from a major disaster without taking into account the dynamics of resilience. More recently, however, scholars have begun to pay attention on designing surveys and base their analysis using the social network analysis method. Others have emphasized the importance of processes and time dimensions in their analysis in order to test the causal relationship between patterns of interorganizational collaboration (i.e., sources of resilience) and the perception on organizational resilience.

Finally, future research should focus on outcomes of resilience over time, and thus building causality based on time points. This is because outcomes of resilience among organizations before, during, and after an event have not been explored nor measured to date. As reference to the four dimensions of organizational resilience, for example, its effectiveness has not been empirically tested. Although the dimensions developed by many scholars are intriguing, it has not been vigorously tested with a specific index over time. Future research should attempt to link factors before an event to tangible outcomes resulting from organizational resilience after the event.

# CHAPTER 3

## SOURCES OF ORGANIZATIONAL RESILIENCE

Scholars in the field of emergency management often argued that the purpose of establishing and maintaining interorganizational collaboration is to overcome internal limitations of organizations and to strengthen organizational capacity (Waugh, 1994; Waugh and Streib, 2006; Kapucu *et al*., 2012). It is assumed that, by working together, it allows organizations to build joint capacity and minimize the effect of disasters, which in turn increases their ability to bounce-back and return to normalcy (Jung, 2013; Andrew *et al*., *forthcoming*). Quarantelli, Lagadec, and Boin (2006), for instance, highlight that interorganizational collaboration has become an indispensable part of emergency management due to the nature of disasters. Drabek and McEntire (2002) also indicate that, because resource coordination for response operations is often problematic, multi-organizational collaboration across sectors provides clues to coping with organizational capacity. According to Phillips, Neal, and Webb (2012), developing interorganizational partnerships among sectors under all aspects of emergency management should be a top priority for building resilient communities.

To examine the effect of organizational collaboration on the ability of an organization to cope with disasters, this essay employed the ICA framework that allows us to analyze the collective action problem at the organizational level. In this essay, an empirical analysis to test the sources of organizational resilience is offered. The results, based on the Heckman selection model, provide evidence for the general argument that organizations holding a central position between two other actors tend to perceive a higher level of organizational resilience, thus supporting the bridging hypothesis. The finding implies that organizations with a bridging

strategy can enhance their capacity to bounce back from a catastrophic event by securing access to critical resources and information. It is also argued that the sources of organizational resilience cam be gained through emergency preparedness and hazards mitigation processes such as joint response and recovery planning.

This essay is organized in the following ways. The next section defines the concept of resilience before discussing the theoretical framework to determine factors explaining organizational resilience. The third section presents the research design, data collection procedures, and methods of analysis. The final section provides the conclusion.

## Paradox of Organizational Resilience

In emergency management, the concept of resilience can be understood as "bouncing back from disastrous events" (Norris et. al, 2008; NRC, 2011). The concept includes the capacity to plan and ability to respond to threats of hazards. Cox and Perry (2011: 395) defined the concept as "the capability of a community to face a threat, survive and bounce back or, perhaps more accurately, bounce forward into a normalcy newly defined by the disaster related to losses and changes." The NRC (2010) added and explained resilience as a continuous capacity of communities to manage their resources during and after disasters.

For the purpose of this essay, we define the term "organizational resilience" as an actual or potential public resources improvement capability of an organization with a strong willingness to manage emergency events in order to bounce-back to its original condition. Following Andrew *et al*. (*forthcoming*), this dissertation examines resilience at the organizational level, which is

defined as "the ability of organizations to work together in minimizing operational disruptions and coordinate critical resources across administrative boundaries to aid local communities." The definition implies that interorganizational collaboration enables organizations to help others during disasters and, at the same time, perform core functions and cope with disasters. Consistent with the ICA framework, the conceptual definition also suggests that collaboration and the ability of organizations to cope with disasters depend on the willingness of individual organizations to internalize coordination costs contributing to organizational cohesiveness in emergency response (Jung *et al.*, 2013, Andrew and Carr, 2013). It is assumed that organizational cohesiveness demands individual organizations to prepare for disasters as a collective in order to minimize their operational disruptions.

However, organizational resilience also presents a paradox. Andrew *et al.* (*forthcoming*), for example, asked why an organization provides assistant to others if such efforts would jeopardize the ability of the organization to perform its core functions during emergency and thus affecting their recovery. The rational choice perspective would suggest that, during emergency situations where resources are limited and scarce, any rational actor would act in its own best interest by not cooperating and providing assistant to others. According to the ICA framework, even if communities and organizations are willing to provide assistance, their ability to cope with an aftermath of disasters requires individuals, organizations, and the community to work together and share tangible resources. Even if organizations are better off designing an institution to improve their ability to cope with disasters, satisfying the preference of the collective often involves considerable collaboration risks. Since the nature of emergency does not exclude organizations from being affected by the disaster, it is difficult for individual organizations to agree on the most efficient way of distributing costs. Individual organizations have a strong

incentive to free ride on the effort of others in order to reap the benefits of collaboration without making contributions to the collective.

There are examples where local governments would turn evacuees away from their jurisdiction rather than taking on the responsibility to assist disaster victims. Tierney, Lindell, and Perry (2001), for example, assert that local governments are likely to neglect residents from a catastrophic event because of functional failures resulted from the deficiency in resource mobilization and risk communication. During the hurricane Katrina, the National Public Radio (NPR, 2005) was critical and reported that local governments neighboring with the City of New Orleans did not help evacuees from New Orleans "because the City of New Orleans was ill-prepared to handle the situation that they had and expected us to evacuate their city without any preparation, without any notice, without any contact." The hurricane Katrina overwhelmed the internal capacity of the City of New Orleans, and thus government terminated their efforts to protect victims and residents. As a result, even the neighboring municipalities such as the City of Crescent and the Town of Gretna turned away refugees from New Orleans at gunpoint during the aftermath of Katrina. Miller (2011) also indicates that under a catastrophic event, small cities and towns in the United States, which do not have enough resources, may not help evacuees from the neighboring cities.

Other examples can also be found internationally. After the 2010 Japan earthquake, for example, local governments were overwhelmed and relinquished their efforts to assist victims from other communities (Cho *et al*., 2013). This reluctance to provide assistance to others is not uncommon. That is because they had failed to build prior commitments and shared arrangements to jointly respond to disasters (Quarantelli, 1983; Dynes, 1994).

Following Bruneau et al. (2003), this research utilizes dimensions of organizational resilience: (1) robustness, (2) rapidity, (3) resourcefulness, and (4) redundancy. First of all, Robustness is the capability of local community to overcome operational disruptions immediately caused by a disaster without suffering degradation. In other words, robustness of local community is an ability to continue to fulfill its function such as communications and information technology supports with other agencies under serious disruption. Rapidity is the ability of local community to provide practical assistance for disaster victims and recovery in a timely manner. Robustness and rapidity are critical attributes of local community to help victims and improve recovery time without loss of function (Kendra & Wachtendorf 2003). Resourcefulness is the extent to which local community has adequate resources to meet the needs of disaster victims and recovery. Redundancy is the extent to which local community has an adequate capability to perform functional requirements and, at the same time, help victims and their communities to cope with disasters. Bruneau et al. (2003) also indicate that resourcefulness and redundancy are the fundamental means for achieving adequate robustness and rapidity of local community.

## Institutional Collective Action Framework

The ICA was built on actor-centered preference integration (Scharpf, 1997) and the Institutional Analysis and Development (IAD) framework introduced by Ostrom. However, the IAD framework considers joint agreement or composite action grounded on individuals' rationality; it has limitations when applied to collective action at the organizational level. The ICA framework employed similar logic when examining fragmented authority among multiple government units

and the collective action dilemmas at the local or institutional level.  In the institutional

collective action dilemma, each organization is assumed to make risk assessment.  They also

have incentives whether they participate in response and planning.  Also, organizations may

encounter high transaction costs exacerbating ICA dilemmas (Feiock, 2013).

The ICA framework provides four general guidelines to understand collective action

dilemmas: (1) the nature of the dilemma, (2) the authorities directly or indirectly involved in the

policy arena, (3) the potential risks associated with action and inaction, and (4) the incentives

explaining the motivation of the actors (Feiock, 2013).  First, the nature of the dilemma from

collective action literature is to identify a collective action problem embedded in

interorganizational collaboration in which individual incentives of organizations may lead to

inappropriate collective outcomes not desired by any of the individuals (Ostrom, 2005; Feiock,

2013).  Second, the authorities directly or indirectly involved in the policy arena focus on

established tools and goals by collective decisions including all participants, which involved in

ICA dilemmas (Williamson, 1985; Feiock, 2013).  Third, the potential risks and uncertainty

derived from action and inaction is closely connected to transaction costs involved in spillover

effect among control, efficiency, political representations, and self-determination of

organizations (McGinnis, 1999; Feiock, 2009).  Lastly, the incentives for the motivation of

organizations indicate a systematic means, e.g., regulations and monitoring mechanisms, to

resolve ICA dilemmas by considering the barriers that prevent authorities from achieving

coordinated decisions (Brown and Potoski, 2005; Feiock, 2013).

From the ICA framework, collaboration and the ability to cope with disasters depend on

the willingness of individual organizations to internalize coordination costs contributing to

organizational cohesiveness in emergency response (Jung *et al*., 2013; Andrew and Carr, 2013).

That is, organizational cohesiveness demands individual organizations to prepare for disasters as a collective in order to minimize operational disruptions. While collaboration in emergency management is often perceived as a "good thing," equally puzzling is on the motivation of organizations to collaborate despite potential hardship in getting resources during disasters and functioning effectively after disasters. But, the question still remains: "with whom" do they collaborate in order to improve the likelihood to bounce back from devastations caused by disasters. To enhance the level of resilience, an organization could position itself to collaborate with a central actor in order to gain access to information and resources not available locally (bridging); it could also work closely with other organizations that are themselves closely connected with each other in order to pool and share redundant resources (bonding). Whether or not such a strategy would generate tangible outcomes is not well understood, however.

### Sources of Organizational Resilience

Before presenting the general hypotheses about the effects of interorganizational collaboration on resilience of an organization, this research presents a hypothetical network structure representing interorganizational collaboration (*see* Figure 1). Following Andrew and Carr (2013), the network structure has 7 organizations with a total of 10 links. The connections are defined as interorganizational collaboration.

According to the bonding effect, organization C has a high level of organizational resilience. On the other hand, according to the bridging effect, organization E has a higher level of organizational resilience (*discussed further below*). An organization's social position is conceptualized to have a high closeness score if the organization has the most number of

connections with organizations who also are closely connected. On the other hand, an organization with the highest betweenness score is one that is positioned with the shortest paths between any two other actors within a network (Freeman, 1980; Wasserman and Faust, 1994). Based on the hypothetical network structure, organization C has the highest closeness score while organization E has the highest betweenness score.
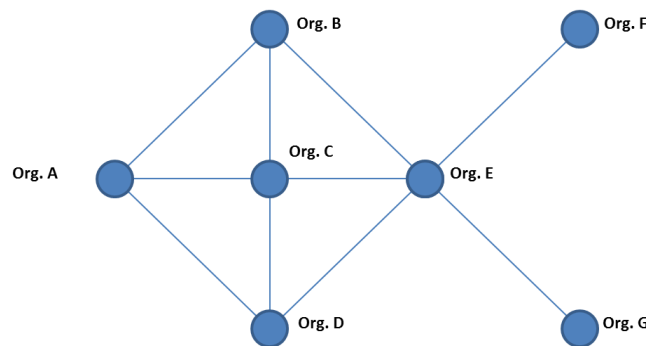
Figure 1. Hypothetical Network Structure

## Bonding Effects

The organizational collaboration embedded in a bonding structure can enhance organizational resilience for several reasons: First, it provides individual organizations with associational benefits, which can increase interorganizational trust, sharing of resources, and transmission of reliable information (Leonard, 2004; Andrew and Carr, 2013; Andrew *et al.*, *forthcoming*). Second, the advantages of being a part of a closely knitted group can be realized through building organizational credibility and reputation. This is because when there is a strong sense of commitment, obligation, and duty, the ICA framework predicts that an organization is likely to avoid behaving contrary to the expectation of group norms. An organization can also minimize the risk of not receiving assistant if the bonding structure is expected to provide mutual supports.

For instance, the organization that provides assistance can expect similar assistance from others, which increases its ability to cope, recover, and return to normalcy after disasters (Andrew, 2010).

In the emergency management literature, interorganizational cohesion provides frequent interactions and facilitates trust by sharing operational cognition (Comfort, 2007). The bonding effect strategy leads to a close-knit structure of organizations engaged in emergency management (Drabek and McEntire, 2002; Robinson, 2012). Owen (1985) also shows that the stronger the sense of community, the more social cohesion, which generates interlocal cooperation and involvement. According to Vasavada (2013) who studied a structure of networks after the Gujarat earthquake of 2001 in India, leading organizations in a densely clustered structure are most effective in achieving network-level outcomes. This is because a high density of trust among various types of organizations can be produced through a close-knitted structure. A similar conclusion was made by Sylves (2008), who asserts that interorganizational agreements for sharing resources facilitated local organizations to effectively respond to and recover from a disaster. Thus, this research hypothesizes that:

Hypothesis 1: Organizations closely linked to other actors in a network have a higher perception on the level of organizational resilience.

**Bridging Effects**

The bridging effect presents a different perspective on sources of organizational resilience. First, an organization positioned as a "gatekeeper" or a bridge between unconnected organizations has a better position to coordinate and distribute resources such as key personnel and equipment.

This organization is assumed to have better access to reliable information in order to coordinate join activities (Freeman, 1980; Lin, 2001; Kapucu, 2006; Andrew and Carr, 2013). Second, from the ICA framework, being centrally positioned not only provides the organization with the opportunity to gain access to information and resources, but also the ability to spread risk and minimize the possibility of organizational failure (*see* Andrew, 2010). Even though the organization can establish formal arrangements to share and coordinate resources, the organization seldom can specify outcomes of the agreement without incurring substantial transaction costs in crafting and enforcing the agreement (Andrew, 2009; 2010). Subsequently, organizational resilience can be enhanced because the organization acts strategically to spread risk by establishing relations with those outside its circle.

The bridging effect can be found in several examples. In the US, for example, the nature of a disaster is such that it requires organizations to interact with the central actor such as state-level agencies and the regional headquarter of the Federal Emergency Management Agency (FEMA). The structure is purposely designed to coordinate critical information and resources (Dynes, 1974; Kreps, 1991; Drabek and McEntire, 2002). Building bridges across different levels of government results in a "spider-web" emergency structure and if this coordination goes well, it can improve organizational resilience. For instance, Quarantelli, Lagadec, and Boin (2006) and Choi and Kim (2007) argue that structural bridges play an important role in mitigating hazards and responding to modern disasters faced by organizations. The structure may arise because of administrative mandates imposed by upper levels of government through grants, financial aid, and/or programs (Waugh, 1993; Sylves, 2008). The central "hub" is assumed to have the ability to coordinate tasks and activities, and thus produce an effective way to enhance organizational resilience. Therefore, this research hypothesizes that:

Hypothesis 2: Organizations positioned as a central actor in a network have perceive a

higher level of organizational resilience.

**Previous Interaction Effects**

A commitment to participate in emergency management exercises can enhance organizational

resilience for the following reasons:  First, pre-established mutual agreements for providing

resources allows organizations to make connections prior to disasters (Comfort and Haase,

2006).  The emphasis is on the development of shared goals leading to a reduction in

coordination costs.  Comfort (2007) contends that interactions accelerate the possibility of

building a common cognitive management.

Second, scholars in the emergency management field also suggest that emergency table-

top exercises and drills signal the credibility of an organization to build trust for sharing

resources (Kartez and Lindell, 1989; Perry and Lindell, 2003; Alexander and Bandiera, 2005;

Kapucu, Arslan, and Demiroz, 2010).  Before a disaster, emergency exercises involving core

organizations provides opportunities for them learn from their experiences.  Previous experiences

and frequency of interactions allow organizations to effectively coordinate and mobilize their

resources during emergency response operations (Kartez and Lindell, 1989; Perry and Lindell,

2003).  For instance, emergency medicine residency programs in the US highlight the benefits

that stem from participating in high-quality medical disaster exercises in the time of disaster

response (Alexander and Bandiera, 2005).  Kapucu, Arslan, and Demiroz (2010) also point out

that frequent interaction through emergency exercises before a disaster contributes to

strengthening response capabilities and enhancing organizational resilience.  Thus, this research

hypothesizes that:

Hypothesis 3: Organizations with previous interactions during emergency exercises have a higher their level of organizational resilience.

