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Back to Normal: Collaborative Emergency Management and Organizational Recovery

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Abstract

Current emergency management has emphasized management through collaboration. Unlike the normative and theoretical emphasis on collaborative emergency management, empirical evidence to support its impacts on organizational recovery is lacking. To fill this gap, this study conducts a natural experiment. Using Texas school districts and Hurricane Rita cases, this study examines how collaborative emergency management at the preparedness stage influences organizational recovery after an emergency. Findings show that after controlling for the severity of Hurricane Rita measured by the size of hurricane wind forces and districts' distance from the coast, school districts reopened their closed schools due to Hurricane Rita faster when superintendents had actively prepared for emergencies through collaboration with external emergency-relevant organizations. This study is expected to contribute to an understanding of emergency management with empirical support that collaborative emergency management matters.

Keywords: collaborative emergency management; organizational recovery; natural experiment

Introduction

Public problems have become so complex that public management struggles in developing better management strategies. As a result, studies of public management try to find solutions from collaborative public management (Frederickson, 1999). Collaborative public management is, according to McGuire (2006), “a concept that describes the process of facilitating and operating in multiorganizational arrangements in order to remedy problems that cannot be solved -or solved easily- by single organizations”(33). Collaborative public management has been examined in various policy contexts from Texas school districts (Meier & O’Toole, 2003) to mental health services (Provan & Milward, 1995). The common implication from previous research is to treat networks seriously, as O’Toole (1997) contends.

In an emergency context, American public management has faced a criticism of its incompetence in recent emergencies. Although terrorists attack on 9/11 and disasters such as Hurricane Katrina and Hurricane Rita have awakened the importance of emergency management (Choi 2008), studies of emergency management are still empirically immature. Particularly, current emergency management studies actively seek managerial solutions to deal with massive emergencies from collaboration (Kapucu, Arslan, & Demiroz, 2010; Waugh & Streib, 2006). Economic theories and organization theories support why collaborative emergency management is an appropriate strategy to manage emergencies. However, lack of empirical evidence to support the effectiveness of collaborative emergency management makes it difficult for research on emergencies to move forward. Once normative and theoretical arguments that collaborative emergency management matters for emergency recovery are empirically supported, the next

questions such as how to initiate, maintain, or develop collaborative emergency management can be explored.

To fill this gap and to promote future research on emergency management, this study conducts a natural experiment in the context of Texas school districts and Hurricane Rita. More specifically, this study investigates superintendents' collaborative emergency management in Texas and provides empirical evidence of how collaborative emergency management helps school districts recovered fast from Hurricane Rita.

First, this study reviews what we have learned from two emergencies: the 9/11 attack and Hurricane Katrina. Second, this study moves to a review of current knowledge of emergency management followed by a theoretical background of collaborative emergency management. The fourth section develops the hypothesis of this study and the fifth section introduces more details about sample, data, and method. The next section reports findings, and the last section makes conclusions and discussions.

Public Management in an Emergency Context: Lessons from 9/11 and Hurricane Katrina

Emergencies occur without notice and disrupt the state of tranquility. Depending on the size of emergencies and the degree of preparedness, emergencies can cause catastrophic results. A tragic example is the 9/11 attack, which would be seen from "a science fiction movie" (Cohen, Eimicke, & Horan, 2002, p. 30). It caused the loss of approximately 2,824 lives and injuries to more than 6,000 (Kapucu & Van Wart, 2006). It was reported that the estimated direct and indirect costs due to the attack was about $83 billion (Kapucu & Van Wart, 2006). Cohen and his colleague (2002) thoroughly described actions taken by the city mayor, the director of New York City's Office of Emergency

Management, the Fire Department of New York, the New York Police Department, and so on at the time of the attack. They found that first responses were properly made, unlike what was reported by the media. New York City had experienced the 1993 World Trade Center attack and lessons learned from the attack set the city government to prepare for future potential emergencies. As a result, according to Cohen and his colleague, at the time of the 9/11 attack, the city administration was able to make effective, decentralized decisions to exercise inspiring, creative and orderly leadership, and to establish timely coordination.

However, the 9/11 attack could have been prevented from happening. According to Waugh and Streib (2006), the most important failure of the 9/11 attack was lack of imagination: despite some information about possible attacks, intelligence agencies as well as decision-makers failed to prepare for a scenario that the World Trade Center would be attacked by commercial airplanes. Lessons learned from the 9/11 attack are that setting all possible scenarios of emergencies and developing strategies to mitigate any potential emergency is as critical as actively responding to an emergency.

The 9/11 attack was a wake-up call for public management and substantial changes in managing emergencies were made across the nation from the federal level to the local level. However, the U.S. had to experience another tragedy due to managerial failure: Hurricane Katrina. Hurricane Katrina hit New Orleans on August 29, 2005, and swept through the city killing approximately 1,440 people (Brunkard, Namulanda, & Ratard, 2008). The worst part of Katrina is that unlike the 9/11 attack, which was unforeseen, the pathway of Katrina was predicted in advance. Despite this, considerable

failure to coordinate among federal, state and local governments as well as to prepare for and initiate the evacuation resulted in catastrophic outcomes (Waugh & Streib, 2006).

