

**ADMINISTRATIVE RESILIENCE:
EVALUATING THE ADAPTIVE CAPACITY OF ADMINISTRATIVE SYSTEMS
THAT OPERATE IN DYNAMIC AND UNCERTAIN CONDITIONS**

by

Thomas W. Haase

B.A., Chadron State College, 1998

J.D., University of Pittsburgh, 2001

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This dissertation was presented

by

Thomas W. Haase

It was defended on

December 7, 2009

and approved by

Dr. Kathleen M. Carley, Ph.D., Professor,
Carnegie Mellon University

Dr. Siddhartha Chandra, Ph.D., Associate Professor,
Graduate School of Public and International Affairs, University of Pittsburgh

Dr. William N. Dunn, Ph.D., Professor,
Graduate School of Public and International Affairs, University of Pittsburgh

Dissertation Advisor: Dr. Louise K. Comfort, Ph.D., Professor,
Graduate School of Public and International Affairs, University of Pittsburgh

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ABSTRACT

An administrative system's capacity to take effective action can be undermined by the uncertain and rapidly changing conditions that are often generated by disruptive events. Resilience has been identified as the most practical approach to overcoming this administrative problem. Resilience has multiple definitions, one of which is "[t]he capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organizing itself to increase this capacity for learning from past disasters for better future protection and to improve risk reduction measures" (International Strategy for Disaster Reduction 2005, p. 4). This study argues that, in contrast to conventional administrative systems, resilient administrative systems have the capacity to successfully respond to disruptive events because they possess the organizational stability to maintain the effectiveness of the community in which it operates and the organizational flexibility needed to adapt to uncertain and rapidly changing conditions.

This study advances a framework for administrative resilience, which can be used to evaluate the resilience of administrative systems. Through the use of a nested case study that employed a mixed-methods design, the framework was used to investigate the administrative response system that operated in Indonesia after the Great Sumatran Earthquake and Tsunami of 26 December 2004. The study generated a number of findings. First, the system was a system of

sub-systems, and the organizations that operated in the domestic sub-system possessed extremely low levels of resilience. The consequence was that the domestic sub-system could not formulate an effective response to the constraints present in the post-tsunami environment. Second, it was the inclusion of the organizations in the international sub-system, which brought with them high levels of resources, technology and experience, as well as the interactions exchanged between international and domestic organizations, which improved the resilience of the overall administrative system. These findings indicate that policy makers can promote the development of administrative resilience through the development and implementation of socio-technical infrastructures that facilitate administrative action.

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PREFACE

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1.0 INTRODUCTION

Some of humankind's most spectacular achievements would not have occurred without the support of complex technological and administrative systems. While these systems have improved humankind's capacity to resolve complicated problems, their uncoordinated development and expansion have enabled many of them to become tightly coupled (Perrow 1984, p. 331). In some instances, the processes employed within these systems have also become rigid; creating the potential for mismatches between a system's structure and the operational conditions that it is designed to manage. These developments have increased the risk that these systems, interconnected together through a complicated web of interdependencies, will fail when stressed by a disruptive event. Today, a minor disturbance in one system, if left unchecked, can create a cascade of failures that can expand to disrupt multiple systems simultaneously.

An expansive cascade of system failures occurred after Hurricane Katrina, when malfunctions in the levee system caused the City of New Orleans to become inundated with floodwater. The subsequent breakdown of the city's critical infrastructure worked to disrupt critical technical systems, including electrical systems, water pumping and distribution systems, transportation systems, and most importantly, communication systems. The administrative systems that relied on these technical systems also became disrupted, in part, because decision makers were constrained by conditions of uncertainty and unable to acquire the information they needed to take effective action (Ostrom 2005; Rosenthal, Boin, and Comfort 2001).

1.1 THEORETICAL PROBLEM: UNCERTAIN CONDITIONS AS A CONSTRAINT FOR ADMINISTRATIVE ACTION

The administrative disruptions that occurred after Hurricane Katrina were caused by uncertain and rapidly changing conditions, which constrained administrative action and facilitated the death of more than 1,300 Americans. Disaster experts, including those from the United States government, concluded that the difficulties encountered by the emergency responders that operated in the City of New Orleans after Hurricane Katrina were generated, in large part, by the administrative system within which they operated. This conclusion was supported by the United States Congress, which indicated in its comprehensive after-action report, *The Failure of Initiative*, that the administrative problems that followed Katrina “cost lives, prolonged suffering, and left all Americans justifiably concerned [that] our government is no better prepared to protect its people than it was before 9/11” (United States Congress 2006, p. 359).