## Emergency Management in South Korea

The empirical study aims to examine, in the area of emergency preparedness, the pattern of interorganizational collaboration in South Korea. Currently, the National Emergency Management Agency (NEMA) is the main agency responsible for developing and coordinating a comprehensive emergency management system. Established in 2004, NEMA is authorized by the Basic Act on Emergency and Safety Management (2004) to implement and develop a national emergency management system that is comprehensive, risk-based, and adopts an all-hazards approach.

However, the national emergency management system has been criticized on several grounds. For example, according to Ha and Park (2012), public agencies at the national level are assumed to play the leading role and provide directives to lower level governments, without paying heed to local preferences. They pay more attention to emergency response rather than mitigation and preparedness. According to Kim and Lee (1998), the national government is only ready to act when disasters are caused by human errors or technological hazards rather than natural disasters. The national legislations and public programs also tend to focus on vertical networks rather than horizontal relations. Thus, little is done to encourage interorganizational collaboration across non-governmental, business, and local community-based organizations (Ryu

and Ahn 2007; Yang 2010).

At the regional level, the pattern of interorganizational collaboration, arguably, had been influenced much by the country's bureaucratic norms and structure. At the provincial level, for example, regional governments tend to function as an intermediary role between the national and local governments. The intermediary function not only provided necessary information from localities to NEMA for assistance and emergency aids, but also to certify local emergency operations plans. The plans must be consistent with the provincial government's emergency operations plan. During disaster response, the emergency operations headquarter at the provincial level would coordinate activities between the Central Emergency and Safety Operations Headquarter (CESOP) and localities' emergency operations centers. The provincial government would also coordinate joint response when local governments are overwhelmed by disaster response and, within their respective jurisdictions, could provide directives to local governments.

There is evidence of interorganizational collaboration at the municipal level. The administrative responsibilities in emergency response are supplemented by local efforts, i.e., formal agreements are established across provincial or metropolitan political boundaries. For example, a bilateral agreement was established in August 2012 between Gangseo City in Busan metropolitan area and Geoje City. The formal agreement was on the development of preparedness and response plans related to emergencies on Geoga-Busan's bridge-tunnel fixed links. Such an agreement was not uncommon in the south east region of the Korean peninsula. Take another example: a bilateral agreement between Yangsan (city) and the Busan Meteorological Agency concluded in April 2008 with a joint meteorological observation agreement. A multilateral agreement has also been established between municipal governments.

On August 2010, for example, an agreement was formed between 14 local governments in Busan metropolitan area and the South Kyeongsang province concerning emergencies related to floods caused by Nakdong River. In the area of emergency management, local governments also established agreements with non-governmental organizations such as Busan Volunteers Center and the regional branch of an NGO Living Good Movement in Busan.

The nature of interorganizational collaboration is also consistent with the observations in the field. For example, since the introduction of the Local Autonomy Act (1990/1994/1995/1989) and the Local Finance Act (1988) as well as the passage of the Devolution Promotion Act in 1999, there have been a growing number of NGOs established at the local level (Choi and Wright, 2004). Although the national government still plays an important role in guiding local affairs, as local autonomy expands to include public programs and services, local governments are increasingly coordinating services with community-based organizations and NGOs (Choi and Wright, 2004). An increasing importance of locality-NGO relations has been documented elsewhere. But, more importantly, according to Bae and Kim (2012) and Choi and Wright (2004), the concern for civil society has actually mobilized local leaders and communities to self-organized and pursuit a greater local autonomy.

The next section aims to examine the pattern of emergency management practices in South Korea. Although collaboration can enhance the likelihood and scope of regional integration, the patterns of interorganizational collaboration in South Korea is still understudied.

## Research Site, Data, and Methods

In order to understand patterns of interorganizational collaboration in South Korea, data collection was conducted in the southeastern region of the Korean Peninsula. The Southeastern Economic Region (SER), comprised of Busan and Ulsan Metropolitan areas and South Kyeongsang Province. The region is the most important industrial region in South Korea as well as the strategic foothold of the national economy. The total population of the SER is approximately 7.94 million, and the Gross Region Domestic Product (GRDP) reaches to about US$ 200 billion (MOPAS 2012). The Busan and Ulsan metropolitan areas have focused on the manufacturing industry such as automobile and marine plant factories. About 22 percent of the national industrial clusters are located in the SER, and global enterprises such as Samsung, LG, Hyundai, and Kia have their factories here (Jung and Jeong 2010). Recently, the SER has extended its economic outreach by partnering with Asian countries by collaborating with global cities such as Shanghai in China and Hukuoka in Japan (Yonhap News 2012). These efforts towards regional economic development have motivated regional stakeholders to build intergovernmental collaborations.

However, the geographical location of the region is vulnerable to natural disasters (i.e., typhoons, floods, and severe wild fires). According to NEMA (2011b), the damages from natural disasters, particularly typhoons have led to storm water overflows in the lowlands of SER resulting in an estimated US$ 4 billion in economic losses (i.e., 23.7 percent of the total losses to South Korea) in the last decade from 2001 to 2010.

The region is also highly fragmented. For example, regional governments often take on the role of coordinating body during emergency recovery processes. Yet, they are not

responsible for establishing short-term planning strategies to mitigate hazards related to natural disasters (NEMA 2011a; MOPAS 2012). The Local Safety Management Committee (LSMC) coordinates local organizations to transmit information and resources by directly communicating with MOPAS and NEMA. Also, the LSMC is only responsible for mapping disaster vulnerability and managing local emergency management fund. The regional headquarters of fire and police administration often perform their duties independently of regional governments and have separate communication channels with local branches.

## Sample Selection

Data collection was conducted in two stages. During the first stage, a snowballing sampling method was employed to identify key organizations involved in emergency management activities in the southeastern economic region of South Korea. Before administering the survey instrument, a pilot test was conducted on 20 public organizations (i.e., 5 cases in each Busan and Ulsan metropolitan areas and 10 cases in the South Kyeongsang province).

At the initial stage, only 43 local governments were contacted between July 16 and 28, 2012, who then identified up to three other organizations they frequently communicated with during emergency response. In the first wave, a total of 130 organizations responded to the survey, which was completed by 43 local governments (33.1%), 34 fire stations (33.3%), and 28 police stations (33.3%), and 25 nongovernmental organizations (19.2%) in the region. Although considerable efforts were made to solicit response from regional and national level agencies, none agreed to complete the survey. The process produced a total of 170 organizations, which included national, provincial, and local agencies and nongovernmental organizations. They were included in the final networks analysis because they were referred by those completed the

survey.

In the second wave, about 86.1% of the organizations (112) have maintained the associated program, i.e., whether or not they had participated in CEM to cooperate with the other organizations dealing with disasters.  The data on organizations' decision whether to participate in CEM was obtained during the first survey in the Southeastern Economic Region (SER), South Korea.  During the second wave of data collection, the composition of the organizations are as follows: The total response was 115 organizations consist of 43 local governments (38.4%), 24 fire stations (21.4%) and 20 police stations (33.0%), and 20 nongovernmental organizations (22.3%).  Table 1 below presents the distribution of respondents by types of organizations.

Table 1. Responded and Citied Respondents by Types of Organizations

| Organizational Types | Before Typhoons | | After Typhoons | |
|---|---|---|---|---|
| | Frequency | Others cited | Frequency | Others cited |
| National agencies | - | 5 | - | 5 |
| Regional agencies | - | 6 | - | 6 |
| Local governments | 43 | - | 43 | - |
| Fire stations | 34 | 9 | 24 | 19 |
| Police stations | 28 | 15 | 20 | 23 |
| Nongovernmental organizations | 25 | 5 | 25 | 5 |
| Total | 130 | 40 | 112 | 58 |

**Measuring Organizational Resilience**

We use a composite index to capture organizational resilience: robustness, rapidity, resourcefulness, and redundancy (Andrew et al., forthcoming; Bruneau et al. 2003; Kendra & Wachtendorf 2003; Bruneau & Reinhorn 2006).  In accordance with the organizations' responses to the survey questions shown in Table 2 below, the four answers with a five-point Likert scale: 0

(strongly disagree) to 4 (strongly agree), were added. This ranged from 0 to 16. The added

scores were then divided by 16, and multiplied by 100 to create an index of organizational

resilience (Cronbach's α =.784). The organizational resilience index (CRI) ranged from 0 to 100.

Table 2. Survey Questions for the Organizational Resilience Index

| Dimensions | Survey Questions |
|---|---|
| Robustness | Would you agree that your [organization] has the ability (or been able) to overcome operational disruptions immediately caused by a disaster? |
| Rapidity | How would you rank the RAPIDITY of providing assistant to disaster victims with resources that you have? |
| Resourcefulness | Do you agree that your organization is RESOURCEFUL in order to meet the needs of disaster victims and their communities? |
| Redundancy | Do you agree that your organization has the ABILITY to carry out routine tasks and, at the same time, help victims and their communities to cope with disasters? |

*Dimensions of resilience adopted by Bruneau et al. (2003)

**Interorganizational Collaboration**

We identify interorganizational collaboration based on a question in our survey instrument:

"Consider the full range of organizational types including national government agencies,

grassroots organization, interest groups, NGOs, and local agencies. Please list the organizations

that you have collaborated with during emergency situations in order to provide assistance to

disaster victims and their communities." The question was purposely designed to capture with

whom local governments established collaboration in the area of emergency management

(preparedness). To determine the nature of interorganizational collaboration, we managed our

data systematically as a directed matrix, where 170 organizations' interorganizational ties were

coded as an $N$ x $N$ matrix reporting all ties among all N actors.

**Bonding Effects**

The bonding effects are measured by the closeness centrality index (Wasserman and Faust, 1994). The index captures the importance of building trust with actors that are connected to other reachable actors (*see* Andrew and Carr, 2013). The standardized closeness centrality index ranges from 0 to 100 (Wasserman and Faust, 1994). The lower closeness index indicates the lack of resources an actor can secure from their networks, while the higher index suggests the actors are pooling their resources from other actors directly and indirectly connected to them. Following Wasserman and Faust (1994), the formula for the closeness centrality is:

$$C_C(n_i) = \left[ \sum_{j=1}^{g} d(n_i, n_j) \right]^{-1}$$

**Bridging effects**

The bridging effects are measured by the betweenness centrality index (Wasserman and Faust, 1994). The theoretical underpinning of the measure captures the strategic importance of being in a central position in a network. The index is based on the frequency that an actor is located on the shortest paths between any two other actors in a region. The standardized betweenness centrality index has the range between 0 and 100 (Wasserman and Faust, 1994). The highest betweenness centrality index indicates the actor has the greatest influence and access to information. The formula for the betweenness centrality is:

$$C_B(n_i) = \sum_{j<k} g_{jk}(n_i) / g_{jk}$$

**Previous Interaction effects**

Organizations previous interaction is measured by a survey question, which asks if an

organization has involved in a full-scale exercise, i.e., the survey item asking "Has your organization participated in the full-size exercise organized by the National Emergency Management Agency (NEMA)?" This variable captures whether or not organizations invest resources and strongly committed in their collaboration with other organizations. In general, simply joining the emergency program does not mean that all the actors are willing to put their strong commitment in sharing their resources or information. However, willingness to participate in the full exercise suggests the organizations are making efforts to build trust and reciprocity. The variable is operationalized as having involved in a full-scale exercise that was coded 1, if the organization has implemented a joint full-size CEM exercise with its collaborators, 0 if otherwise. Table 3 summarizes the concepts, measures, and data sources for the control variables.

**Methods of Analysis: Heckman Selection Model**

This research employs the Heckman selection model in two stages. One reason to employ the model is because 14 of our total cases never joined CEM affiliation, and thus potentially leading to bias estimation. They were coded 0 in the first stage of the analysis, which means the data were truncated in the second stage. The selection model is generally adapted for systemically selected samples in order to correct a selection bias (Heckman, 1979). In the first stage, we included variables representing organizational capacities such as personnel and financial resource. We also include local community characteristics such as social and environmental vulnerability as well as the role of coordinators in local emergency management. In the first stage of the selection equation, it tests factors facilitating organizations to participate in CEM.

During the second stage, the outcome equation analyzes factors explaining the level of

organizational resilience as perceived by organizations that were selected during the first stage of the analysis. In addition, the second-stage outcome equation includes the variables considered in the first stage (i.e., organizational capacities, community characteristics, and existence of EM department as a coordinator).

Table 3. Concepts, Measurements, and Data Source

| Variable | Concept | Measurement | Source |
|---|---|---|---|
| Selection | Participation in CEM | Coded 1 if a public organization actually participated in local emergency management planning, 0 otherwise | 2012 SER EM Survey |
| Outcome | Organizational resilience | Score of the perceived organizational resilience index | 2013 SER EM Survey |
| Full Exercise | Strong commitment | Coded 1 if an organization has implemented joint full-size EM exercise with its collaborators, 0 otherwise | 2012 SER EM Survey |
| Total Emergency Manager | Personnel resource | The number of EM staff | 2011 Government Census |
| Public Safety Expenditure | Financial resource | Log of total public safety expenditure | 2011 Government Finance Yearbook |
| EM Department | Institutional resource | Coded 1 if a public organization has an specialized EM department | 2012 SER EM Survey |
| Ratio of Senior population | Social vulnerability | Percentage of population over 65 years old from the total population | 2010 Census of Population |
| Coastal Area | Environmental vulnerability | Coded 1 if a public organization is located on a coastal city, 0 otherwise | 2012 SER EM Survey |
| River Side | Environmental vulnerability | Coded 1 if a public organization is located on a riverside city, 0 otherwise | 2012 SER EM Survey |
| Local Government | Local EM coordinator | Coded 1 for local government, 0 otherwise | 2011 Government Census |

**Results and Discussion**

Table 4 shows the descriptive statistics with the measures for each variable included in the

Heckman selection model. As shown in Table 4, approximately 112 organizations (86.1 %)

engaged in CEM after the 2012 Korean typhoons. Only 39 out of 112 organizations have

activated the full-size exercise with their collaborating partners. The average score of the

organizational resilience index was about 77.26. On average about 6 emergency managers were

working in the organizations participating in local emergency management.

Table 4. Descriptive Statistics

| Variable | N | Mean | Std. Dev. | Minimum | Maximum |
|---|---|---|---|---|---|
| Collaborative Emergency Management (CEM) | 130 | .891 | .312 | 0 | 1 |
| Organizational Resilience Index | 112 | 77.261 | 12.778 | 50 | 100 |
| Bonding Effects (Closeness) | 130 | 8.942 | 2.334 | 0 | 10.01 |
| Bridging Effects (Betweenness) | 130 | 4.696 | 7.169 | 0 | 37.82 |
| Previous Interaction Effects (Full exercise) | 130 | .302 | .461 | 0 | 1 |
| Total Emergency Manager | 130 | 6.651 | 2.439 | 2 | 14 |
| Public Safety Expenditure | 130 | 14.691 | 1.046 | 12.641 | 17.429 |
| EM Department | 130 | .488 | .502 | 0 | 1 |
| Ratio of Senior Population | 130 | .145 | .076 | .041 | .308 |
| Coastal Area | 130 | .465 | .501 | 0 | 1 |
| River Side | 130 | .256 | .438 | 0 | 1 |
| Local Government | 130 | .636 | .483 | 0 | 1 |

Table 5 presents the results of the Heckman selection model. In the first-stage of the

analysis, the Heckman selection model examines factors that explain organization decisions to

participate in CEM; and in the second stage, the level of organizational resilience is examined by

the patterns of interorganizational relations and previous interaction effects. The model includes 130 organizations responded to the first survey conducted before the typhoons, and 18 of the total respondents are truncated by the first selection stage. The Wald $\chi^2$ test result shows that this model is statistically significant, rejecting the null hypothesis that all coefficients in the model do not explain both dependent variables. The likelihood ratio test supports the use of the Heckman selection model indicating that there is no nonrandom selection bias.

The results provide evidence of the bridging effect that organizations positioning in a central actor between two other actors after the 2012 Korean typhoons tend to perceive a relatively high level of organizational resilience ($\beta = .218$, $p < .05$). That is, securing a brokerage role leads to the acquisition of essential resources from other organizations after a catastrophic event and thus holding a central position can enhance their capacity to bounce back from a disaster. As highlighted by Andrew and Carr (2013), this finding implies that the bridging strategy within a self-organized emergency management network plays a critical role in gaining access to other organizations' personnel and financial resources after a disaster. This also reduces uncertainties derived from joint emergency response and recovery operations.