The 9/11 attack and Hurricane Katrina brought heartbreaking but alerting lessons, and since then, emergency management has received quite a lot of support. However, generally emergency management has not reached satisfactory levels of political and fiscal support due to apathy among citizens (Briechle 1999; Choi 2008). Moreover, studies of emergency management are yet to be intellectually and practically mature (Farazmand 2007). Researchers and practitioners of public management need adequate understanding of emergencies as well as developing emergency management strategies in order to protect public organizations and public values against emergencies.

Understanding Emergency Management and Developing Emergency Management Strategies

Researchers emphasize four core phases for effective emergency management: mitigation, preparedness, response, and recovery. Mitigation activities "try to eliminate the causes of a disaster … by reducing the likelihood of its occurrence or limiting the magnitude of its negative effects" (Perry & Lindell, 2007, p. 5). Mitigation activities aim at creating solutions to mitigate long-term risks (Bumgarner, 2008). Public managers can build their facilities away from hazardous sites or establish building codes for safety.

Preparedness activities "protect lives and property when threats can't be controlled or when only partial protection can be achieved" (Perry & Lindell, 2007, p. 6). This phase assumes the occurrence of a disaster and alerts public and emergency management-relevant organizations in order for them to take necessary actions for

effective response (Perry & Lindell, 2007). Public managers can develop emergency plans, exercise regular emergency drills, or establish emergency warning systems.

Response activities "are the actions of officials just before and during the disaster impact that protect public safety and minimize physical damage" (Perry & Lindell, 2007, p. 6). Public managers at the response stage activate emergency plans, help evacuation of their subordinates and constituents, or provide emergency assistance for victims (Mushkatel & Weschler, 1985).

Lastly, recovery activities "begin after disaster impact has been stabilized and seek to restore lost functions" (Perry & Lindell, 2007, p. 7). Public managers come to understand the extent of damage and repair the damage in order to provide normal public operations as soon but safe as possible.

Each of these phases is important for effective emergency management, but they are not always compartmentalized, and the boundaries of each phase are not clear (Bumgarner, 2008); rather, each phase is closely related, and public managers need to develop strategic plans for each phase.

Many scholarly works have focused on emergency management, but only a little empirical research focusing on organizational recovery or performance was found. For instance, Meier, O'Toole, and Hicklin (2010) investigated how school closure due to Hurricane Rita influenced students' academic performance. They found that students in school districts with more days of school closure showed lower academic performance. However, they also found that strong central administration capacity gradually mitigated the negative impacts. The theoretical logic behind this finding is that greater central administration capacity enables school districts to make effective decisions with regard to

manage an emergency such as assigning evacuees students, restructuring curricula, or allocating resources to needed schools (Meier, O'Toole, & Hicklin, 2010). Thus, developing strong administrative capacity is one strategy to manage unexpected emergencies.

In an emergency context, however, some researchers have argued that internal management or organizational capacity does not play as much of a role as collaborative emergency management. For instance, Waugh and Streib (2006) contend that internal management is expected to protect organizations in an emergency but its effects are limited. They contend that organizations need carefully reviewed plans to respond to a disaster, but plans themselves rarely fit circumstances. In addition, the organization's hierarchy may interact with a disaster in order to reduce the impact of the disaster (O'Toole & Meier, 1999), but management for better disaster preparedness needs to be conducted by collaborating with relevant external actors (Waugh & Streib, 2006). Waugh and Streib (2006) further contend that "…collaborative networks are a fundamental component of any emergency response" (p. 132). For better management of the emergency, they instead emphasize networking with relevant external actors.

Theoretical Background: Collaborative Emergency Management

The needs and effectiveness of collaborative emergency management in an emergency context can be theoretically supported by transaction cost theory. In markets, the production processes of organizations include many transactions on the part of the owners of monetary and non-monetary resources, and these transactions inevitably generate costs (Coase, 1937). To eliminate or at least substantially reduce such

transaction costs, Coase (1937) argues that organizations need to internalize some transactions with external agents in the market. By producing within organizations, economic agents reduce transaction costs and produce more efficiently (Moe, 1984).

However, at a certain point the ability to integrate activities or internalize external functions is limited. For instance, organizations may not have enough capacity to deal with unexpected, large-scale emergencies. In this case, organizations have no choice but to enter into transactions with external agents who hold resources to manage emergencies. Thus, one has to carefully examine internal activity which generates internal costs (IC) and external activity (or subcontracting) that generates external costs (EC) composed of external price (EP, the price imposed by the supplier) and transaction costs (TC) (Jarillo, 1988).

In an emergency management context, based on Jarillo (1988), if TC for emergency management functions supplied to (or by) external organizations are lowered to the point where EC is smaller than IC, then an organization will not internalize external emergency management functions and will seek external emergency management functions through networks. The assumption here is that if and only if EP, the price charged by the supplier, is smaller than IC (Jarillo, 1998), and collaborative emergency management can make EP lower than IC by delivering necessary goods more efficiently. As a result, emergency management through collaboration with external suppliers becomes an important and efficient management skill and/or strategy.

Related to transaction costs, resource dependence theory also explains the purpose of collaborative emergency management in terms of economic incentives. Since individual organizations do not have all the resources they need to accomplish their goals,

they attempt to fulfill their shortcomings by depending on resources from external actors (Fleishman, 2009). In a school district context, for instance, the main service is to provide education. Most resources are allocated to education services and only limited resources may be available to manage emergencies. In such case, school districts should strategically prepare for and respond to emergencies by relying on resources of external organizations including local fire/police department, local welfare government organizations, or local private/nonprofit organizations. In so doing, school districts can manage emergencies without hurting their routine operations. In this process, collaborative emergency management is critical to obtain essential scarce resources from external organizations.