To improve the capacity of administrative systems, the problems generated by uncertain and rapidly changing conditions, which inhibit governmental and non-governmental organizations from taking timely and coordinated action during a crisis event, must be moderated or eliminated. According to Elinor Ostrom, uncertainty represents the indeterminacy that occurs when “institutional arrangements leave open wide avenues for choice, and each individual’s outcome is dependent upon the actions taken by others” (Ostrom 2005, p. 48-49). Ostrom indicates that “[u]ncertainty characterizes a situation in which the probabilities of specific actions leading to outcomes are unknowable. The set of actions and the set of outcomes are still assumed to be finite and knowable. The linkages between actions and outcomes are also presumed to be knowable” (Ostrom 2005, p. 49).

Uncertainty creates problems for administrative systems when their constituent organizations and decision makers find that their structures and processes no longer apply to the conditions present within the operational environment. When this occurs, decision makers may know the general type of action they should take to obtain certain outcomes, but they are unable to predict with any degree of certainty which of their actions will actually enable them to obtain the outcomes they desire. In the context of administrative systems that manage post-disaster operations, this type of uncertainty is exacerbated by two interrelated factors. First, as suggested by Ostrom, it is difficult to predict whether a particular action will lead to a particular outcome because such predictions depend on knowing the actions of others, which is highly unlikely. Second, the operational environment can change, for example, through the collapse of critical infrastructure or the movement of dislocated populations. Changes in the operational environment can force policy makers to either modify the activities they need to complete to obtain their desired outcomes, or in the most extreme circumstances, modify their desired outcomes. By way of further explanation, when an administrative system responds to a crisis, the uncertainty present within the operational environment can beget uncertainty, which constrains administrative action and creates additional uncertainty. This study seeks to identify the mechanisms that can help administrative systems to break this cycle of uncertainty.

The customary response to the problems created by uncertain and rapidly changing conditions has been to reinforce administrative structures and to provide decision makers with increasingly detailed standard operational plans and procedures. Such forms of administrative reinforcement can be extremely successful, especially when policy makers are attempting to respond to small predictable events that are not constrained by limitations in information access. An excellent example of administrative reinforcement has been the use of fire departments to

respond to the problem of structure fires in urban areas. As communities have expanded, policy makers have adjusted the distribution of fire departments and the procedures used by fire fighters to ensure that personnel and resources can be directed to fires immediately after they are detected. Policy makers have also expanded the responsibilities of fire departments to include other tasks, for instance, search and rescue activities. The evolution of the administrative systems that are responsible for managing the problems caused by structure fires has been extremely effective, and has almost eliminated the threats and risks posed by urban conflagrations.

The strategy of administrative reinforcement can be ineffective when policy makers seek to improve an administrative system's capacity to respond to disruptive events that unfold in operational environments constrained by limitations in information access. For example, the strategies used by policy makers to confront the problem of urban structure fires would be inappropriate for the management of large wildland fires, which are dynamic in their growth and can experience rapid change in response to shifts in weather, wind and other environmental conditions. Beyond the financial costs involved in building and staffing fire houses in rural areas, the decision makers that respond to wildland fires may find that additional layers of administrative structure can undermine their operational flexibility. Moreover, given that wildland fires do not stop at city and county boundaries, the development of a large administrative system for wildfire response would create a number of issues for decision makers. This means that disagreements could develop among officials from neighboring communities about jurisdictional restrictions and the management of operations. The successful resolution of these issues may require the development of increasingly detailed policies and procedures, which would only further constrain the capacity of decision makers to initiate and coordinate activities. If decision makers have to review check lists of required tasks before commencing operations, a

wildland fire can consume thousands of acres and encroach upon urban areas. To rapidly extinguish a wildland fire, decision makers must have the capacity to identify and implement creative solutions to the problems generated by uncertain and rapidly changing conditions.