Since organizations after joining collective actions may have incentives to free-ride and take advantage of higher level government's efforts, the collaboration risk embedded in collective action problems may increase enforcement costs but decrease the level of joint outcome (Feiock, 2013). Based on this logic, the finding highlights that the bridging strategy is critical to overcome ICA dilemmas, i.e., organizations generally aligned their actions through a central hub after a disaster. Agian, organizations can reduce the collaboration risk that may cause failure to jointly respond to a disaster and recover by holding a central position in which they can access timely information and intangible resources from other collaborating partners.

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Table 5. Analysis Results of the Heckman Selection Model

|  | Coefficient | Std. Err. |
|---|---|---|
| *Selection Equation (likelihood of participating in CRM)* | | |
| Total EM Staff 2011 | -.146** | .106 |
| Public Safety Expenditure 2011 | .745*** | .282 |
| EM Department 2011 | .467 | .519 |
| Ratio of Senior Population | .041 | .027 |
| Coastal Area | -.016 | .358 |
| Riverside | .114 | .441 |
| Local Government | 6.024*** | 2.521 |
| Constant | -12.348** | 4.998 |

Note: Coefficient and standard error of the bonding, bridging, and previous interaction effects in the selection equation are not reported.

| *Outcome Equation (organizational resilience index)* | | |
|---|---|---|
| Bonding Effects (Closeness) | .881 | .604 |
| Bridging Effects (Betweenness) | .218** | .109 |
| Previous Interaction Effects (Full exercise) | .676 | 2.723 |
| Total EM Staff 2011 | -.487 | .727 |
| Public Safety Expenditure 2011 | 1.258 | 1.819 |
| EM Department 2011 | 5.388 | 3.374 |
| Ratio of Senior Population | -.396** | .177 |
| Coastal Area | 6.508*** | 2.432 |
| Riverside | 1.031 | 2.717 |
| Local Government | 4.936* | 2.875 |
| Constant | 60.292* | 33.034 |

| | |
|---|---|
| N (uncensored) | 130 (112) |
| Log Likelihood | -475.504 |
| Wald $\chi^2$ | 32.81*** |
| LR test of Indep. eqns. (rho = 0) | 1.08* |

***$p$ < .01; **$p$ < .05; *$p$ < .10

The bonding effect, i.e., organizations closely collaborating with other actors, has a higher level of perceived organizational resilience but this effect is not statistically significant. This hypothesis is based on the belief that some organizations may utilize their involvement in local emergency management committees as a tool to share information and intangible resources (Andrew et al., forthcoming). Although both Murphy (2007) and NRC (2009) argue that, when organizations are affiliated to a strong collaborative group (e.g., fire, police stations, and nongovernmental organizations), they can secure essential resources; and, therefore has a better sense of resilience, there is no empirical evidence to support that organizations with a higher closeness centrality have a higher perception on the level of organizational resilience after a disaster.

From the ICA perspective, the bonding strategy may provide a source for organizational resilience (Andrew et al., forthcoming), but the result in the Korean context was not found. It moves our attention to the presumption that organizations have to maintain their relations with others after a disaster. That is, the continuous interactions among local organizations are important for possessing valuable resources. For instance, local governments need to prepare for future disasters by strategically reinforcing reciprocal relationships with other local organizations. In order to establish a close-knit structure, they should develop plans to mitigate uncertainties and also promote the mutual interests of local organizations (Lin 2001; Andrew & Carr 2012).

The analysis results also show that, if an organization interacted previously through full-scale exercises, the likelihood of having more connection with others in the region is high. This is consistent with other observations (Comfort and Haase, 2006; Lubell, 2007; Feiock, 2013). The finding suggests that, mutual understanding, shared goal, and strong commitments

established before a catastrophic event can encourage capacity building (Comfort, 2007). While organizational resilience is seldom reinforced by a joint full-size exercise as part of emergency planning and preparedness, it may be argued that continuous interactions lead to building mutual trust and understanding and thus reducing behavioral uncertainty. However, we found no evident that the previous interaction effect, which is resulted from the participation in joint full-size exercises with other organizations, has an effect on the perceived level of organizational resilience. While organizations activating full-size exercises may increase the likelihood of enhancing their ability to return to normalcy, the results did not show significant result.

We also found that organizational resilience is associated with social and environmental vulnerability (Norris et al., 2008). This research found that organizations serving a larger number of elder populations over 65 year old tend to perceive a lower level of organizational resilience. This finding implies that organizations' capacity to bounce back from a disaster is likely to be impeded by resources due to vulnerability of it population. That is, the dependency ratio – the ratio of female, children, and elder people over 65 – may cause an increase in the costs of responding to a catastrophic event (Cutter et al. 2003). However, environmental vulnerability surprisingly has a positive effect on the level of organizational resilience. It can be argued that if an organization is located in an environmentally vulnerable are, the organization is more likely to prepare for disasters.

## Conclusion

The objective of this essay is to examine the effect of bonding and bridging collaboration on interorganizational resilience. It does this by using a Heckman selection model by first

examining the effect of organizations participation in a full-scale exercise. Based on the Heckman selection model, the model suggests that organizations holding a central position between two other actors tend to perceive a higher level of organizational resilience, thus supporting the bridging hypothesis. The finding implies that organizations with a bridging strategy can enhance their capacity to bounce back from a catastrophic event by securing access to critical resources and information. It is also argued that the sources of organizational resilience can be gained through emergency preparedness and hazards mitigation processes such as joint response and recovery planning. On other words, organizations holding a central position between other organizations can gain access to relevance of information and intangible resources (Comfort, Boin, and Demchak, 2010).

This study provides two contributions to the study of intergovernmental collaboration in general and emergency management in particular. Despite calls from scholars and practitioners about importance of organizational resilience (Kendra and Wachtendorf, 2003; NRC, 2009; 2011; Norris et al., 2008; Cox and Perry, 2011; Andrew et al., forthcoming), previous research has not fully examined interorganizational factors affecting the resilience. Understanding organizational resilience allows us to explore a broad set of adaptive capacities of an organization by focusing on its ability to mobilize resources and facilitate successful adaption to unpredictable situations. Since resource mobilization and information access are principally derived from interorganizational coordination, the importance of social positions also provides insights on the sources of organizational resilience.

Second, from a dimensional perspective, this essay fills a gap between the concept of resilience and measurements. The dimensions of organizational resilience utilized in this study allow scholars to measure the concept by utilizing various aspects of adaptive capacity during

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and after disasters. Robustness, rapidity, resourcefulness, and redundancy that this research has employed showed that the dimensions are perceived differently by various organizations engaged in collaborative emergency management. In order to facilitate organizational resilience, national, regional, local principal governments should provide platforms for organizations to interact allowing them to reduce uncertainties (Andrew et al., forthcoming).

Despite the contributions of this essay, there are several limitations. First, an entire regional network relies on egocentric measures. Scott (2000) points out that unreported ties may influence the different network measures. Second, this study only examined a region in South Korea, and may not be generalized to other regions in the country. Despite the limitations, this research hopes that others can build upon the relationship between social positions and organizational resilience by identifying key actors at the local, regional, and national level. Future research should focus on formations of ties that explain intergovernmental behavior to overcome the barriers to collective action by using an exponential random graph ($p$*) model. More importantly, an in-depth interview with local officials is expected to provide validity of future research.

# CHAPTER 4

## THE DYNAMICS OF INTERORGANIZATIONAL TIES

The purpose of this research is to test interdependent and independent risk hypotheses that explain the formation of interorganizational ties using the network evolution approach. The main objective is to uncover the dynamic structure of interorganizational emergency management network after a disaster. As proposed by Snijders et al. (2010), the method of analysis is based on a forward model selection strategy where the endogenous network structural effects are considered first before including the exogenous effects in the final model. Based on the datasets collected before and after the 2012 typhoons in South Korea, the results of the stochastic actor-based models found support for the interdependent risk hypothesis suggesting the interorganizational collaboration tends to be based on the notion of "shared risk." The results also suggest that organizations, located on the coastline and/or participated in the joint full-sized exercise, are more likely to form interorganizational ties after a disaster. Taken together, the findings imply that an organization experiencing prefer to collaborate with other organizations in order to minimize respond to disasters.

### Introduction

Building organizational resilience is a complex and dynamic process playing out over multiple scales of public, private, and nonprofit organizations. While much of growing research has highlighted the importance of interorganizational emergency management networks (Waugh, 2003; Waugh and Streib, 2006; Kapucu, 2006; Choi and Brower, 2006; Andrew and Carr, 2012),

few research has identified how patterns of social relations established by diverse local organizations is modified by a disaster. The transformation of interorganizational ties in order to enhance organizational resilience is timely and an important topic for the fields of emergency management (Kapucu et al., 2012). Given the limitations of resource and fragmented regional governance, previous literature has argued that emergency networks encompassing federal, state, and local governments played an important role in promoting successful adaptation to adversity (Kapucu et al., 2010; Andrew, 2009; 2010). Helping to build organizational resilience – characterized by a community's ability and capacity to respond and recover damages from disasters – has also received much attention by regional, state, and national policymakers (Norris et al., 2008; Chandra et al., 2010; Sherrieb et al., 2010).

This research is intentionally designed to test two general hypotheses: interdependent and independent risk hypothesis. While the former illustrates the importance of trust and information redundancy to coordinate and align emergency preparedness and response, the latter captures the tendency for local actors to seek dominant partners in order to bridge crucial information across the region (see Andrew, 2009; 2010; Andrew and Carr, 2012). The relationship between interorganizational ties and organizational resilience is timely and an important topic for the fields of urban and emergency management (Kapucu et al., 2012). Given the limitations of resource and fragmented regional governance, scholars have argued that emergency networks encompassing national, regional, and local governments as well as private and non-governmental organizations play an important role in promoting adaptation to adversity and establishing meaningful emergency planning processes (Kapucu et al., 2010; Andrew, 2009; 2010).

The main objective is to determine the patterns of interorganizational relations and how planned joint coordination efforts are modified to meet unexpected local demands and thus

contributing to organizational resilience. The term organizational resilience is generally conceptualized as the capability of an organization to bounce- back from an adverse situation (National Research Council, 2010; Cox and Perry, 2011; Andrew et al., Forthcoming). The concept has gained wide interest after the adoption of the Hyogo Framework for Action 2005-2015, calling for the need of national and organizational resilience to disasters (Manyena, 2006). Organizational resilience is operationalized as the capability of interconnected networks of organizations to foster the following resilience dimensions: robustness, rapidity, resourcefulness, and redundancy.

Moreover, in the realm of emergency management, whether planned or not, during disasters self-organizing governance will emerge in one form or another (Dynes, Quarantelli, and Kreps, 1972; Kreps, 1991; Dynes, 1994). Although this stream of work provides insights into the different types of emergence groups during disasters, it tends to focus on the normative issues rather than investigating factors explaining the process of interorganizational coordination. This research overcomes this gap by collecting data at the organization level. This is an innovative approach in that it focuses our attention on how a diverse set of organizations are transforming their resources and devising alternative means to overcome unexpected challenges, thereby building organizational resilience.

**Institutional Collective Action Framework**

The Institutional Collective Action (ICA) framework posits that transaction costs of collaboration can prevent organizations from working together to achieve better outcomes. The relative advantage analysis of transaction costs (e.g. information costs, negotiation costs, agency

costs, and enforcement costs) provides insights on obstacles preventing collective decisions to be realized (Inman and Rubinfeld, 1997; 2000; Feiock, 2007). The dilemmas also arise from a system of fragmented authority (i.e. vertical, horizontal, and functional fragmentation), which become barriers to mutually beneficial action because they generate transaction costs when organizations consider agreements for joint activities. The ICA perspective extends the collective action theory that is concerned with individuals' behaviors and identifies problems associated with sub-optimal outcomes at the organizational level. The framework has also been utilized to study organizational behaviors using contract and transaction cost theories (Feiock, 2009; Feiock and Scholz, 2010).

In the context of emergency management, the ICA framework has been applied to study interorganizational collaboration as interactions or interorganizational ties (Andrew and Carr 2012; Andrew et al. forthcoming; Andrew, Jung, and Li, forthcoming). Such interactions can improve the level of emergency response as they offer informal mechanisms for actors to reduce the cost of coordination and cooperation (Andrew et al., Forthcoming). A beneficial exchange is realized when actors received crucial resources from multiple actors. For instance, bonding strategy stresses the importance of social cohesion leading to the ability of organizations to pool their resources together (Andrew et al., Forthcoming), but bridging facilitates connection to those organizations that otherwise would not be connected in order to coordinate human and capital resources (Burt, 1992).

Disasters can overwhelm the capacity of any single sector or community, making the inclusion of different actors in emergency response activities a necessity (Robinson, 2012; Comfort, 1994; Kapucu, 2006; 2007). Since collaboration between different functional organizations and levels of government often generates coordination problems, creating a "hub"

or a bridge that spans across multiple actors can facilitate access to new information and novel resources (Burt, 2005). The bridging strategy can also broaden the range of participants. The participants then spread the risk with adjacent communities, and they respond quickly and appropriately. These mechanisms integrate decision-making, create mutually binding agreements, delegate authority, and impose authority through networks (Feiock, 2013). Each mechanism resolves a collective action dilemma differently. Social network studies suggest that various coordination strategies are adopted to minimize transaction costs of collaboration and risks associated with potential default (Berardo and Scholz, 2010).

In the underlying ICA framework, collaboration risks reflect incoordination (inaction), division (division of costs), and defection (agreement violation) (Feiock, 2013). Defection risks are especially high in disaster situations because if even one participant does not conform to the agreement, others will probably fail to respond effectively to the disaster. Each disaster has different frequency and intensity in general. This might change the action of each organization relying on their internal condition or capacity. For better response, the collaborative networks have been already established at the preparedness stage, but rational actors might consider the benefit and cost when they face disasters regardless of agreement. High risk deriving from high uncertainty increases transaction cost.

## What Explains the Evolutionary Structure of Interorganizational Ties?

Organizational ties that build an effective interorganizational collaboration change after a catastrophic event. The unpredictable and chaotic features of catastrophic events overwhelms the capacity of any single organization and thus, motivating organizations to include and/or

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exclude certain actors in emergency response activities (Comfort, 1994; Perry and Lindell, 2003; Waugh and Streib, 2006; Robinson, 2012). From the resource dependency perspective, Pfeffer and Salancik (1978) assert that if an organization is not self-sufficient, it will adapt to its environment in order to survive. Since the need for acquiring crucial resources suggests that an organization is dependent on other organizations (Scott, 1987, p. 111), the formation of interorganizational ties is determined by both internal and external factors. During a period of adversity, for instance, resilient organizations are more likely to establish efficient measures for securing tangible resources, which can improve response operations. On the other hand, some organizations may have limited sources to exchange indispensable resources, and thus may not be able to manage disaster situations without depending on outside assistance (Sutcliffe and Vogues, 2003).

However, collaboration may not be materialized in the presence of uncertainty. Despite the emphasis on the importance of coordination and communication between diverse actors (Kettl, 2003, McEntire and Dawson, 2007), strategies for mitigating risks may not work in emergency contexts (Andrew and Carr, 2013). Unlike an effort on achieving the goal of collaborative relations in the area of mitigation, the cost of establishing and sustaining interorganizational networks can be high and the enforcement mechanism might be absent. Commitment that local government should follow in planning documents can be unrealistic if key elements required to implement the planning activities are not tested. Moreover, the changes in collaboration also are affected by changing environmental conditions such as natural and technical disasters (Dynes and Drabek, 1994). Such changes can be explained by two general hypotheses: "interdependent risk" and "independent risk" (Berardo and Scholz, 2010). The next section explains the causal mechanisms explaining strategies to minimize collaborative risk in

the presence of disasters.