From the theories above, one can learn that collaboration is a critical management strategy in an emergency context. The following section develops a hypothesis for empirical analysis on the effects of collaborative emergency management.

Collaborative Emergency Management for Organizational Recovery: Empirical Analysis

A strategy to deal with emergencies can be derived from the combination of emergency management with four stages (mitigation-preparedness-response-recovery) and the emphasis on the collaborative emergency management: collaborative emergency management at the earlier stages can minimize emergency shocks, enhance emergency recovery, and eventually protect organizational core functions. Good mitigation activities may prevent an emergency from occurring by eliminating any possible causes of an emergency. However, emergencies could occur even after mitigation efforts and the next

step one can take is preparedness and response activities in order to minimize the size of the shock and get things back to normal as soon and safe as possible.

Among other activities, this study focuses on collaborative emergency management at the preparedness stage. In organization theories, government hierarchy and its rigid structure uphold consistency through which other aspects of modern life are managed (Waugh & Streib, 2006). However, according to Waugh and Streib (2006), emergency response is different and a single governmental organization does not have enough capacity to deal with an emergency. As a result, collaborative emergency management involving governmental and nongovernmental actors are required for speedy recovery from an emergency (Waugh & Streib, 2006). Moreover, development of organizational and technological interconnectedness enables more effective emergency management (Kapucu, 2005). In fact, the Federal Response Plan and the FEMA situation reports reveal complex networks involving multiple public, private, and nonprofit organizations in order to manage emergencies (Kapucu, 2005). Theoretically and practically, collaborative emergency management becomes an essential management strategy to deal with an emergency.

Given the four stages of emergency management and the emphasis on collaborative emergency management, it is highly likely that managers who prepare for an emergency through collaborating with external, emergency-relevant organizations may speed organizational recovery after they experience an emergency. The logic is that when emergency occurs, managers may have limited time and resources to develop new collaboration relationships to respond to an emergency. Rather, they may make use of their existing collaboration partnerships in order to respond to and recover from an

emergency. Thus, developing and managing collaboration at the emergency preparedness stage may be very critical for overcoming an emergency. Unfortunately, the current body of emergency management literature keeps emphasizing collaborative emergency management for effective organizational recovery, but few have provided empirical evidence to support the critical impact of collaborative emergency management on organizational recovery after an actual emergency. As a result, this study will investigate how managers' collaborative emergency management influences the speed of organizational recovery in the case of Hurricane Rita.

Background of Hurricane Rita and Texas School District

Less than a month after Hurricane Katrina, Hurricane Rita hit the border of Texas and Louisiana on September 24, 2005. On the Saffir-Simpson Hurricane Scale, Rita was recorded as a Category 5 hurricane. By the time Rita made landfall, however, its strength had weakened to Category 3.[1] Seven fatalities and $10 billion in property damage resulted from the hurricane (Meier, O'Toole, & Hicklin, 2010). Moreover, about 400,000 Texas students were displaced and some schools were closed temporarily or used as shelters for displaced students and their families (Texas Education Agency, 2005). A total of 243 school districts were closed for an average of six days, with certain school districts closed for more than five weeks (Meier, O'Toole, & Hicklin, 2010). According to previous research, school closure resulted in poor academic performance (Meier, O'Toole,

[1] According to National Hurricane Center, a Category 3 hurricane can result in the destruction of older mobile homes, metal buildings, unreinforced masonry buildings (built prior to 1994), poorly constructed frame homes, and severe damages to most newer mobile homes. It can also cause fatal injury or death to people and livestock due to flying and falling debris. More information about Beaufort Wind Scale as well as the source of this footnote is available at http://www.marinewaypoints.com/marine/wind.shtml.

& Hicklin, 2010). As a result, emergency management may face to reopen schools as soon as possible with safety guaranteed.

Data, Sample, Variables, and Method

Data

This study uses data from Emergency Preparedness and the Impact of Hurricanes Katrina and Rita on Texas School Districts, which was conducted immediately after Hurricane Rita (the initial survey was conducted in November 2005 and finished by early 2006). Superintendents were asked about the impact of the hurricane on their school districts, level of their emergency preparedness and responses, and the pattern of collaboration. The response rate was 58 percent (720 superintendents). This study focuses on how collaborative emergency management helps organizations recover from Hurricane Rita; thus, only those school districts affected by Hurricane Rita are selected as a sample of analysis. More details of sample selection will be presented in the following section.

In addition to the post-hurricane survey data, this study uses demographic and financial resource information related to the school districts from the Texas Education Agency (TEA) website.[2] Finally, geographic information provided by Sea Island Software, Inc.[3] is used to track Hurricane Rita and to control for the severity of Hurricane Rita.

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[2] Texas Education Agency. (2011). Academic Excellence Indicator System 2011. Retrieved from http://ritter.tea.state.tx.us/perfreport/aeis/.

[3] More information about this company is available at http://www.hurricanemapping.com.