**Interdependent Risk Hypothesis**

The interdependent risk hypothesis suggests that organizations have a strong preference to forge ties with those that are connected closely together in order to share risks and cope with disasters. In other words, an organization closely connected to other organizations may be more resilient than another organization because of the following reasons: (1) Andrew (2010) highlights that forging a direct tie can broaden the range of collaborators leading to risk-sharing with adjacent communities and enables people to respond quickly; (2) Burt (2005) suggests, when applies to emergency management, holding a close-knit structure provides informal structural power to directly access and mobilize indispensable resources that an organization urgently needs during a disaster; (3) Choi and Kim (2006) and Vasavada (2013) highlight the importance of associational benefits resulting from close-knitted structures, implying that locally clustered organizations mobilize themselves to share resources through formal and informal arrangements after a disaster.
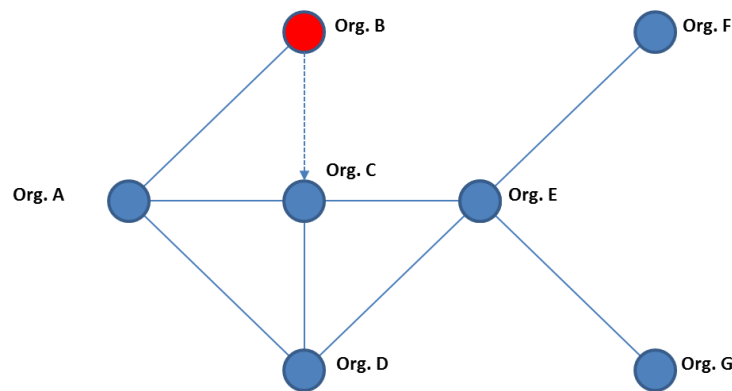


Figure 1. Interdependent Risk Hypothesis

According to the interdependent risk hypothesis (*see* Figure 2), organization B has a motivation to collaborate with organization C in order to maintain response operations (Dooley, 1997; Comfort *et al*., 2001).  Given the hypothesized network, solid lines indicate existing interorganizational ties and the dotted line represents the choice made by organization B after a disaster.  When deciding whether to collaborate with either organization C, E, F, or G, organization B would rather forge a tie with organization C at time 2.  This is because a close-knitted triadic structure not only can facilitate mutual reciprocity but also ensures organizations within the network commit to their agreement to cooperate (Andrew, 2010).  Since a single organization cannot effectively cope with a disaster (Katz and Kahn, 1966; Donaldson, 1996), a group of organizations may prefer to share risks by forging ties with those that are socially positioned in a highly clustered network.  Therefore, this research hypothesizes that:

Hypothesis 1: After a disaster, organizations have a strong preference to forge ties with those that are closely connected with each other in order to share risks and cope with the aftermath of the disaster.

**Independent Risk Hypothesis**

Alternatively, the independent risk hypothesis posits that an organization will spread risks by establishing ties with those outside their close-knitted circle.  The hypothesis highlights the importance of entrepreneurial behaviors of organizations to spread risks.  The independent risk-spreading strategy is important for organizations to minimize potential losses from the disaster (Kreimer, Arnold, and Carlin, 2003).  The reasons motivating organizations to spread risks and

establish ties with a central organization are that by establishing organizational ties with a central actor, the organization can reduce additional costs of coordination (Andrew 2010).

According to Kapucu (2006), organizations in the peripheral of a network prefer to directly link to core actors because they cannot bear the costs of crafting and monitoring other collaborators independently. For instance, organizations with a limited number of skilled personnel and budget constraints may be motivated to seek exclusive exchange partners who can provide an opportunity for additional resources. They also spread risks after a disaster if the organization has preference to enhance organizational capacity. Such a strategy is important if the region has a low probability of disaster occurrence, especially in megacities located in East Asian (Hochrainer and Mechler, 2011).
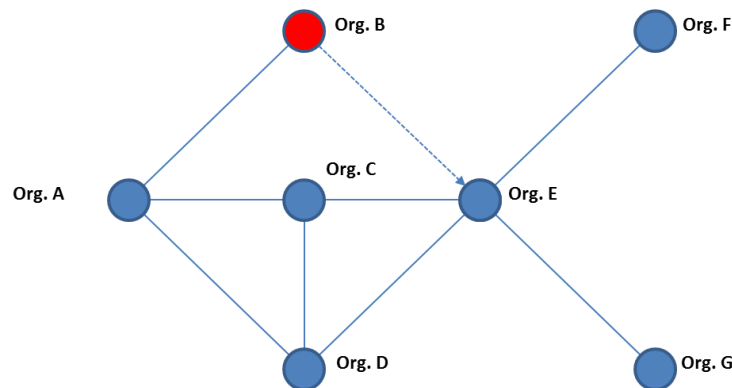


Figure 2. Independent Risk Hypothesis

According to the independent risk hypothesis (*see* Figure 3), organization B would rather establish a tie with organization E than organization C, F, or G at time 2. This is because organization E does not have any commitment with organization A. In this situation, organization B can secure exclusive access to organization F and G. In other words, organization B could better spread its risks by establishing tie with organization E (Andrew, 2010). The

decision is consistent with the entrepreneurial behavior of an organization aiming to secure the

most influential actor within its network in order to cope with internal constraints (Kreimer,

Arnold, and Carlin, 2003).  Thus, this research hypothesizes that:

> Hypothesis 2: After a disaster, an organization has a preference to forge ties with those
>
> that are centrally connected to orders in order to spread risks and cope with the aftermath
>
> of the disaster.

## Homophily Hypothesis

In the field of emergency management, the homophily hypothesis allows us to investigate the

similarity of organizational attributes.  The hypothesis suggests that similarities of actors will

predispose the actors to have comparable policy preferences and strategic behaviors to reduce

transaction costs (Goodreau *et al*., 2009).  Lubell (2007) argues that intrinsic similarities among

organizations are crucial for selecting potential collaborative partners.  This is important because

it helps reduce transaction costs (Feiock and Scholz, 2010) and/or minimize risks derived from

collaboration (Gulati and Gargiulo, 1999).

According to the homophily hypothesis, an organization has a strong preference to forge

a tie with another organization if both have similar organizational attributes (i.e., level of

government and type of emergency tasks).  In the emergency management literature,

collaboration among similar organizations can reduce collaborative risks because previously

shared authority can enhance trust and working relationships between them after a disaster

occurs (Moynihan, 2009).  In addition, Comfort (2007) indicates that interorganizational

cohesion between similar organizations reinforces trust building by sharing operational

cognition. That is, because network diversity derived from inter-sector collaboration may hinder effective resource mobilization during a disaster as the heterogeneity of backgrounds, beliefs, and interests of organizations, which creates "a greater coordination burden than faced by small homogenous networks" (Provan and Milward, 2001, p. 41; Moynihan, 2009). Therefore, this research hypothesizes that:

> Hypothesis 3: After a disaster, organizations with similar organizational attributes have a strong preference to forge ties.

## Research Design and Methods

### Scope of Study and Site Selection

This research focuses on the role of interorganizational coordination in the recovery phase of the Southeastern region, which consists of Busan Metropolitan City, Ulsan Metropolitan City, and South Kyeongsang Province. The region was affected by three major typhoons. On 28 August 2012, Typhoon Bolaven devastated the Korean peninsula, resulting in 25 deaths and causing severe destruction in infrastructure and livelihood. The economic lost was estimated at $374.3 million in South Jeonna and South Kyeongsang provinces. Unlikely previous years, between August 28 and September 18, 2012, the recent disaster was caused by three successive typhoons: Bolaven, Tembin, and Sanva, (see Table 1). The National Emergency Management Agency (NEMA) (2012) reported that, the region experienced maximum wind speed of 130 and 175 mph, which led to overflows of water along the southern coastlines and a heavy runoff from the Nakdong river basins. Over 1.9 million households in the southwestern provinces experienced total blackout for more than a week. Approximately 20,000 hectares of agricultural lands were

damaged. Samsung, Hyundai, and Kia factories located in the Southeastern regions were also affected, especially in Ulsan Metropolitan area.  With an estimated $730 million in economic losses, the Korean national government officially designated 45 cities as "special disaster zones".

Table 1. Characteristics and Impacts of Three Typhoons in South Korea, 2012

|  | Bolaven | Tembin | Sanva |
|---|---|---|---|
| Category (SSHS*) | Category 4 typhoon | Category 4 typhoon | Category 5 super typhoon |
| Maximum winds | 145 mph | 130mph | 175 mph |
| Date of impacts | 28 - 30 August 2012 | 31 August -2 September 2012 | 16 - 18 September 2012 |
| Fatality | 25 | 2 | 2 |
| Total damage | USD 374.3 million | USD 8.25 million | USD 347.5 million |

*The Saffir–Simpson Hurricane Scale (SSHS) is the classification of hurricanes from 1 to 5 categories distinguished by the intensities of continual winds. A typhoon with maximum sustained winds of at least 74 mph is classified as Category 1. The highest classification in the scale, Category 5, is earmarked for the typhoon with winds exceeding 156 mph (National Hurricane Center 2012).
** Source: The National Typhoon Center in South Korea (2012)

**Data Collection and Survey Instruments**

The data collection involves a two steps process. First, before the typhoons, on 16-28 July 2012, I collected data in the region related to emergency planning.  The unit of analysis is at the organization level (e.g., local and provincial agencies, fire and police stations, and non-governmental organizations). A semi-structured interview technique was employed where I interviewed 30 key informants who had direct responsibility for processing and/or providing

services on behalf of their organizations in the region. The semi-structured interview guideline was developed around the following research questions:

1. With whom local organizations/agencies coordinate their efforts to provide emergency services in the affected areas?

2. What are the key issues surrounding their coordination planning and the modification they made in order to meet local demand for services during the response?

3. Given the nature of the disaster, what types of resources being deployed and utilized to ensure local community are able to bounce back from the disasters?

The second stage, after the typhoons, I administered another survey[2] on 7-12 January 2013. The objective was to determine whether interorganizational networks changed during the transitional stage of the disaster. However, only a total of 159 organizations were contacted in the region, and 112 organizations agreed to complete the surveys (i.e., 70.4 percent respond rate). The organizations responded to the phone survey included senior public officials from municipal governments, assistant chief of fire and police stations, and non-governmental organizations.

Table 2 provides the distribution of the responded organizations in both July 2012 and January 2013, indicating that 43 local governments and 25 nongovernmental organizations responded both surveys while only 24 fire and 20 police stations less than the first survey answered the second survey.

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[2] Appendix A: Human Subject Application No. 12567 approved by Institutional Review Board in University of North Texas

Table 2. Responded and Citied Respondents by Types of Organizations

| Organizational Type | Before the typhoons | | After the typhoons | |
|---|---|---|---|---|
| | Frequency | Others cited | Frequency | Others cited |
| National agencies | - | 5 | - | 5 |
| Regional agencies | - | 6 | - | 6 |
| Local governments | 43 | - | 43 | - |
| Fire stations | 34 | 9 | 24 | 19 |
| Police stations | 28 | 15 | 20 | 23 |
| Nongovernmental organizations | 25 | 5 | 25 | 5 |
| Total | 130 | 40 | 112 | 58 |

The interorganizational emergency management (EM) networks consist of 170 (responded organizations and those cited by the organizations). The sociograms are presented in Figures 2 and 3. The figures illustrate interorganizational networks of all organizations interacting in before and after natural disasters, and isolators in both EM networks decreased from 8 (4 fire and 4 police stations) to 5 organizations (4 police stations and 1 nongovernmental organization). There are apparent patterns that national agencies (i.e., NEMA and Ministry of Public Administration and Safety) and metropolitan and provincial governments play a significant role in coordinating emergency management resources. In addition, noteworthy from the networks is that local governments are placed in a central position of local emergency management compared to other types of organizations. On the contrary, fire and police stations are not well represented in both networks. Lastly, non-governmental organizations shown in the networks are evidence for different interaction patterns in accordance with their status such as regionalized and localized branches (e.g., Busan and Ulsan branch of Korean Medical Association and municipal branches of Korean Marine Veteran Association).
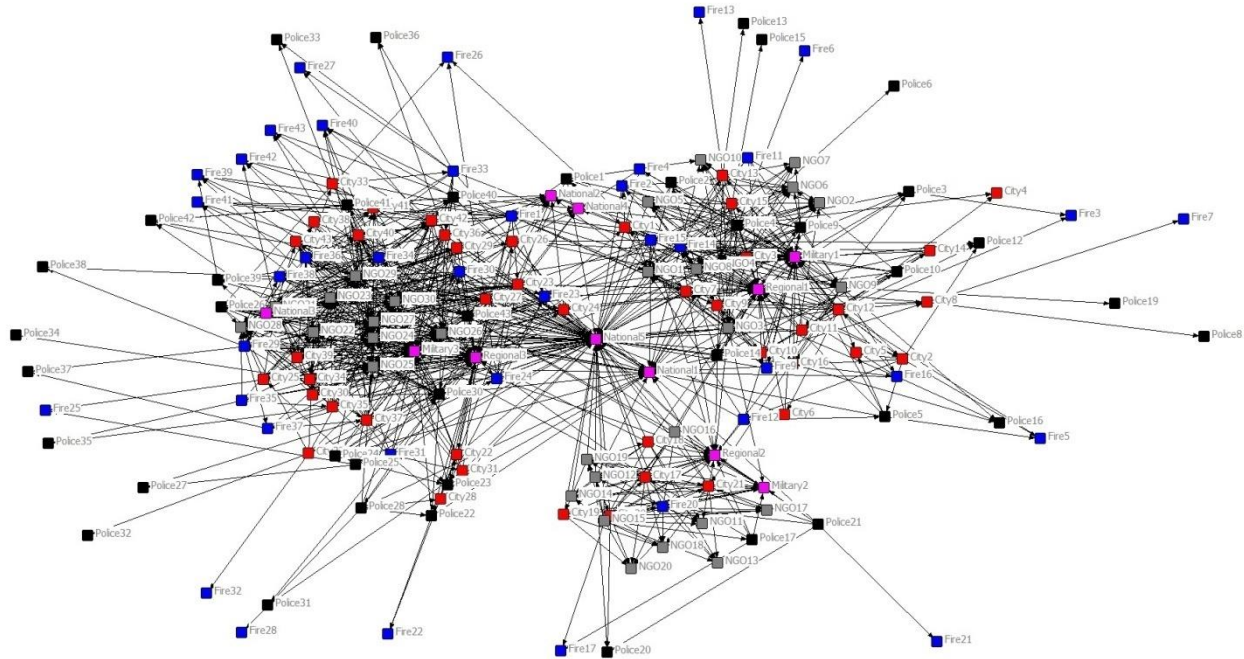
Note: Red nodes are local governments; blue nodes are fire stations; black nodes are police stations, gray nodes are nongovernmental organizations; and purple nodes are national and provincial agencies.

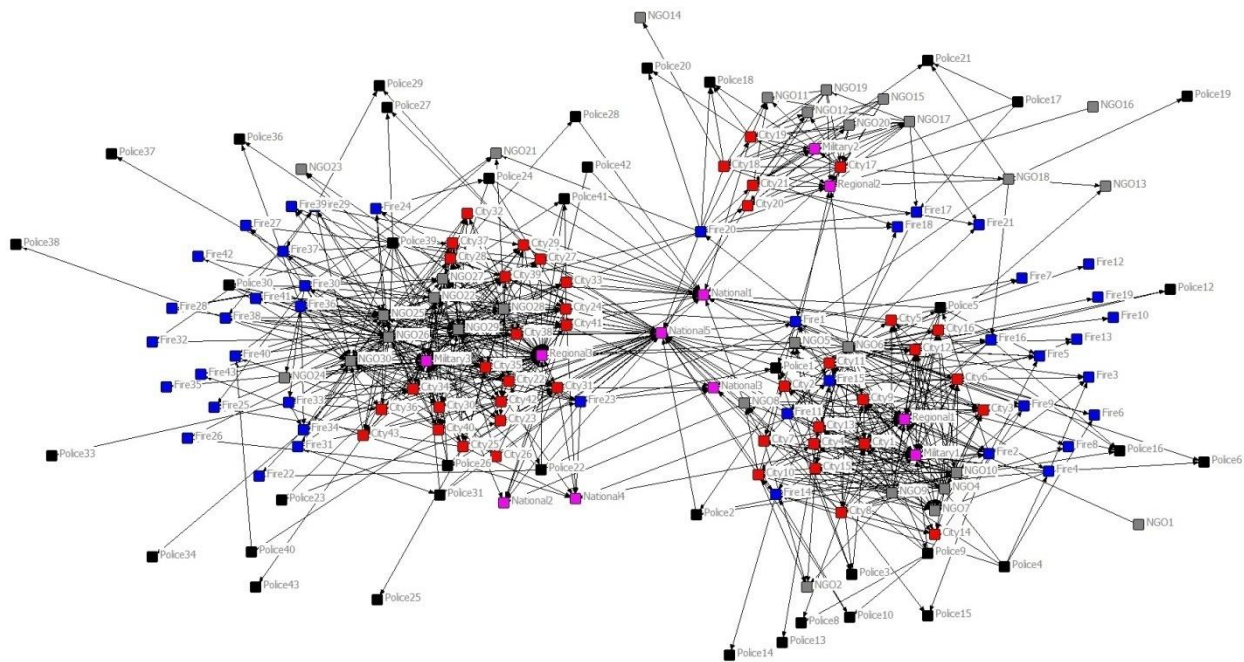Figure 3. Interorganizational Emergency Management Networks before the typhoons



Figure 4. Interorganizational Emergency Management Networks after the typhoons

## Descriptive Statistics

The descriptive analysis in Table 4 presents specific network statistics of two interorganizational EM networks. In the overall networks, mutual dyads increased from 54 to 68 while asymmetric dyads decreased from 1,159 to 832. As a result of that, the network density decreased from 0.039 to 0.028. In columns 2 through 6 of Table 4, I categorize the samples into five groups by a type of organizations. In terms of the relationships among same organizational type (i.e., local government, fire and police stations, and organizations in the nongovernmental sector), the network density of the nongovernmental sector (.054) is only greater than the overall density (.039) in the network before the typhoon while there is no group that is greater than the overall density (.028) in the network after the typhoon. Despite that, the density of the fire station group increased from .012 to .014 through the disaster. Although the density of relationships across sectors decreased from .038 to .029, moreover, its density in the network after the typhoon is greater than any other types of organizations, indicating that approximate 89.7 percent of mutual and 91.9 percent of asymmetric dyads are established by relationships across sectors.

Table 3. Networks Statistics

|  | Overall Network | Among Governments | Among Fire Stations | Among Police Stations | Among Nongovernmental Organizations | Across Sector |
|---|---|---|---|---|---|---|
|  |  | Gov ↔ Gov | FS ↔ FS | PS ↔ PS | NGO ↔ NGO |  |
| **Before the typhoons** |  |  |  |  |  |  |
| Mutual | 54 | 4 | 2 | 2 | 1 | 45 |
| Asymmetric | 1159 | 22 | 19 | 15 | 45 | 1058 |
| Null | 16352 | 879 | 882 | 886 | 389 | 13316 |
| Density | .039 | .014 | .012 | .009 | .054 | .038 |
| Average Degree | 6.351 | .605 | .488 | .395 | 1.567 | 6.937 |

**After the typhoons**

| | | | | | | |
|---|---|---|---|---|---|---|
| Mutual | 68 | 1 | 2 | 1 | 3 | 61 |
| Asymmetric | 832 | 24 | 21 | 8 | 14 | 765 |
| Null | 19753 | 878 | 880 | 894 | 418 | 16683 |
| Density | .028 | .014 | .014 | .005 | .023 | .029 |
| Average Degree | 4.741 | .605 | .581 | .209 | .667 | 5.194 |

Table 5 shows tie changes between subsequent observations. The changes of ties indicate that through the catastrophic event, organizations participating in the EM network maintained 1,183 ties while established 487 new ties and terminated 696 previous ties.  While Andrew (2009) and Steglich et al. (2006) argue that the changes of ties may not examine dynamics of the network evolution due to limited methods of data collection based on documents and contents, this research proposes that at least the changes of ties show dynamic impacts of the catastrophic event when the data collection procedures based on the peer-to-peer survey covered a full range of organizations in both networks.  Again, the changes of ties between networks before and after the typhoon would account for the notion that those organizations may maintain existing ties, establish new ties, or terminate previous ties by learning the significance of certain interorganizational collaboration from natural disaster.

Table 4. Tie Changes between Subsequent EM Networks

| | No Tie | New Tie | Broken Tie | Maintained Tie |
|---|---|---|---|---|
| | $0 \rightarrow 0$ | $0 \rightarrow 1$ | $1 \rightarrow 0$ | $1 \rightarrow 1$ |
| $t_1 - t_2$ | 27,228 | 487 | 696 | 1,183 |

**Model Specification**

The dynamic of interorganizational ties is estimated by including the endogenous and exogenous effects in a model that is performed using the Stochastic Actor-based Models for network evolution (*see* Snijders, 2005; Snijders *et al*., 2010). The endogenous effects include a set of network effects as specified in SIENA (i.e., reciprocity, distance-2, betweenness, transitive triplets, and 3-cycles effects). The exogenous factors include social and environmental vulnerability indicators, and a dyadic covariate indicating joint full-sized exercises that encompass professional training and comprehensive education.

In Stochastic Actor-based Models, the model specification estimates the rate parameter, network effects, and organizational attributes simultaneously (Snijders *et al*., 2010). In order to capture the probability that organizations decide to change their ties, the rate parameter estimates the change before and after the 2012 Korean typhoons. The parameter estimates the average number of changes in bridging and bonding strategies, which are the endogenous factors in my model. The first endogenous effect is the reciprocity effect (*see* Figure 5), which captures the propensity of organizations to establish a mutual tie with those who had a one-way relationship with them during the period under a catastrophic event. A positive value for the reciprocity parameter indicates that organizations have a strong tendency to forge reciprocal relations, while a negative value suggests these organizations tend not to do so. It is formally defined by:

$$\text{Reciprocity, } s_{i1}^{net}(x) = \sum_j x_{ij} x_{ij}$$



Figure 5. Reciprocity

The interdependent risk hypothesis is tested by identifying the transitive triplets and 3-cycles effects (*see* Figures 8 and 9). These effects explore the behaviors of organizations that prefer to share risks by building a close-knit network structure. A positive parameter value for the transitive triplet and 3-cycle effect indicate that in order to establish a highly clustered network at time $t_2$, an organization forges direct ties with another organization that was indirectly connected at time $t_1$. A negative value associated with these effects suggests the interdependent risk effect is not probable. The transitive triplets and 3-cycles effect are defined respectively as:

$$\text{Transitive triplets, } s_{i4}^{net}(x) = \sum x_{ij} x_{ih} x_{jh}$$
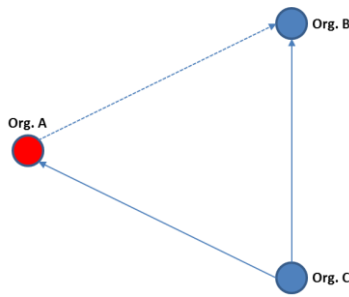


Figure 6. Transitive Triplets

$$\text{3-cycles, } s_{i5}^{net}(x) = \sum_{j,k} x_{ij} x_{jh} x_{hi}$$
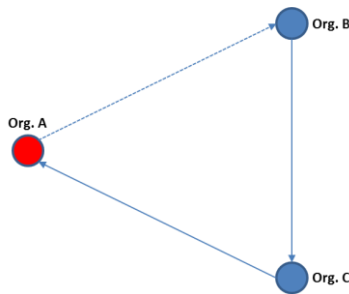


Figure 7. 3-Cycles

The number of actors at distance-2 and betweenness effects uncovers the independent risk hypothesis of how an organization spreads risks by seeking a bridging organization or playing an entrepreneurial role in bridging between two other organizations after a disaster. A positive value suggests organizations without the bridging organization or role at time $t_1$ tend to at least forge a tie with it or two other organizations at time $t_2$. A negative value suggests organizations have a tendency to not utilize the independent risk strategy due to the higher collaboration risk and uncertainty after a catastrophic event (Jung, 2013). The numbers of actors at distance-2 and betweenness effects (see Figures 6 and 7) are defined respectively by:

The number of actors at distance-2, $s_{i2}^{net}(x) = \#\{j x_{ij} = 0, \max_h (x_{ih} x_{hj}) > 0\}$



Figure 8. Number of Actors at Distance-2

Betweenness, $s_{i3}^{net}(x) = \sum_{j,k} x_{hi} x_{ij} (1 - x_{hj})$



Figure 4.8 Betweenness Effect

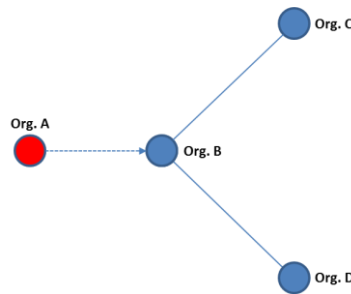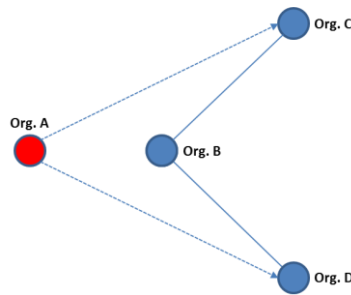This research also tests for the homophily effect, which examines whether or not an organization is likely to establish ties with similar organizations. For the homophily effect, a positive parameter implies that actors prefer ties to others with similar preferences, while a negative parameter suggests the actors' preferences for similar actors are less likely to drive actors to establish ties with them. The organization of interest is the local governments (i.e., whether local governments are likely to establish interorganizational ties among themselves before and after a disaster). The indicator function is coded 1, if an organization is local government, otherwise 0.

Following Snijders *et al*. (2010), the exogenous effects such as social and environmental vulnerability and the joint full-sized exercise are included in the rate function effect. It captures "the average frequency at which an actor gets the opportunity to change their outgoing ties" (Snijders *et al*., 2010, 53). For instance, organizations with environmental vulnerability may change their network ties more frequently than others that are not located in the coastal line. Depending on such actors' attributes, the stochastic actor-based model allows us to test whether the exogenous factors have an effect on the rate function (*see* Snijders, 1996; Snijders *et al*., 2008). A positive parameter value for the exogenous effects suggests that organizations with one of the attributes tend to change their network ties.

The forward model selection strategy is employed as proposed by Snijders *et al*. (2010). The approach first considers only endogenous effects followed by the inclusion of the exogenous effects. The model convergence is also performed to determine the model fit. This is performed in the following ways: Based on a continuous-time Markov chain Monte Carlo (MCMC) simulation--where the algorithm computes the maximum likelihood estimates SIENA employs a three-phase stochastic approximation algorithm to estimate the pattern of relationships (Snijders

*et al,.* 2010).  Through these methods, the SIENA conducts a test of convergence of each variable.  If the convergence diagnostic statistics for the algorithm is less than 0.2 in absolute value, the parameter estimate is considered to have good convergence and excellent when they are less than 0.1 (Snijders *et al.*, 2010).  The convergence diagnostic, covariance, and derivative matrices were based on 1,000 iterations, and the t-value provides a significance test of the estimated parameters.

## Results and Discussion

The parameter for reciprocity is positive and statistically significant in the two models. The parameter indicates that organizations tend to establish mutual relationships after a disaster.  Two organizations establish a mutual relationship, even though collaboration creates complexity and uncertainty.  This implies that when organizations change their ties, they collaborate reciprocally rather than asymmetrically.  These norm/information-sharing relationships in dense networks are more likely to be firm (e.g. Granovetter, 1985; Coleman, 1990). Further, as Burt (2005) argues, the level of trust can be more critical where brokerage is more valuable.

The parameters for the interdependent risk hypothesis, i.e., the effect of transitive triplets and 3-cycles are positive and statistically significant.  It indicates that organizations tend to have not only reciprocity in an exchange but they also interpret the hierarchy of the network differently (Snijders et al., 2010).  For example, through the 2012 Korean typhoons, local interorganizational networks that organize themselves within the administrative boundary of each city may have switched from hierarchical to non-hierarchical emergency management structures.  Because disasters require a comprehensive response from different organizations,

research has focused on networks that collaborate functionally and interact at the same level organizationally, even though national organizations, such as NEMA and MPAS, help coordinate local efforts. During a disaster, the government may not be able to do everything, but diverse organizations can collaborate to help local governments responding effectively.

The parameters for the independent risk hypothesis i.e., the number of actors at distance two and the betweenness are negative and statistically significant. They indicate that organizations are not inclined to spread the risk during a disaster. From the perspective of the ICA framework (Feiock, 2013), the results show that collaboration risks generated by the 2012 Korean typhoons may have encouraged organizations to directly collaborate with other organizations that had critical resources and information rather than rely on national and regional agencies. The findings imply that spreading risk through other organizations may not function effectively during a disaster response (Comfort and Haase, 2007). In addition, the homophily effect of local government is positive and significant ($E = 0.548$; $p < .01$), indicating the propensity that interorganizational ties are more likely to be established among local governments. The finding is consistent with the argument of Andrew (2009), indicating that in order to reduce the administrative costs, local governments tend to establish ties with other local governments under regional EM coordination enforced by metropolitan and provincial governments.

The exogenous effects on rate function are included in model 2. The model 2 tests the probability that organizations under certain social and environmental conditions such as social and environmental and the joint full-sized exercise are more likely to collaborate with other organizations after a disaster. The results report that organizations that are located on the coastline ($E = .461$; $p < .01$) and have had the joint full-sized exercise ($E = .293$; $p < .01$) are more

likely to create interorganizational ties after the typhoons.  Both results may support the notion

that organizations collaborating with other organizations are influenced by environmental

vulnerability (Villa & McLeod, 2002).  It also implies that by enhancing joint exercise activities

for hazard mitigation before a disaster, organizations actively secure critical resources and

information under an unexpected condition (Randolph, 2012). The final results are presented in

Table 5.

Table 5. Parameter Estimates and Standard Errors

| | | Model 1 | | Model 2 | |
|---|---|---|---|---|---|
| | | Estimates | Std. Err. | Estimates | Std. Err. |
| Rate Parameter (rho) $t_{1-2}$ | | 13.907*** | .358 | 13.059*** | .317 |
| Endogenous Effects | Reciprocity | 2.048*** | .231 | 2.051*** | .274 |
| | Transitive Triplets | .239*** | .05 | .285*** | .058 |
| | 3-Cycles | .945*** | .256 | 1.354*** | .302 |
| | The Number of Actors at distance 2 | -1.112*** | .287 | -1.354*** | .302 |
| | Betweenness | -.164*** | .042 | -.148*** | .023 |
| Homophily Effects | Local Government | .544*** | .075 | .548*** | .082 |
| Exogenous Effects on Rate Function | Social Vulnerability | - | - | -.048 | .070 |
| | Environmental Vulnerability | - | - | .461*** | .078 |
| | Joint Full-Scale Exercise | - | - | .293*** | .082 |

Note:  All coefficients are resulted from the SIENA (3.12) with directed network matrixes; All statistics converged with a t-statistic <0.1 with a minimum of 1,000 iterations; ***$p<.01$; **$p<.05$; *$p<.1$

## Conclusion

Interorganizational collaboration for building resilient community comes in many forms, and thus it is critical to understand the change of its formation before and after a catastrophic event. Given uncertainty and complexity of building organizational resilience (National Research Council 2010), the dilemmas of local organizations are: (1) the decision whether to forge a tie as interorganizational collaboration or not and (2) the choice with whom to create collaborative ties. Through much trial and error in the dilemmas, interorganizational EM networks have evolved over the years (Feiock and Scholz, 2010; Kapucu et al., 2012). The network evolution in terms of natural disasters is predicted on the success of previous collaboration, the significance of current partners, and the expectation of subsequent collaboration that ultimately enhance organizational resilience. By perceiving, experiencing, and learning the significance of collaborative ties through the disaster, consequently, organizations optimize the costs to establish new ties, terminate previous ties, and maintain existing ties as procedures of the network evolution.

The findings in this chapter provide two implications to understand the dynamics of interorganizational EM networks. First, interorganizational collaboration for enhancing organizational resilience proposes the importance of mutual aids rather than unilateral. Since interdependency offers the potential benefits to reduce conflicts among local organizations as well as across the sector (Feiock and Scholz, 2010), self-organizing EM networks are more likely to consist of reciprocal collaboration that enhance organizational resilience. In terms of the importance of bilateral aids, particularly, the interview results highlight that the three typhoons hold up a true mirror to the existing limit of the unilateral aids provided by other organizations. According to the principal administrator in the City of Changnyeong, Kwon Heeduck, the

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requests for emergency aids relying on the unilateral agreement was easily overlooked during the disaster. The director of regional fire administration headquarter in the South Kyeongsang province, Jung Dongcheol, also pointed out that successive catastrophic events such as continuative three typhoons shelved almost of the unilateral requests and aids until at least passing the typhoons while a committed bilateral aids between organizations intensified the resource mobilization during the disaster in order to support those who are located on the affected area.