Sample

Figure 1 shows Texas school districts and the path of Hurricane Rita. Each block in the map indicates a school district, and colors on the block represent the length of school closure due to Hurricane Rita. As shown in the map, school districts located in east Texas closed schools are unlike school districts in the middle and west side of Texas. It is because Hurricane Rita passed the east side of Texas. This study focuses on how collaborative emergency management at the preparedness stage influences the speed of organizational recovery after Hurricane Rita; thus, school districts that Hurricane Rita did not pass are not a sample of interest and were dropped from the sample. In order to do so, this study draws lines indicating maximum reach of hurricane wind forces. The red, olive green, and light blue lines indicate maximum reach of wind forces at 74 mph, 58 mph, and 39 mph respectively. All school districts located within these lines must have severe impact from the hurricane; thus they are included as a sample. In order to include school districts that were affected by wind forces at less than 39 mph, the following steps are taken. First, the distance between the olive-green line and light blue line is measured. Second, using the distance, another line apart from the light blue line was drawn. Lastly, all school districts between this new line (this line is not shown in the map) and the light blue line were included as a sample.

[Figure 1 about here]

Variables

a. Measuring organizational recovery

Organizational recovery is the act of restoring organizational functions that are lost due to an emergency (Perry & Lindell 2007). In this study, the speed of organizational recovery is measured by the number of days that districts closed their schools to evacuate for Hurricane Rita or because of the damage caused by Hurricane Rita. This information is available from the post-hurricane survey (see Appendix 1). Some may understand more days of school closure due to an emergency as good management, because superintendents may want to cancel classes and wait until emergency threats are completely removed. In this case, more days of school closure may represent good responses to an emergency. However, too many missed classes can harm students' learning and further cause students' poor academic performance (Meier, O'Toole, & Hicklin, 2010). Scheduling make-up classes may not be an easy option for superintendents especially when the curriculum was already set. Therefore, superintendents have strong incentive to re-open schools as soon as possible with districts' safety guaranteed after an emergency. Because the dependent variable is the days of school closure due to Hurricane Rita, more days of school closure indicate slower recovery and any negative effects of explanatory variables represent faster recovery.

b. Measuring collaborative emergency management

This study employs two measures to operationalize collaborative emergency management: number of regular meeting partners and the extent of resource sharing.

Number of Regular Meeting Partners Prior to Hurricanes Rita, superintendents had voluntarily engaged in regular meetings with key groups in their districts in order to prepare for a potential emergency. Holding regularly scheduled meetings is an act of networking that requires relatively high efforts for the participants (Robinson & Gettis 2012). According to Robinson and Gettis (2012), initiating and maintaining a regular meeting schedule requires high motivation and commitment especially since busy managers have several obligations. Accordingly, numbers of regular meeting partners for emergency preparation captures the managerial efforts of collaborative emergency management.

The post-hurricane survey asked superintendents to check all regular meeting partners among the following external actors: 1) police, fire department, and first responders; 2) government relief and welfare organizations; 3) nonprofit and relief organizations; 4) local/community/religious organizations; 5) other school districts; and 6) business organizations (see Appendix 1 for the actual survey item). This measure ranges from 0 to 6 with a mean of 1.67 and standard deviation of 1.4.

The Extent of Resource Sharing Although this study assumes that number of regular meeting partners well represent superintendents' collaborative emergency management activities, this measure does not capture precise information about the meetings' content or quality. In order to supplement the measure of regular meeting partners, this study also measures collaborative emergency management by examining superintendents' efforts to share resources with the same key external organizations. Previous literature finds that identifying and assembling resources is critical for better emergency management (Bumgarner, 2008; Perry & Lindell, 2007). Most organizations have

limited resources and in a time of emergency they find resources to be particularly scarce; thus, resources including money, personnel, equipment, and supplies should be identified and gathered prior to the emergency (Bumgarner, 2008).

The survey asked whether superintendents share money, information, goods or personnel with the external actors discussed earlier (police, fire department, and first responders; government relief and welfare organizations; nonprofit and relief organizations; local/community/religious organizations; other school districts; business organizations; see Appendix 1). First, this study counts the number of external actors with which the superintendents share resources; thus, each of the four resource variables (sharing money, sharing information, sharing goods, and sharing personnel) ranges from zero (non-sharing) to six (sharing with all six external actors). Then, a factor analysis of four summed resource variables is conducted to produce a factor score, which may represent managerial efforts to share resources in order to prepare for the emergency. Those four summed variables were loaded on one factor with an eigenvalue of 1.362.[4]

Since the post-hurricane survey was conducted after Hurricane Rita, the severity of the hurricane may have motivated superintendents to develop new networking strategies. If so, the problem of endogeneity can be raised. However, it is clear that the endogeneity issue is not serious in this study for two reasons. First, the survey asked how long superintendents have collaborated with six given parties and this study dropped

[4] A factor score is a better measure to capture managers' effort to share resources than the summation of each variable. Variables used for generating resource sharing have two dimensions – what resources superintendents shared and with whom superintendents shared resources. Because of these dimensions, a one unit change of a summed variable is hard to interpret. Resource sharing measured by a factor analysis operationalizes a latent variable that captures superintendents' resource sharing activities with external actors regardless of with whom and what they shared. Thus, one unit change of a factor score for resource sharing is a better and easier measure to interpret as compared to the summed variable. In addition, Poisson regression presents similar results when resource sharing is measured by the summation of each variable.