Second, the interdependent risk hypothesis highlighting direct collaborative ties with other organizations generate structural benefits derived from close-knit EM networks. Formulating a clustered structure in efforts to enhance organizational resilience not only provides associational benefits such as reputation, knowledge, and institutional norms. Also, a highly dense network structure provides practical advantages such as sharing technical resources and coordinating joint activities based on consensus reflecting organizational preferences (Randolph, 2012). For example, local governments and agencies located on the riverbank (i.e., Nakdong River across the Southeastern Economic Region) established the committee for hazard mitigation planning and implementation in 2011 and have developed the resource mobilization framework that activates during the disaster. Given the institutional committee, local organizations can enhance organizational resilience through formal and informal communication and availability of shared resources (Andrew, 2009; Kapucu et al., 2012). The principal manager of Fire Station in the City of Changwon, Park Changho, emphasized the importance of a close-knit EM network in the local level, arguing that direct collaborative ties forging a dense network structure allow local organizations to secure their own communication channel to increase organizational resilience. Those findings imply that separate communication channels of organizations such as local

governments, police, and fire stations have impeded effective information and resource mobilization in emergency responsiveness as well as recovery procedures.

While scholars in the field of emergency management have speculated for years on the importance of networks, they have fallen short in predicting the change of structures that are likely to emerge after natural disaster (Waugh and Streib, 2006; Kapucu, 2006; Kapucu et al., 2010; 2012; Andrew and Kendra, 2011). This research aims to test two hypotheses i.e., interdependent and independent risk, and draw implications about the formation of interorganizational EM collaboration that can enhance a particular configuration of ties, and thus, organizational resilience. The findings in this chapter are considerably consistent with the argument provided by the assistant director of National Urban Disaster Management Research Center, Dr. Lee Byoungjae. In the interview, he strongly underlined that because current interorganizational collaboration tends to heavily rely on emergency planning and paper-based system, a sparse network based on one-way relationships are more likely to fail to secure resources and critical information that local organizations need during a catastrophic disaster. Given the nature of natural disaster and organizational resilience, this report provides strong evidence that local organizations related to emergency management transform from the unilateral into bilateral relationships as well as from indirect into direct collaboration with other organizations through natural disaster.

Despite these significant findings, this research has two limitations. First, an entire network relies on egocentric measures. As Scott (2000) points out, unreported ties may influence the different network measures. Second, this study only examined a case in the Seoul metropolitan area, South Korea. It may not be generalized to other regions and states. Future research could examine other metropolitan areas and identify key actors at the local, regional,

and national level. Also, in-depth interviews with local officials could prove the validity of future

research.

# CHAPTER 5

# INSTITUTIONAL TIES, SOURCES OF ORGANIZATIONAL RESILIENCE, AND DYNAMICS OF INTERORGANIZATIONAL COLLABORATION

This dissertation critically analyzes how organizations can form interorganizational emergency management networks. This research started at the challenge to understand sources of organizational resilience and the dynamics of interorganizational collaboration before and after a disaster. This dissertation is guided by three research questions: (1) What are the sources of organizational resilience?; (2) Given the evolutionary nature of organizational ties, how do organizations develop relations before and after a disaster?; and (3) What are the endogenous and exogenous factors explaining changes of organizational behaviors after a disaster?

This concluding chapter summarizes the empirical results presented in the previous chapters, and then discusses theoretical and practical implications, examines the limitations, and outlines directions future research could take.

## Summary of Empirical Findings

This dissertation has discussed theoretical arguments related to organizational resilience and incentives for various actors to participate in interorganizational emergency management networks. From theories of institutional collective action, this research has classified bonding, bridging, and previous interaction effects as sources of organizational resilience under self-

organized network structures and interorganizational coordination. Also, this research has created two general hypotheses to test theories of collaboration risk.

In the first part of the empirical analyses in this dissertation, the Heckman selection model was used to explore factors that have an effect on an organizations' decision to participate in collaborative emergency management at the first-stage, and then examines the bonding, bridging, and previous interaction effects on the level of organizational resilience at the second-stage. The results show that the decision of organizations' participation in collaborative emergency management is significantly influenced by organizational capacity such as the financial resource at the first stage. In addition, local governments are more likely to engage in collaborative emergency management than other types of organizations. That is, because local governments as a coordinator of local emergency management have a principal responsibility derived from law and institutional backgrounds.

At the second stage i.e., outcome equation, the results report that the bridging effect, that captures the notion that organizations holding a central position between two other actors in collaborative emergency management perceive the higher level of organizational resilience. This finding implies that organizations with the bridging strategy might enhance their capacity to bounce back from a catastrophic event by securing access to gain critical resources and risk information through emergency preparedness and hazards mitigation processes such as joint response and recovery planning. The results also confirm that the level of organizational resilience is significantly affected by social and environment vulnerability, implying that the higher level of social vulnerability may impede organizations to rapidly respond to damages and victims from a disaster.

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The second part analyzes the dynamics of interorganizational emergency management network before and after the 2012 Korean typhoons by utilizing stochastic actor-based models to test the interdependent and independent risk hypothesis. The results show that the effect of transitive triplets and 3-cycles, which capture the interdependent risk hypothesis are positive and statistically significant, implying that organizations sharing risk with other organizations are more likely to forge a tie after a disaster. On the other hand, the parameters for the independent risk hypothesis, which are the number of actors at distance two and betweenness, are negative and statistically significant, indicating that organizations spreading risk through other actors are less likely to make a tie after a disaster. The findings provide two critical implications to understand the dynamics of interorganizational emergency management networks. First, interorganizational collaboration for responding to a disaster proposes the importance of mutual aids rather than unilateral. Second, the interdependent risk hypothesis highlighting direct collaborative ties with other organizations generate structural benefits derived from a close-knit structure.

**Theoretical and Practical Implications**

Theoretically, communities can cope with disasters if they can enhance their organizational capacity. Resilience is not a stand-alone capacity nor can it be achieved without a strong commitment from all sectors of a local community. This research fills three major gaps in the literature: (1) an alternative approach to studying resilient communities, (2) the extent to which interorganizational collaboration can enhance the ability of organizations to cope with the aftermath of disasters, and (3) the application of social networks analysis in studying

interorganizational collaboration before and after a disaster.

Moreover, since patterns of interorganizational relations are constantly changing, understanding the dynamic nature of interorganizational collaboration is a critical step to examine a community's ability to bounce back from a catastrophic event. The method of analysis used in this research captures emergency response and recovery processes arising from joint coordination, which leads to a better assessment of how organizations behave before and after a disaster.

The most significant contribution of this dissertation to theoretical development is that it synthesized two major areas of literature in the field of public administration: the theories of collective action and emergency management. That is, the research advances our understanding of collaborative emergency management by integrating the institutional collective action theory with the theory of organizational resilience. For instance, local organizations' social positions in interorganizational emergency management network may be an institutionalized source of their capacity to bounce back from disasters. Again, an individual organization's strategic action after a disaster matters in the dynamic evolution of interorganizational structures, and a set of the strategic actions to respond to a disaster results in different levels of organizational resilience.

Moreover, this dissertation is the only study that empirically to test the endogenous and exogenous factors examining the dynamics of interorganizational emergency management networks by using longitudinal data directly collected from a research site before and after a disaster. That is to say, a disaster leads to structural changes of collaborative emergency management to resolve particular institutional collective action dilemmas. For example, bonding or bridging effects are one of organizations' strategies to minimize uncertainty and risk derived

from interorganizational collaboration after a disaster. In addition, this research assumes that

interorganizational collaboration is a source of organizational resilience and that the purpose of

establishing and maintaining interorganizational collaboration is to overcome limitations of

internal organizational capacity (Kapucu et al. 2012). Consequently, collaborative emergency

management allows organizations to build a joint capacity in order to minimize devastations that

are brought about by disasters before a catastrophic event occurs (Andrew and Carr 2013). But,

a strong commitment problem depends on the ability of individual organizations to internalize a

sense of cohesiveness. That is, organizational cohesiveness that demands individual

organizations to prepare for disasters as a collective in order to minimize disruptions and

function of an organization.

Practically, this dissertation has also contributed to public managers and nonprofit

leaders' understanding of organizational resilience and the importance of collaborative

emergency management. Studying organizational resilience and interorganizational

collaboration is a timely and important topic for the field of public administration. This research

provides two practical implications: (1) the role of public organizations, and (2) the role of

nongovernmental organizations (NGOs) before and after an emergency. Given the increasing

severity of natural and man-made disasters, organizations are required to enhance organizational

resilience to withstand and recover from a catastrophic event (i.e., public organizations such as

local governments, fire and police stations, and national and regional agencies). Public agencies

are expected to establish effective preparedness and mitigation arrangements in order to assess

resources and share responsibility. In addition, NGOs, such as grass-root organizations, are at

the forefront of building a resilient community in disaster-affected regions. Since organizational

resilience requires all local organizations taking their share of responsibility for preparing,

responding to, and recovering from catastrophic events, interorganizational collaboration is critical in facilitating local communities to cope with and recover from a disaster.

This dissertation does not propose a resolution to collective action dilemmas that public and nonprofit managers face with, but it do suggest they think carefully about interorganizational collaboration when working across levels and boundaries of organizations. Building effective collaborative emergency management – a set of incentives and regulations established by actors to jointly prepare for and respond to a catastrophic event – is critical for practitioners. That is, because interorganizational collaboration during a disaster is not a simple mechanism for achieving an individual organization's goals, but a governance mechanism to pursuing collective goals. Thus, this dissertation has moved current local emergency management system a step further by facilitating practitioners to consider not only the sources of organizational resilience and the structural evolution of organizations' interactions before and after a disaster.

## Limitations

Despite the significant implications, this dissertation has several limitations. First, an entire regional network relies on egocentric measures. As Scott (2000) points out, unreported ties in the empirical analyses of this dissertation may influence the different network measures. For instance, this research must remind that underreporting ties of interorganizational activities by national and/or regional agencies is highly probable when interpreting results using the data collected before and after a disaster. That is, because the data collection process this dissertation used has rely on a snowball sampling which started from local governments generally connecting to national and/or regional agencies. It is reasonable to assume that a comparable degree of bias

toward activities between local and regional organizations as well as underreporting affect the results presented in this dissertation.

The second shortcoming is related to the nature of social network data that attempts to capture the strength of interorganizational ties. For example, interorganizational arrangements have been treated as a dichotomous variable i.e., 0 or 1, which does not examine the extent to which interorganizational collaboration actually occurred before and after an event (e.g., the frequency of interorganizational activities). At the stage using SABMs, SIENA is not able to deal with the strength of ties. While this may not be possible at SABMs, future research should develop more effective measures and simulation models to test the strength of interorganizational ties in order to validate the empirical evidence.

The third challenge is connected to the nature of interorganizational collaboration embedded in the formation of structural ties. That is, the information derived from two surveys, which were conducted before and after a disaster, does not clearly explain the extent to which resources or information flow among organizations as a result of interorganizational collaboration. As a case of interorganizational activities, even though local governments often played a pivotal role in coordinating and mobilizing resources for local emergency management, the interactions with other organizations are not implicitly stated in the dataset judging about the type of the activities during a disaster.

**Future Directions for Research**

While this dissertation aims to demonstrate the potential application of the institutional collective

action framework for the field of emergency management, future research should clearly address the following issue.  First, there is a need to further focus on performance of interorganizational collaboration at the local level.  That is, because outcomes of interactions among organizations during an event were not explored and measured yet.  As reference to the four dimensions of organizational resilience, for example, its effectiveness has been barely tested in the empirical setting.  Although the dimensions developed by Bruneau et al. (2003) are intriguing, it has not been vigorously tested with a specific index.  Future research based on the institutional collective action framework should attempt to link interorganizational collaboration to potential outcomes resulted from organizational resilience.

Second, future research on collaborative emergency management can also be extended exogenous factors across political contexts such as mayors and councils in order to gain insight and predictions about effective interorganizational collaboration after an event occurs.  Although the current dissertation has utilized a model that takes into account organizational capacity such as personnel and financial resources, the attributes of political actors can be also introduced to account for local governments' choice to collaboration with other types of organizations before and after disaster.  The results and analysis for such models could present critical insight into the importance of political contexts to examine organizational behavior under an unexpected condition.

Third, geographical boundaries and physical distances as a proxy to recursive activities in interorganizational collaboration should be directly considered in future research.  While a structural zero has been used to control for geographical distance among administrative boundaries, organizations' proximity to others have not been addressed yet.  During a catastrophic event, such geographical factors often play a critical role in an organization's

decision to collaborative with others.  This might be important for organizations attempting to

rapidly mobilize resources they need at the local level in the sense that these interorganizational

collaboration depends more on close proximity to respond to a disaster than a distant

organization.  More importantly, an in-depth interview with public and nonprofit managers is

expected to provide validity of future research.

**Appendix 1**

**Survey Instruments during the First and Second Stage of Data Collection**

# University of North Texas Institutional Review Board
# Informed Consent Notice

Before agreeing to participate in this research study, it is important that you read and understand the following explanation of the purpose, benefits and risks of the study and how it will be conducted.

**Title of Study:** Network Resilience

**Supervising Investigator:** Dr. Simon A. Andrew, Associate Professor in the Department of Public Administration of University of North Texas

**Student Investigator:** Kyujin Jung, Doctoral Student in the Department of Public Administration of University of North Texas

**Purpose of the Study:** You are being asked to participate in a research study which involves understanding why some communities are more resilient than others following a disaster.

**Study Procedures:** You will be asked to answer questions pertaining to the activities your organization undertook to contribute to the overall resilience of your organization and community. The questions are listed in order of precedence on the on-line survey program provided by Research & Research Inc. as a survey service research agency. The approximate time for participation is 10 minutes.

**Foreseeable Risks:** There are no foreseeable risks involved in this study.

**Benefits to the Subjects or Others:** This study is not expected to be of any direct benefit to you, but we hope to learn more about factors that influence organizational resilience in order to generate knowledge that may help communities plan for and create more disaster-resilient communities.

**Compensation for Participants:** None.

**Procedures for Maintaining Confidentiality of Research Records:** All precautions will be taken to maintain the confidentiality and anonymity of both you and your organization. The confidentiality of your individual information will be maintained in any publications or presentations regarding this study. We will not publish the names of our participants or the organizations that they work for. All identifiable information will be maintained in a password protected file and only the investigators will have access to this information. This information will not be distributed to any other parties.

**Questions about the Study:** If you have any questions about the study, you may contact Dr. Simon A. Andrew (sandrew@unt.edu)

**Review for the Protection of Participants:** This research study has been reviewed and approved by the UNT Institutional Review Board (IRB).  The UNT IRB can be contacted at (940) 565-3940 with any questions regarding the rights of research subjects.

**Research Participants' Rights:**

Your participation in the survey confirms that you have read all of the above and that you agree to all of the following:

- The investigator has explained the study to you and you have had an opportunity to contact him/her with any questions about the study.
- You understand that your participation is entirely voluntary.
- You understand that you do not have to take part in this study, and your refusal to participate or your decision to withdraw will involve no penalty or loss of rights or benefits.
- You understand why the study is being conducted and how it will be performed.
- You understand your rights as a research participant and you voluntarily consent to participate in this study.
- You understand you may print a copy of this form for your records.