those who responded that they had had collaborated since Katrina out of the sample. Second, mean tests for the average days of school closure, the average number of regular meeting partners, and the average level of resource-sharing between coastal districts and inland districts were conducted. Because hurricanes lose their power as they make landfall, inland districts are less likely to be impacted than coastal districts. As expected, the results showed that coastal districts had more days of school closure than inland school districts. However, no differences in numbers of regular meeting partners and levels of resource sharing were found between coastal districts and inland districts. From this finding, this study did not find endogeneity to be an issue.

c. Control variables

For better emergency preparedness, an emergency operations plan needs to be developed for the activation and coordination of response organizations (Bumgarner, 2008; Perry & Lindell, 2007, p. 6). To assess the quality of the emergency operations plan, the post-hurricane survey asked superintendents to evaluate the quality of their existing disaster/emergency plan with a 4-point scale (from poor to excellent; see Appendix 1). The current study utilizes this survey item to control for the effects of the emergency operations plan on organizational recovery.

Emergency response is as important as emergency preparedness. Timely responses to an emergency may minimize the negative impact of an emergency on organizations and speed recovery. The post-hurricane survey asked when the district recently activated their emergency plan (4-point Likert scale from past 6 months to more than 2 years; see Appendix 1). Using this variable, the present study generated an

emergency response variable with a value of 1 if school districts had activated emergency plan within past 6 months from the time being asked; otherwise, the emergency response variable was coded as 0.[5]

To control for a district's financial and non-financial support from the community, this study includes the percentage of low-income students (the percentage of students who are eligible for free or reduced-price lunch or eligible for other public assistance). Generally speaking, districts with more low-income students may find limited financial and/or non-financial support from their community. As a result, districts with low-income students may be more vulnerable to emergency shocks. For this reason, this study controls for the percentage of low-income students in academic year 2004-5.

In order to respond to the emergency and recover from the hurricane damages, the financial status of the district and districts' size may be critical. Currently, districts' expenditure on emergency management is not available. Instead, this study controls for a district's expenditure on transportation per pupil in 2004-5. The logic is that districts should be able to provide students with transportation services and a hurricane's damages may keep districts from adequately providing transportation services. Therefore, districts with more expenditure on transportation per pupil may overcome obstacles to operate transportation services faster than other districts. For the same reason, total operating expenditure per pupil in 2004-5, which excludes transportation expenditure, is controlled. Controlling for other aspects, a higher expenditure for operations may lead to faster recovery from the hurricane damages as compared to districts with lower operating expenditure.

[5] School districts in the sample are those influenced by Hurricane Rita. Thus, if they appropriately responded to the hurricane, they should have a record of emergency plan activation within last 6 months from the time being asked.

To control for the size of the school district, this study uses the numbers of students in 2004-5. It may be reasonable to believe that as compared to small districts, bigger districts may have more monetary or non-monetary resources/supports from the communities that can be utilized to respond to the emergency.

The superintendent's tenure at the district is also controlled. Previous literature suggests that superintendent's tenure as managerial stability may be associated with buffering environmental shocks (see O'Toole & Meier, 2003). Based on the TEA database, this study controls for a categorical variable that is coded as 1 if a superintendent held her position for one year, as 2 if for two years, as 3 for three years and as 4 for more than three years.

As for hurricane severity, no objective measures are available. The survey asked superintendents to rate the degree of damages by the hurricane but their perception could be biased. In order to control for the most unbiased hurricane severity, this study utilizes two indicators that might capture the severity of hurricane most accurately: hurricane wind force categories and the district's location from the coast. Based on geographic information and hurricane wind force information, this study codes wind forces into four categories: coded as 1 if districts were under Hurricane Rita's wind force less than 39 mph; coded as 2 if districts are under the Hurricane Rita's wind force between 39 and 58 mph; coded as 3 if districts are under the Hurricane Rita's wind force between 58 and 74 mph; and coded as 4 if districts are under the Hurricane Rita's wind force more than 74 mph.

Along with the hurricane wind forces, districts' distance from the coast is another important factor to take into account. According to Kleinschmidt (1951), the

thermodynamic disequilibrium that occurs between the tropical atmosphere and oceans is the energy source of hurricanes (cited in Emanuel, 1991). Once the hurricane makes landfall, it loses its energy from the ocean and gradually ceases to exist. Relying on this information, it may be reasonable to control for districts' location and their distance from the coast as a measure of the hurricane severity. The distance variable is coded as 4 if a district is located within 50 miles from the coast; coded as 3 if located between 50 miles and 100 miles from the coast; coded as 2 if located between 100 miles and 150 miles from the coast; and coded as 1 if located farther than 150 miles from the coast.

Descriptive statistics and correlation matrix for variables are listed in table 1.

[Table 1 about here]

Method

The dependent variable in this model is days of school closure and it is a count variable. To estimate the count variable, this study finds that a Poisson regression model is more preferred over a negative binomial regression model or a zero-inflated Poisson regression model. A negative binomial regression model may be employed in cases in which the dependent variable is over-dispersed. However, this study conducted over-dispersion test, and did not detect over-dispersion.[6] As a result, this study finds that a Poisson regression model is a more preferred method for this study.

A zero-inflated Poisson regression may be used to estimate a count variable if the count variable includes a group of individual observations that are always zero, and a

[6] Long and Freese (2006) suggest an overdispersion test using log-likelihood ratio of a Poisson regression model and a negative binomial regression model. This study used STATA version 11 to conduct an overdispersion test and found that the dependent variable was not over-dispersed.

group of individual observations that are not always zero (Long & Freese, 2006). A Poisson regression model is more preferred to estimate a count variable if the count variable has a group of observations that are not always zero (Long & Freese, 2006). This study samples those districts affected by the hurricane and excludes districts that were not. Thus, every district in the sample had a possibility to cancel their classes for any given number of days depending on the level of Rita's severity. In other words, the sample satisfies the assumption of a Poisson regression method. Moreover, the Vuong closeness test for model selection between a zero-inflated Poisson regression and a Poisson regression finds that a Poisson regression model is preferable.[7] As a result, this study will estimate days of school closure using a Poisson regression model.

Cameron and Trivedi (2009) argue that the distribution of the count variable does not perfectly follow the Poisson distribution. To control for the violation of the distribution assumption that the variance is equal to the mean, they suggest using robust standard errors for the parameter estimates. As a result, this study will estimate robust standard errors.

Findings

Table 2 presents the estimation of days of school closure analyzed by a Poisson regression. First, Model 1-1 finds that higher hurricane wind forces and districts' location closer to the coast resulted in more days of school closure. Given that hurricane wind forces were classified into four categories in this analysis, one category increase in hurricane wind forces increases the expected days of school closure by a factor of 2.208,

[7] The null hypothesis for Vuong closeness test is that a Poisson regression is preferred over a zero-inflated Poisson regression. The z-statistics for a one-tailed Vuong's test is .540; thus, it fails to reject the null hypothesis that a Poisson regression is preferred over a zero-inflated Poisson regression.

holding all others constant. Districts' location from the coast causes similar negative results. Reminding that districts' location from the coast were categorized in four regions in this study, the expected days of school closure increases by a factor of 1.554 as school districts are located closer to the coast by one given category. It implies that hurricane wind forces and the distance from the coast are decent measures of the severity of Hurricane Rita.

Model 1-2 shows impacts of collaborative emergency management on days of school closure after controlling for the severity of the hurricane. While the severity of hurricane is still found to delay school reopening, it is found that both collaborative emergency management variables are statistically significant and they play important roles in reducing the days of school closure. For instance, having one more regular meeting partner decreases the expected days of school closure by a factor of .896. One unit increase in resource sharing also leads to decreases in the expected days of school closure by a factor of .887.

Same positive impacts of networking on reopening schools are found in Model 1-3 where all control variables are included. Superintendents' holding one more regular meeting with an emergency-relevant key external player decreases the expected days of school closure by a factor of 9 percentage points (odds-ratio: .912). Also, one unit change in resource-sharing efforts decreases the expected days of school closure by a factor of 13 percentage points (odds-ratio: .873). These findings support the hypothesis that managers' collaborative networking in preparation for the emergency hastens the speed of organizational recovery after the emergency.

Good qualities of emergency plans are found significant in Model 1-3, although the statistical power of this variable is not very strong. Some scholars argue that emergency plans may have limited functions because they do not fit real emergency situations. However, well-designed emergency plans can reduce a number of uncertainties, which managers and subordinates of the organization would otherwise have to deal with while in an urgent situation. Thus, developing good quality emergency plans may be a good predictor for fast organizational recovery.

Model 1-3 shows that some districts' environmental factors influence districts' recovery. As anticipated, school districts with more low-income students take more days to reopen, although the magnitude of its impact is not high (odds-ratio: 1.009). It was also found that spending more on transportation can lead to faster recovery after an emergency, but its magnitude and statistical significance were not so high (odds-ratio: .999; p-value: .087). Lastly, results from Model 1-3 show that districts with more students are likely to reopen their schools faster, but its magnitude and statistical significance are found not high (odds-ratio: .993; p-value: .062).

[Table 2 about here]

In summary, the hurricane wind category and districts' location from the coast are two major factors that influence days of school closure due to the hurricane. Controlling for these measures of the severity of the hurricane, the analysis finds that districts reduced the days of school closure due to the hurricane when superintendents had more regular meeting partners and were more involved in resource-sharing in preparation for

the emergency. Also, having a good quality emergency plan plays a significant role in reducing the number of days of school closure. These findings confirm the argument that collaborative emergency management matters.

Conclusion and Discussion

Current public management faces multiple, complex public problems, and no single public organization is expected to fully resolve such problems. In an unexpected, massive emergency context as well, one may exercise internal management or rely on organizational structure to buffer the negative shocks and protect organizational core functions. Scholars of emergency management, however, point the limitation of a single organization approach to emergency management due to its lack of resources and limited applicability. As an alternative, scholars find collaborative emergency management as a critical strategy and practitioners in a government body have developed complex networks to effectively manage an emergency. Moreover, the lessons learned from the 9/11 attack and Hurricane Katrina confirm the inevitability of managing emergencies through collaboration.