**Q1: Has your [organization's <u>operation</u>] been <u>terminated</u> by the following disasters within the last 2 years?**

| Disaster Types | Yes (Go to Q2-a) | No (Go to Q2-b) |
|---|---|---|
| 1.  Floods | | |
| 2.  Drought | | |
| 3.  Wild Fire | | |
| 4.  Typhoon | | |
| 5.  Earthquake | | |

**If "YES" to Q1:**

**Q2-a: Consider the full range of organizational types including national government agencies, grassroots organization, interest groups, NGOs, and local agencies. Please list the organizations that you <u>have collaborated</u> during emergency situations with in order to provide assistance to disaster victims and their communities.**

**1.**
**2.**
**3.**

**If "NO" to Q1:**

**Q2-b: Consider the full range of organizational types including national government agencies, grassroots organization, interest groups, NGOs, and local agencies. Please list the organizations that your organization <u>will collaborate</u> during emergency situations with in order to provide assistance to disaster victims and their communities.**

**1.**
**2.**
**3.**

*Please select the number that best describes the degree with the following statements:*

**Q3: Would you agree that your [organization] has <u>the ability</u> (or <u>been able</u>) to overcome operational disruptions immediately caused by a disaster?**

| Very Slow | Slow | Neither Slow and Fast | Fast | Very Fast |
|---|---|---|---|---|
| <u>**1**</u> | <u>**2**</u> | <u>**3**</u> | <u>**4**</u> | <u>**5**</u> |

**Q4: How would you rank the RAPIDITY of providing assistant to disaster victims with resources that you have?**

| Very Slow | Slow | Neither Slow and Fast | Fast | Very Fast |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

*Please select the number that best describes the degree with the following statements:*

**Q5: Some organizations identified the needs of the community by opening up distribution centers at temples, others spearheaded fund raising events, shared resources or worked jointly with other organizations. Do you agree that your organization is <u>RESOURCEFUL</u> in order to meet the needs of disaster victims and their communities?**

| Strongly Disagree | Disagree | Neither Agree nor Disagree | Agree | Strongly Agree |
|:-:|:-:|:-:|:-:|:-:|
| **1** | **2** | **3** | **4** | **5** |

**Q6: Some organizations are required to continue providing essential-mission functions; and at the same time, provide assistant to disaster victims and their communities. For example, a hospital providing out-patient services along with expanding psychotherapy services for flood victims. Do you agree that your organization has the <u>ABILITY</u> to carry out routine tasks and, <u>at the same time</u>, help victims and their communities to cope with disasters?**

| Strongly Disagree | Disagree | Neither Agree nor Disagree | Agree | Strongly Agree |
|:-:|:-:|:-:|:-:|:-:|
| **1** | **2** | **3** | **4** | **5** |

**Q7: Do you agree that your organization has the <u>CAPABILITY</u> to help disaster victims and their communities rebound (or return to normalcy)?**

| Strongly Disagree | Disagree | Neither Agree nor Disagree | Agree | Strongly Agree |
|:-:|:-:|:-:|:-:|:-:|
| **1** | **2** | **3** | **4** | **5** |

**Q8: Given your organization experiences with disasters, have you changed your organizational practices in dealing with disaster?  Yes □  /  No □**

**Q9: If "YES" to Q8, <u>give examples</u> of how you have changed or adapted your practices to suit the community needs and prepare for the next disaster?**

_____

_____

**Q10: If "No" to Q8, <u>Why</u> have you maintained or sustained your practices to suit the community needs and prepare for the next disaster?**

_____

_____

## Appendix 2

## IRB Approval Letter

# UNT
## UNIVERSITY OF
## NORTH·TEXAS
Discover the power of ideas.

OFFICE OF THE VICE PRESIDENT FOR RESEARCH AND ECONOMIC DEVELOPMENT

May 30, 2012

Supervising Investigator: Dr. Simon Andrew
Student Investigator: Kyujin Jung
Department of Public Administration
University of North Texas

Re: Human Subjects Application No. 12277
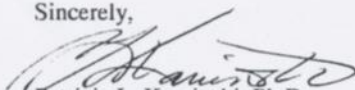
Dear Dr. Andrew:

As permitted by federal law and regulations governing the use of human subjects in research projects (45 CFR 46), the UNT Institutional Review Board has reviewed your proposed project titled "Networks Resiliency." The risks inherent in this research are minimal, and the potential benefits to the subject outweigh those risks. The submitted protocol is hereby approved for the use of human subjects in this study. **Federal Policy 45 CFR 46.109(e) stipulates that IRB approval is for one year only, May 30, 2012 to May 29, 2013.**

Enclosed is the consent document with stamped IRB approval. Please copy and **use this form only** for your study subjects.

It is your responsibility according to U.S. Department of Health and Human Services regulations to submit annual and terminal progress reports to the IRB for this project. The IRB must also review this project prior to any modifications.

Please contact Shelia Bourns, Research Compliance Analyst, or Boyd Herndon, Director of Research Compliance, at extension 3940, if you wish to make changes or need additional information.

Sincerely,

Patricia L. Kaminski, Ph.D.
Associate Professor
Department of Psychology
Chair, Institutional Review Board

PK:sb

# Appendix 3

The Second Survey and Data Collection were funded by a grant from the University of Colorado Natural Hazards Center through its Quick Response Grant Program, which is funded by National Science Foundation grant number CMMI1030670.

**Natural Hazards Center**
Institute of Behavioral Science
University of Colorado at Boulder
482 UCB
Boulder, CO 80309-0482

phone    303.492.6818
fax      303.492.2151

www.colorado.edu/hazards/

December 4, 2012

Kyujin Jung
University of North Texas
1155 Union Circle #310617
Denton, TX 76203

Dear Kyujin Jung:

This letter confirms our approval for you to enter the field to begin your quick response research entitled *Community Resiliency and Emergency Management Networks Following the Korean Typhoons of 2012* in accordance with your proposal of November 16, 2012. We will support this project for actual expenses up to $2,500.

This grant requires a final report be submitted to us within 90 days. Your report should be received by the Natural Hazards Center by April 12, 2013, unless we have approved other arrangements in writing.

Your 5-15 page report should describe your research question, methodology, sample size and characteristics, research findings, and how those findings might be used to address hazards and disasters in the United States.

As discussed, we will cover the following research expenses: airfare, mileage, and per diem.

Reimbursement for your research will take place after your final report has been received and approved as meeting Quick Response Grant Program requirements and your expense invoice has been received. Late reports might not be reimbursed. For timely and complete reimbursement, please familiarize yourself with the reimbursement instructions before entering the field.

Similarly, we suggest you review the terms of the Quick Response Grant Program Agreement and the program guidelines before submitting your report. I am available to answer your questions at all stages of your research. Please contact me at 303.942.4180 or 720.378.3479 after hours.

We wish you a most successful research endeavor and look forward to reading the final report.

Sincerely,

Jolie Breeden
Program Associate

cc:  NSF

# Appendix 4
## The Stochastic Actor-based Model

The stochastic actor-based model is a specialized network analysis that captures the dynamics of network structure that evolves over time "on the basis of observed longitudinal data, and evaluate these according to the paradigm of statistical inference" (Snijders, Bunt, and Steglich, 2010, 44). The key proposition here is that actors within a network make a rational choice in terms of forging and/or terminating their ties and maximize an objective function of network positions and patterns (Snijders, 1996; Snijders *et al*., 2007). In this model, the objective functions of individual actors are represented as network dynamics at the micro level, which originate observed patters at the macro level (Snijders *et al*., 2010), implying that changes of structural formation in the network are induced by actors' rational choice.

For example, the reciprocity effect on interorganizational ties means that one organization helps the other during a catastrophic event and then receives the favor in return. The transitivity effect in the objective functions indicates that interorganizational ties with the other organizations will also be the collaborators of another, i.e., "a friend of a friend is also a friend." By simultaneously estimating the network effects, the stochastic actor-based model provides a good representation of the stochastic dependence between the different interorganizational ties and thus, allowing us to test hypotheses and estimate parameters while controlling for endogenous and exogenous factors.

The model take into account directed networks, in which each tie, (i.e., $i \rightarrow j$) consists of a sender $i$ (i.e., ego) and a receiver $j$ (i.e., alter) and have at least two observation moments at a consecutive time-point. Snijders *et al*. (2010, 45) provides the following basic assumptions:

- The underlying time parameter $t$ is continuous, indicating that dependences between network ties are the result of processes where one tie is formed as reaction to the existence of other ties.
- The changing network is the outcome of a Markov Process as a useful lens to offer the notion that the total network structure is the social context influencing the probability of its own change.
- The actors control their outgoing ties, meaning that changes in their ties are induced by their and others' attributes, their position in the network, and their perceptions about the rest of the network.
- At a given moment, one probabilistically selected actor – 'ego' – may get the opportunity to change one outgoing tie, implying that the actor-based network change process is decomposed into two stochastic sub-processes.
- The change opportunity process, modeling the frequency of tie changes by actors, which indicates that the change rates may depend on the network positions of the actors (e.g., centrality) and on actor covariates (e.g., age and sex).
- The change determination process, modeling the precise tie change made when an actor has the opportunity to make a change, which shows that the probabilities of tie changes may depend on the network positions, as well as covariates, of ego and alters in the network.

According to Snijders *et al*. (2010), the objective function that incorporates different

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network effects in the stochastic actor-based model is defined as:

$$f_i(\beta, X) = \sum_k \beta_k s_{ki}(X)$$

Here, $f_i(\beta, X)$ defines the objective function of an actor $i$, and the effective function $s_{ki}(X)$ indicates endogenous network patterns and/or exogenous attributes that may influence actor $i$'s behavior. In addition, the probability that an actor $i$ changes its ties relies on the objective function of potential network patterns:

$$p_i(\beta, X) = \frac{exp\big(f_i(\beta, X)\big)}{\sum exp\big(f_i(\beta, X')\big)}$$

Where $X$ and $X'$ respectively designate networks generated by the specific change of actor $i$'s ties and attributes; $p_i(\beta, X)$ indicates the probability that the network will change to $X$; $exp\big(f_i(\beta, X)\big)$ represents the exponential transformation in the objective function of actor $i$. Statistics for evaluating network effect are based on the parameter $\beta_k$ and standard deviation. While a positive effect parameter shows that the network is more likely to evolve into one with a higher corresponding effect, a negative effect one suggests a lower corresponding effect in the future. More importantly, Snijders *et al.* (2010) highlight that selecting of network effects and actors' attributes should be based on a legitimate theoretical foundation. This is because the stochastic actor-based model with a single set of endogenous and exogenous effects cannot capture all the dynamics.

Given interorganizational ties that I am interested to study, organizations engaged in local emergency management (e.g., local governments, fire and police stations, and nongovernmental organizations) are the actors included in the stochastic actor-based model. Since the model is basically defined as a stochastic process X (*t*) on the state space of all binary directed networks on as set of n actors, over a time interval [$t_{begin}$; $t_{end}$] (Snijders and Steglich, 2013), the stochastic actor-based model examines why some organizations that establishes interorganizational ties with others before a disaster do not sustain their relations after a disaster.

The stochastic actor-based model involves three main steps (Snijders *et al.*, 2010; Liu *et al.*, 2013). First, the model, based on a theoretical framework, incorporates selected endogenous network patterns (e.g., reciprocity and transitivity) and exogenous covariates (e.g., actors' attributes), both of which influence actors' behavior after a disaster occurs. Second, the model with a selected network effect is parameterized prior to including exogenous factors. Third, in order to find a reasonable model specification, the goodness of fit is assessed by comparing the observed and the estimated networks through (a 1,000 number of iterations) simulation.

# REFERENCES

Agranoff, Robert and Michael McGuire. (2003). *Collaborative Public Management: New Strategies for local Governments.* Washington, DC: Georgetown University Press.

Ainuddin, S., and Routray, J. K. 2012. Earthquake hazards and community resilience in Baluchistan." *Natural Hazards* Volume 63, Issue 2: 909-937.

Aldrich, Daniel P. (2012). *Building Resilience: Social Capital in Post-Disaster Recovery*. Chicago IL: University of Chicago Press.

Allenby, B., and Fink, J. (2005). Toward inherently secure and resilient societies. *Science*, 309, 1034–1036.

Anderies, J., Janssen, M., and Ostrom, E. (2004). A framework to analyze the robustness of social-ecological systems from an institutional perspective. *Ecology and Society* 9(1):18.

Andrew, Simon A. 2009. "Regional Integration Through Contracting Networks: An Empirical Analysis of Institutional Collection Action Framework." *Urban Affairs Review* no. 44:378-402.

———. 2010. "Adaptive versus Restrictive Contracts: Can They Resolve Different Risk Problems?" In *Self-Organizing Federalism: Collaborative Mechanisms to Mitigate Institutional Collective Action Dilemmas*, edited by R. C. Feiock and John Shcholz, 91-113. New York: Cambridge University Press.

Andrew, Simon A., Sudha Arlikatti, Laura Siebeneck, Kannapa Pongponrat, and Kraiwuth Jaikampan. Forthcoming. "Sources of Organizational Resiliency during the Thailand Floods of 2011: A Test of Bonding and Bridging Hypotheses." *Disasters* Forthcoming.

Andrew, Simon A., and Jered B. Carr. 2012. "Mitigating Uncertainty and Risk in Planning for Regional Preparedness: The Role of Bonding and Bridging Relationships." *Urban Studies* no. Published online before print August 20, 2012, doi: 10.1177/0042098012455718.

Andrew, Simon A., and James M. Kendra. 2011. "An adaptive governance approach to disaster-related behavioural health services." *Disasters* no. 36 (3):514-532.

Berardo, Ramiro, and John T. Scholz. 2010. "Self-Organizing Policy Networks: Risk, Partner Selection, and Cooperation in Estuaries." *American Journal of Political Science* no. 54 (3):632-649. doi: 10.1111/j.1540-5907.2010.00451.x.

Berke, P. R. and Campanella, T. J. 2006. Planning for posterdisaster resiliency. *Annals of the American Academy of Political and Social Science* 604(1): 192-207.

Berkes, F., Colding, J., and Folke, C. (2003). *Navigating social-ecological systems: building resilience for complexity and change*. Cambridge Univ Press.

Bonanno, G. (2004). Loss, trauma, and human resilience: Have we underestimated the human capacity to thrive after extremely aversive events? American Psychologist, 59, 20–28.

Borgatti, S., M. G. Everett, and L. Freeman. 2002. *UCINET for Windows: Software for Social Network Analysis*. Harvard, MA: Analytic Technologies.

Brown, D., and Kulig, J. 1996. The concept of resiliency: Theoretical lessons from community research. *Health and Canadian Society* 4: 29-52.

Bruneau, M., S.E. Chang, R.T. Eguchi, G.C. Lee, T.D. O'Rourke, A.M. Reinhorn, M. Shinozuka, K. Tierney, W.A. Wallace, and von Winterfeldt. D. 2003. "A Framework to Quantitatively Assess and Enhance the Seismic Resilience of Communities." *Earthquake Spectra* no. 19 (4):733-752.

Bruneau, M., and A. M. Reinhorn. 2006. "Exploring the Concept of Seismic Resilience for Acute Care Facilities." *Earthquake Spectra* no. 23 (1):41-62.

Burt, Ronald S. 1992. *Structural Holes: The Social Structure of Competition*. Cambridge, MA: Harvard University Press.

———. 1997. "The contingent value of social capital." *Administrative Science Quarterly* no. 42 (2):339-365.

———. 2005. *Brokerage and Closure: An Introduction to Social Capital*. New York: Oxford University Press.

Carpenter, S. 2003. Regime shifts in lask ecosystems: patterns and variation. Volume 15. *Excellence in Ecology Serise*. Ecology Institute, Oldendorf/Luhe: Germany.

Carpenter, S. R. 2003. *Regime shifts in lake ecosystems*. Ecology Institute, Oldendorf/Luhe, Germany.

Carpenter, S., Brock, W., and Hanson, 1999. Ecological and social dynamics in simple models of ecosystem management. *Conservation Ecology* 3(2): 4-10.

Chandra, S., Acosta, J., Stern, S., Uscher-Pines, L., Williams, M. V., and Yeung, D., et al. 2011. *Building community resilience to disasters*. Santa Monica, CA: RAND Corporation, Accessed December 20, 2011. http://www.rand.org/pubs/technical_reports/TR915.html.

Chandra, Anita, Joie Acosta, Lisa S. Meredith, Katherine Sanches, Stefanie Stern, Lori Uscher-Pines, Malcolm Williams, and Douglas Yeung. 2010. Understanding Organizational

resilience in the Context of National Health Security: A Literature Review. WR-737-DHHS: RAND HEALTH.

Choi, Sang Ok, and Ralph S. Brower. 2006. "When Practice Matters More Than Government Plans: A Network Analysis of Local Emergency Management." *Administration & Society* no. 37 (6):651-678. doi: 10.1177/0095399705282879.

Choi, Sang Ok, and Bok-Tae Kim. 2007. "Power and Cognitive Accuracy in Local Emergency Management Networks." *Public Administration Review* no. 67:198-209. doi: 10.1111/j.1540-6210.2007.00828.x.

Coleman, James S. 1988. "Social Capital in the Creation of Human Capital." *American Journal of Sociology* no. 94 (ArticleType: research-article / Issue Title: Supplement: Organizations and Institutions: Sociological and Economic Approaches to the Analysis of Social Structure / Full publication date: 1988 / Copyright © 1988 The University of Chicago Press):S95-S120. doi: 10.2307/2780243.

Comfort, L. K. 1999. *Shared risk: Complex systems in seismic response*. New York: Pergamon.

———.. 2007. "Crisis Management in Hindsight: Cognition, Communication, Coordination, and Control." *Public Administration Review* Volume 67, Issue Supplement s1: 189–197,

Comfort, L., Boin, R., & Demchak, C. 2010. *Designing Resilience for Extreme Events: Socio-Technical Approaches*. Pittsburgh University Press, Pittsburgh, PA.

Comfort, L. K., Sungu, Y., Johnson, D., and Dunn, M. (2001). Complex systems in crisis: anticipation and resilience in dynamic environments. *Journal of Contingencies and Crisis Management*, 9(3): 144-158.

Cox, R.S., and K.M.E. Perry. 2011. "Like a Fish Out of Water: Reconsidering Disaster Recovery and the Role of Place and Social Capital in Community Disaster Resilience." *American Journal of Community Psychology* no. 48:395-411.

Crichton, M.T., Ramsay, C.G. and Kelly, T. (2009), "Enhancing organizational resilience through emergency planning: learnings from cross-sectoral lessons", *Journal of Contingencies and Crisis Management* Vol. 17 No. 1, p. 14

Cutter, S., C. Burton, and C. Emrich. 2010. "Disaster resilience indicators for benchmarking baseline conditions." *Journal of Homeland Security and Emergency Management* no. 7:1-22.

Cutter, S., Emrich, C., Mitchell, J., Boruff, B., Gall, M., Schmidtlein, M., et al. (2006). The long road home: Race, class, and recovery from Hurricane Katrina. *Environment* 48, 10–20.

Cutter, Susan L., Bryan J. Boruff, and W. Lynn Shirley. 2003. "Social Vulnerability to Environmental Hazards*." *Social Science Quarterly* no. 84 (2):242-261. doi: 10.1111/1540-6237.8402002.

Douglas Paton, Marian Millar, and David Johnston. 2001. "Community Resilience to Volcanic Hazard Consequences." *Natural Hazards* Volume 24, Issue 2: 157-169.

Drabek, Thomas E.  1985. "Managing the Emergency Response." *Public Administration Review* 45:85-92.

Drabek, Thomas E. and David A. McEntire.  2002.  "Emergent Phenomena and Multiorganizational Coordination in Disasters:  Lessons from the Research Literature."  *International Journal of Mass Emergencies and Disasters* 20:197-224.

Dynes, Russell R. 1974. Organized Behavior in Disaster. Columbus: Ohio State Univ. Disaster Res. Cent. Monogr. Series No. 3.

Dynes, Russell R. 1994. "Community Emergency Planning: False Assumptions and Inappropriate Analogies." *International Journal of Mass Emergencies and Disasters* no. 12 (2):141-158.

Dynes, Russell R., E.L. Quarantelli, and Gary A. Kreps. 1972. *A Perspective on Disaster Planning*. Columbus, Ohio: Disaster Research Center, Ohio State University.

Feiock, Richard C. 2007. "Rational Choice and Regional Governance." *Journal of Urban Affairs* no. 29 (1):49-65.

———. (2009). Metropolitan governance and institutional collective action. Urban Affairs Review, 44(3), 356-377.

———. (2013). The Institutional Collective Action Framework. Policy Studies Journal. Published online first.

Feiock, Richard C., and John T. Scholz. 2010. *Self-Organizing Federalism: Collaborative Mechanisms to Mitigate Institutional Collective Action Dilemmas*. Cambridge, MA: Cambridge University Press.

Flynn, B. (1994). Mental health services in large scale disasters: An overview of the Crisis Counseling Program. *NCPTSD Clinical Quarterly*, 4, 11–12.

Folke, C., Carpenter, S., Brian Walker, Marten Scheffer, Thomas Elmqvist, Lance Gunderson and C. S. Holling. 2004. "Regime Shifts, Resilience, and Biodiversity in Ecosystem Management." *Annual Review of Ecology, Evolution, and Systematics* Vol. 35: 557-581.

Freeman, L. 1980. "The gatekeeper, pair-dependency and structrural centrality." *Quality and*

*Quantity* no. 14:585-592.

Fritz, C., & Williams, H. (1957). The human being in disasters: A research perspective. *Annals of the American Academy of Political and Social Science*, 309, 42–51.

Goodman, R., Speers, M., McLeroy, K., Fawcett, S., Kegler, M., Parker, E., et al. (1998). Identifying and defining the dimensions of community capacity to provide a basis for measurement. *Health Education & Behavior* 25, 258–278.

Granovetter, Mark. 1983. "The Strength of Weak Ties: A Network Theory Revisited." *Sociological Theory* no. 1 (ArticleType: research-article / Full publication date: 1983 / Copyright © 1983 Wiley):201-233. doi: 10.2307/202051.

Guy, Carpenter. 2003. Typhoon Maemi Loss Report 2003. Seoul, South Korea: Guy Carpenter & Company.

Handmer, J. and Dovers, S. (1996). A typology of resilience:Rethinking institutions for sustainable development. *Industrial and Environmental Crisis Quarterly* 9, 482–511.

Janssen, M., Anderies, J., and Ostrom, E. (2007). Robustness of social-ecological systems to spatial and temporal variability. *Society & Natural Resources*, 20(4):307–322.

Jonas Joerina*, Rajib Shawa, Yukiko Takeuchia & Ramasamy Krishnamurthyb 2012. Action-oriented resilience assessment of communities in Chennai, India." *Environmental Hazards* Volume 11, Issue 3, 2012 pages 226-241

Jung, Kyujin. 2013. "Community Resiliency and Emergency Management Networks: Following the 2012 Korean Typhoons" The Natural Hazards Center (Boulder, CO), Quick Response Report QR237.

Jung, Kyujin, and Moon Gi Jeong. 2010. "An Analysis on Economic Effect of Urban Collaborative Network for Great-sphere Economic Policy: Focusing on the case of Korean Southeastern Area." *Korean Policy Study Review* no. 19 (1):313-340.

Kapucu, Naim. 2006. "Interagency Communication Networks during Emergencies: Boundary spanners in multi-agency coordination." *American Review of Public Administration* no. 36 (2):207-225.

———. 2011. "Collaborative Governance in International Disasters: Nargis Cyclone in Myanmar and Sichuan Earthquake in China Cases." *International Journal of Emergency Management* no. 8 (1):1-25.

Kapucu, Naim, Tolga Arslan, and Matthew Lloyd Collins. 2010. "Examining Intergovernmental

and Interorganizational Response to Catastrophic Disasters:Toward a Network-Centered Approach." *Administration & Society* no. 42 (2):222-247. doi: 10.1177/0095399710362517.

Kapucu, Naim, Christopher V. Hawkins, and Fernando I. Rivera. 2013. *Disaster Resilience: Interdisciplinary Perspectives*. New York: Routledge.

Kendra, James M., and Tricia Wachtendorf. 2003. "Elements of Resilience After the World Trade Center Disaster: Reconstituting New York City's Emergency Operations Centre." *Disasters* no. 27 (1):37-53. doi: 10.1111/1467-7717.00218.

Korean National Assembley, 1. 2004. The Basic Act on Emergency and Safety Management. Seoul, South Korea: The Office of Legislation.

Kreps, Gary A. 1991. "Organizing for Emergency Management." In *Emergency Management: Principles and Practice for Local Government*, edited by Thomas E. Drabek and Gerard J. Hoetmer. Washington, DC: International City Management Association.

Kwon, Sung-Wook, and Richard C. Feiock. 2010. "Overcoming the Barriers to Cooperation: Intergovernmental Service Agreements." *Public Administration Review* no. 70 (6):876-884.

Leonard, Madeleine. 2004. "Bonding and Bridging Social Capital: Reflections from Belfast." *Sociology* no. 38 (5):927-944. doi: 10.1177/0038038504047176.

Lin, Nan. 2001. *Social Capital: A Theory of Social Structure and Action*. New York: Cambridge University Press.

Longstaff, P. H. 2005. *Security, resilience, and communication in unpredictable environments such as terrorism, natural disasters and complex technology*. Cambridge, MA: Harvard University and the Center for Information Policy Research, .

Lubell, Mark, and Lucas Lippert. 2011. "Integrated regional water management: a study of collaboration or water politics-as-usual in California, USA." *International Review of Administrative Sciences* no. 77 (1):76-100. doi: 10.1177/0020852310388367.

Manyena, Siambabala Bernard. 2006. "The concept of resilience revisited." *Disasters* no. 30 (4):434-450. doi: 10.1111/j.0361-3666.2006.00331.x.

———. 2014. Disaster resilience: A question of 'multiple faces' and 'multiple spaces'? International Journal of Disaster Risk Reduction Volume 8, June 2014, Pages 1–9.

Martin-Breen, P., and Anderies, J. M. 2011. *Resilience: a literature review*. The Rockefeller

Foundation: New York.

Maton, K., & Salem, D. (1995). Organizational characteristics of empowering community settings: A multiple case study approach. *American Journal of Community Psychology* 23, 631–656.

Meijer, M. de Boois, I., Scheffer, M., Portielje, R., and Hosper, H. 1999. Biomanipulation in shallow lakes in the netherlands: an evlotion of 18 case studies. *Hydrobiolgia* 408: 13-30.

Murphy, BrendaL. 2007. "Locating social capital in resilient community-level emergency management." *Natural Hazards* no. 41 (2):297-315. doi: 10.1007/s11069-006-9037-6.

National Emergency Management Agency. 2011a. *Disaster Yearbook*. Seoul, South Korea: National Emergency Management Agency.

———. 2011b. *Chronological list of disasters*. Seoul, South Korea: National Emergency Management Agency.

———. 2012. *Successive Three Typhoons and Special Disaster Zones*. National Emergency Management Agency 2012a [cited October 16 2012].

National Research Council. 2009. *Applications of Social Network Analysis for Building Community Disaster Resilience: Workshop Summary*. Washington, DC National Academies Press.

———. 2010. *Private-Public Sector Collaboration to Enhance Community Disaster Resilience: A Workshop Report*. Washington, DC National Academies Press.

———. 2011. *Building Community Disaster Resilience through Private-Public Collaboration*. Washington, DC National Academies Press.

National, Typhoon Center. 2012. *Typhoons Information in 2012* 2012b [cited October 1 2012].

Nelson, M., Kintigh, K., Abbott, D., and Anderies, J. (2010). The cross-scale interplay between social and biophysical context and the vulnerability of irrigation-dependent societies: Archaeology's long-term perspective. *Ecology and Society* 15(3):31.

North, D. (2009). *Institutions, institutional change and economic performance*. Cambridge university press.

Norris, Fran H., Susan P. Stevens, Betty Pfefferbaum, Karen F. Wyche, and Rose L. Pfefferbaum. 2008. "Organizational resilience as a Metaphor, Theory, Set of Capacities, and Strategy for Disaster Readiness " *American Journal of Community Psychology* no. 41:127-150.

Ostrom, E. (1990). *Governing the commons*. New York: Cambridge universty press.

Ostrom, E. (2005). *Understanding institutional diversity*. New Jersey: Princeton universtiy press.

Pendall, R. J., Foster, K. A., & Cowell, M. M. (2010). Resilience and regions: Building understanding of the metaphor. Cambridge Journal of Regions, *Economy and Society*, 3, 71–84.

Pfefferbaum, B., Reissman, D., Pfefferbaum, R., Klomp, R., and Gurwitch, R. (2005). Building resilience to mass trauma events. In L. Doll, S. Bonzo, J. Mercy, & D. Sleet (Eds.), *Handbook on injury and violence prevention interventions*. New York: Kluwer Academic Publishers.

Putnam, Robert D. 1993. *Making democracy work. Civic traditions in modern Italy*. Princeton: Princeton University Press.

Quarantelli, E. L.  1996.  "Emergent Behaviors and Groups in the Crisis Time of Disasters."  Pp. 47-68 in *Individuality and Social Control: Essays in Honor of Tomatsu Shibutani*.  Edited by Kian M. Kwan.  JAI Press: Greenwich, Connecticut.

Quarantelli, E.L.  1987.  "Disaster Studies: An Analysis of the Social Historical Factors Affecting the Development of Research in the Area."  *International Journal of Mass Emergencies and Disasters* 5 (3): 285-310.

Randolph, J. 2012. *Environmental Land Use Planning and Management*. Washington DC: Island Press.

Rivera, F. and Settembrino, M. 2012. Sociological insights on the roel of social capital in disaster resilience. In *Disaster Resiliency: Interdisciplinary Perspectives* edited by Naim Kapucu, Christopher V. Hawkins, and Fernando I. Rivera. Routledge: New York.

———. 2010. *Toward a sociological framework of community resilience*. Grant Research Reprot supported by the U.S. Department of Agriculture under Award No. 2010-67023-21698.

Scheffer, M. 2004. *Ecology of Shallow Lakes*. Springer: Washington D.C.

Scheffer, M. and Nes, E. 2007. Shallow laskes theory revisited: various alternative regimes driven by climate, nutrients, depth and lake size. *Sallow Lakes in a Changing World* page 455-466.

Scheffer, M., Hosper, S., Meijer, M., Moss, B., and Jeppesen, E. 1993. Alternative equilibria in shallow laskes. *Trends in Ecology & Evolution* 8(8): 275-279.

Schoch-Spana, M. 2008. Communtiy resilience for catastrophic health events. *Biosecurity and*

*Bioterrorism: Biodefense Strategy, Practice, and Science* 6(2): 129-130.

Scott, John. 2000. *Social Network Analysis: A handbook*. London: Sage Publications.

Sherrieb, K., F. Norris, and S Galea. 2010. "Measuring Capacities for Organizational resilience. ." *Social Indicators Research* no. 99 (2):227-247.

Snijders, Tom A. B. 2005. "Models for longitudinal network data." In *Models and methods in social network analysis*, edited by Peter J. Carrington, John Scott and S. Wasserman. Cambridge, MA: Cambridge University Press.

Snijders, Tom A. B., Gerhard G. van de Bunt, and Christian E. G. Steglich. 2010. "Introduction to stochastic actor-based models for network dynamics." *Social Networks* no. 32 (1):44-60. doi: 10.1016/j.socnet.2009.02.004.

Somers, S. (2009). "Measuring resilience potential: An adaptive strategy for organisational crisis planning." *J. Conting. Crisis Manage.* 17(1), 12–23.

Steglich, Christian E. G., Tom A. B. Snijders, and P. West. 2006. "Applying SIENA: An illustrative analysis of the co-evolution of adolescents' friendship networks, taste in music and alcohol comsumption." *Methodology* no. 2 (1):48-56.

Thurmaier, Kurt, and Curtis Wood. 2002. "Interlocal Agreements as Overlapping Social Networks: Picket–Fence Regionalism in Metropolitan Kansas City." *Public Administration Review* no. 62 (5):585-598. doi: 10.1111/1540-6210.00239.

Tierney, K. J. 1989. Improving theory and research on hazard mitigation: Political economy and organizational perspectives. *International Journal of Mass Emergencies and Disasters*, 7, 367-396.

———. 2012. "Disaster Governance: Social, Political, and Economic Dimensions." *Annual Review of Environment and Resources* Vol. 37: 341-363. DOI: 10.1146/annurev-environ-020911-095618

Tobin, G., and Whiteford, L. (2002). Community resilience and volcano hazard: The eruption of Tungurahua and evacuation of the Faldas in Ecuador. *Disasters* 26, 28–48

Toivonen, Riitta, Lauri Kovanen, Mikko Kivelä, Jukka-Pekka Onnela, Jari Saramäki, and Kimmo Kaski. 2009. "A comparative study of social network models: Network evolution models and nodal attribute models." *Social Networks* no. 31 (4):240-254.

Uphoff, Norman. 2000. "Understanding social capital: learning from the analysis and experience of participation." In *Social Capital: A Multifaceted Perspective*, edited by Partha

Dasgupta and Ismail Serageldin. Washington, D.C.: World Bank.

Villa, Ferdinando, and Helena McLeod. 2002. "Environmental Vulnerability Indicators for Environmental Planning and Decision-Making: Guidelines and Applications." *Environmental management* no. 29 (3):335-348. doi: 10.1007/s00267-001-0030-2.

Wasserman, S., and K. Faust. 1994. *Social Network Analysis: Methods and Applications*. New York: Cambridge University Press.

Waller, M. (2001). Resilience in ecosystemic context: Evolution of the concept. *American Journal of Orthopsychiatry* 71, 290–297.

Williamson, O. (1998). *The Economic Intstitutions of Capitalism*. Free Press.

Waugh, William L. 2003. "Terrorism, Homeland Security and the National Emergency Management Network." *Public Organization Review* no. 3:373-385.

Waugh, William L., and Gregory Streib. 2006. "Collaboration and Leadership for Effective Emergency Management." *Public Administration Review* no. 66 (ArticleType: research-article / Issue Title: Special Issue: Collaborative Public Management / Full publication date: Dec., 2006 / Copyright © 2006 American Society for Public Administration):131-140. doi: 10.2307/4096577.