However, studies of emergency management in public administration are yet to be intellectually and practically mature (Farazmand 2007). Unlike some government programs such as Medicare or Medicaid, beneficiaries of emergency management are not clear; in other words, emergency management targets many and unspecified persons who may or may not suffer from unexpected potential emergencies. The public as well as administrators cannot evaluate the actual performance of emergency management unless they experience emergencies. In this sense, management preparation for unexpected

emergencies may be economically and stochastically inefficient. However, public administration should not take a narrow economizing approach, because a government is responsible for protecting its citizens against emergencies. Accordingly, public administration should treat emergency management seriously.

This study is expected to contribute to the study of public management in several ways. First, empirical findings to support the positive effects of collaborative emergency management confirm the current emphasis on emergency management through collaboration. This study is conducted in a natural experiment setting; superintendents had exercised collaborative emergency management at different levels before Hurricane Rita and it was found that collaborative emergency management helps school districts recover faster after Hurricane Rita. This natural experiment validates the role of collaborative emergency management. Second, GIS technique was employed in this study to measure the severity of Hurricane Rita. Among others, it is commonsense that hurricane's wind forces and geographic location from the coast are most objective measure of the severity of a hurricane. However, few have employed GIS techniques to capture the size of a hurricane's shock. The combination of a natural experiment and objective measures of hurricane shocks allows this study to distinctively contribute to understanding public management in an emergency context.

Now, more active future research needs to continue. First, due to the limitation of secondary dataset, this study fails to investigate the contents of regular meetings even if this study tries to overcome such limitation by measuring resource sharing. Future research needs to investigate the contents of collaborative emergency management in depth in order to provide better arrangement and management of collaboration for

emergencies. Second, this study bases on school districts. Even if school districts represent a significant portion of the whole public organizations, still the findings from this study need careful application to other public organization contexts in which public organizations have different characteristics from school districts. In order to ensure the validity of findings from this study, similar efforts have to be made in different contexts as well. Last but not least, network-level outcomes need to be investigated. This study focuses on an individual collaborative emergency management and recovery of an individual organization. Collaborative emergency management not only aims at recovery of an individual organization but also pursues recovery of the community as a whole. Sometimes one may find cases in which an individual organization in emergency networks finds delays at the expense of fast recovery of the community as a whole. Thus, studies of collaborative emergency management with networks as a level of analysis need to be followed to investigate the effectiveness of emergency networks as a whole.

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Figure 1. Texas School Districts with Days of School Closure, Track of Hurricane Rita, and Its Wind Forces

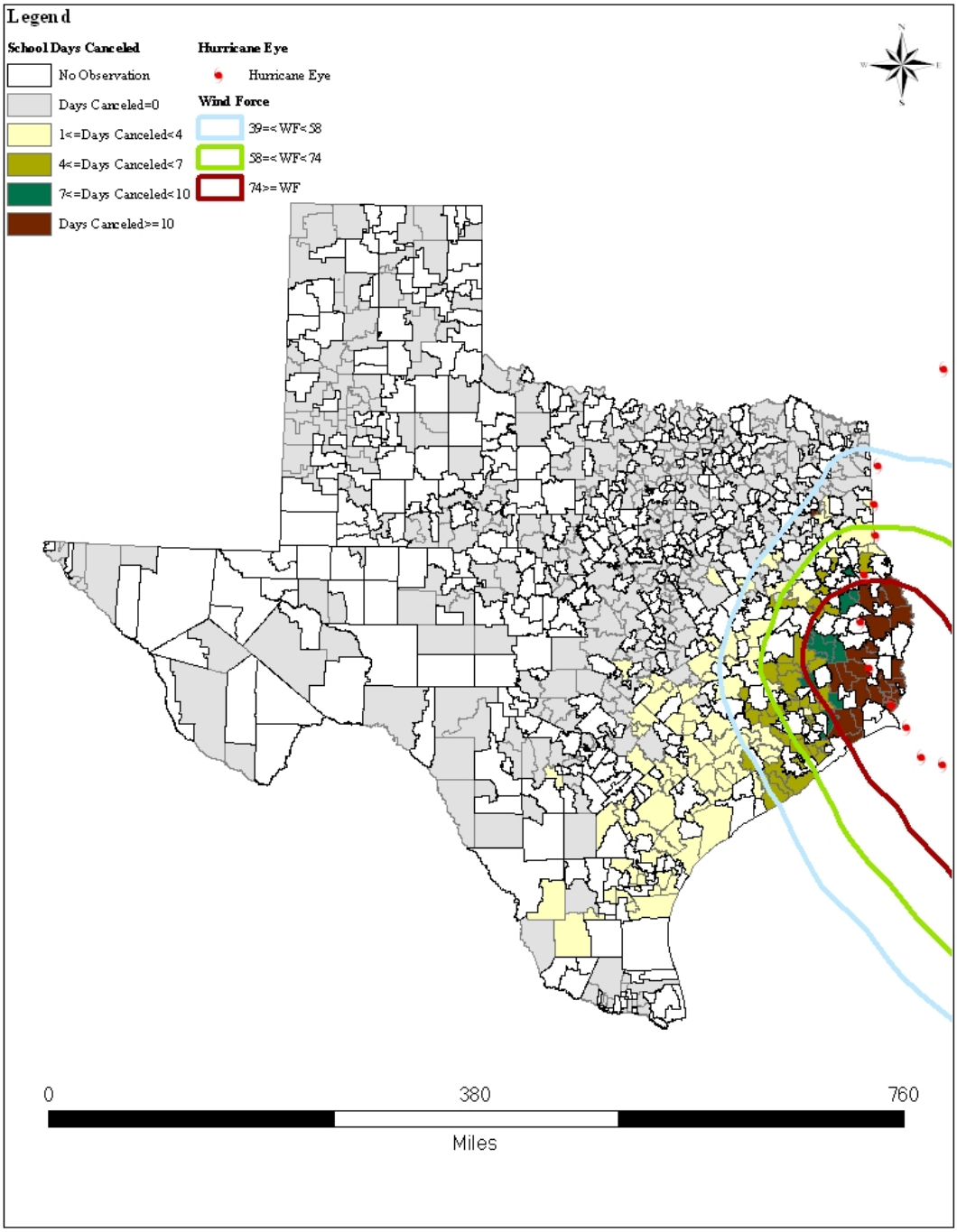

Table 1. Descriptive Statistics and Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Number of Days Closed	1											
(2) Number of Regular Meeting Partners	.049	1										
(3) Resource Sharing (factor score)	.038	.117	1									
(4)) Quality of Emergency Plan	-.124	.132	-.003	1								
(5) Recent Activation of Emergency Plan	.391	.087	.240	.065	1							
(6) % Low-income Students	-.092	-.094	.005	-.029	-.074	1						
(7) Expenditure on Transportation per Pupil	.208	-.073	.095	-.103	.146	.007	1					
(8) Total Operating Expenditure per Pupil (except Transportation; in thousand)	-.040	-.302	-.066	-.077	-.109	.421	.325	1				
(9) Number of Students (in thousand)	.051	.218	.021	.019	.176	-.154	.013	-.249	1			
(10) Superintendent's Tenure	-.020	.079	.090	-.013	-.167	-.079	-.012	.076	-.116	1		
(11) Hurricane Wind Category	.746	.108	.173	-.003	.339	-.099	.420	-.046	.183	-.104	1	
(12) Districts from the Coast	.597	.240	.107	.022	.370	-.163	.279	-.049	.300	.028	.522	1
Mean	3.667	1.676	.151	3.010	.255	49.796	245.480	7.417	5.188	1.902	2.225	2.314
Standard Deviation	4.954	1.401	1.005	.605	.438	13.894	93.334	.837	1.675	1.148	1.142	1.274
Minimum	0	0	-.673	1	0	18.9	0	6.061	.082	1	1	1
Maximum	30	6	4.506	4	1	87.9	486	1.265	62.657	4	4	4

Observation Number: 102

Table 2. Poisson Regression of Days of School Closure

Dependent Variable: Days of School Closure	(Model 1-1)		(Model 1-2)		(Model 1-3)	
	Beta Coefficient	Odds Ratio	Beta Coefficient	Odds Ratio	Beta Coefficient	Odds Ratio
Number of Regular Meeting Partners			-.110**	.896	-.092**	.912
			(.049)		(.042)	
Resource Sharing (factor score)			-.120**	.887	-.135***	.873
			(.047)		(.041)	
Quality of Emergency Plan					-.146*	.864
					(.079)	
Recent Activation of Emergency Plan					.117	1.124
					(.109)	
% Low-income Students					.008**	1.009
					(.004)	
Expenditure on Transportation per Pupil					-.001*	.999
					(.001)	
Total Operating Expenditure per Pupil (except Transportation; in thousand)					-.064	.938
					(.070)	
Number of Students (in thousand)					-.007*	.993
					(.004)	
Superintendent's Tenure					-.004	.996
					(.048)	
Hurricane Wind Category	.792***	2.208	.800***	2.225	.785***	2.193
	(.072)		(.062)		(.062)	
Districts from the Coast	.441***	1.554	.506***	1.659	.511***	1.667
	(.069)		(.071)		(.063)	
Constant	-1.448***		-1.443***		-.666	
	(.246)		(.227)		(.598)	
Pseudo R-squared	.570		.590		.604	
Observations	102		102		102	

Robust standard errors in parentheses; *** p<.01, ** p<.05, * p<.1

APPENDIX 1. Survey Items

Variable	Questionnaire
Days of School Closure	How many days did your district have to cancel (to evacuate for Hurricane Rita or because of the damage caused by Hurricane Rita)?
Regular Meeting	With which of these groups do you hold ***regularly scheduled*** meetings? (check all that apply) ___ police, fire, and first responders___ non-profit/relief organizations (i.e. Red Cross) ___ other school districts ___ government relief/welfare organizations ___ business organizations ___ local/community/religious organizations
Resource Sharing	What do you share with these groups? (check all that apply) Money Personnel Goods Information Police, Fire, and First Responders ___ ___ ___ ___ Non-Profit/Relief Organizations ___ ___ ___ ___ Other School Districts ___ ___ ___ ___ Government Relief/Welfare Organizations ___ ___ ___ ___ Business Organizations ___ ___ ___ ___ Local/Community/Religious Organizations ___ ___ ___ ___
Quality of Plan	How would you evaluate the quality of your district's existing disaster/emergency plans? _____Poor _____Fair _____Good _____Excellent
Recent Activation of Emergency Plan	Has your district faced an emergency that called for the activation of your district disaster/emergency plan in: ___ past 6 months ___ past year ___ past two years ___ Not in the past 2 years