Alternative forms of administrative structure may improve the capacity of administrative systems that operate in such conditions. One strategy might be for policy makers to transition towards administrative structures that take better advantage of the flexibility provided by decentralization and heterogeneous organizational networks (Kettl 2002). There is growing support for such a transition, as evidenced by the range of scholars who advance the argument that networks have come to play an increasingly important role in the governance of public administration systems (Agranoff 2006, 2007; Goldsmith and Eggers 2004; O'Toole and Meier 2004). Other scholars have expanded upon this argument by suggesting that heterogeneous organizational networks can improve the capacity of administrative systems by providing decision makers the information and flexibility they need to adapt and self-organize (Comfort, 1999). While this research has contributed to the field of public administration, questions remain about the extent to which alternative administrative structures would facilitate good governance, and more importantly, the extent to which these structures would emerge and evolve.

1.2 THEORETICAL INQUIRY: ADMINISTRATIVE RESILIENCE AS A RESPONSE TO CONDITIONS OF UNCERTAINTY

Resilience has been identified as the most practical approach to overcoming the administrative problems generated by uncertain and rapidly changing conditions. Resilience is a construct that has many definitions, one of which is “[t]he capacity of a system, community or society

potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organizing itself to increase this capacity for learning from past disasters for better future protection and to improve risk reduction measures” (International Strategy for Disaster Reduction 2005, p. 4). Even with its prominence in recent policy discourse, resilience has remained an exclusive policy goal, in part, because the concept of resilience has been primarily used as a metaphor to describe a desired condition (Manyena 2006).

There has been some success with efforts to evaluate the resilience of communities, especially those that live under the threat of disaster. Engineers have evaluated resilience with respect to the manner in which communities are prepared to deal with a specific type of threat, for example, seismic risk (Bruneau et al. 2003). Economists have evaluated resilience using models that measure the economic losses of disaster (Rose 2004). Others have taken a broader perspective, and have developed quantitative measures that can evaluate the resilience of a community’s economic, social and technological components (Bruneau and Tierney 2006). Despite these contributions, scholars acknowledge the need for studies that expand contemporary theoretical and empirical understandings of resilience (Manyena 2006).

One important question that can be asked is how these ideas contribute to the notion of administrative resilience. A wide variety of theorists, including Gunderson and Holling (2002), have indicated that systems are resilient to the extent they possess either the organizational stability to resist a system disturbance, for example, through the construction of life-line systems that can survive an earthquake, or the organizational flexibility to absorb a system disturbance, for example, to bounce back after experiencing a system permutation. This study argues that resilient administrative systems possess both characteristics. That is, they demonstrate the

stability needed to maintain the operational effectiveness of the community in which it operates, and the flexibility needed to absorb the shock of the event by rapidly scaling up activities in response to the demands generated by changing operational conditions. The notion of administrative resilience is similar to the concepts of robustness, which Elinor Ostrom defines as a system's capacity to maintain a certain level of performance, even if certain components of the system, or the environment within which the system operates, changes (Ostrom 2005, pp. 258). Like Ostrom's Institutional Advancement and Development Framework, the concept of administrative resilience draws a distinction between a system's structure, which represents the operational environment and the rules that decision makers employ to make decisions, and a system's processes, which represents the methods of communication that decision makers use to make decisions. The key to administrative resilience resides in the interaction between structure and process, which is driven by the exchange of information among the actors in the system, thereby enabling the system to adapt in response to changes in operational conditions.

1.3 THEORETICAL QUESTIONS: EXPLORING THE ELEMENTS AND DYNAMICS OF ADMINISTRATIVE RESILIENCE

If we accept the proposition that administrative systems can adapt and self-organize, various theoretical questions need to be addressed before such systems can actually be designed and implemented. This inquiry into resilient administrative systems begins with a review of five critical theoretical questions. The initial theoretical question asks: what are the characteristics of resilient administrative systems? First, while they may vary in size, resilient administrative systems will share a common system goal or outcome. Some resilient systems would be

extremely small, comprised of only a few individuals or a few groups within a specific organization. Other resilient systems would be extremely large and comprised of a multitude of individuals or organizations. Whether the system is large or small, the decision makers and organizations that operate in a resilient administrative system would be focused on completing a single overarching task, for example, surviving a battlefield engagement with an unpredictable enemy or delivering humanitarian assistance in a complex post-disaster environment.

Second, resilient administrative systems would vary in terms of their heterogeneity, meaning that while the participants in the system may all share similar characteristics, for example, they might all be individuals or organizations, they will possess a diversity of resources, capacities, goals and constraints (Comfort and Haase 2006; Ostrom 2005). Third, resilient administrative systems would also be scalable. In the disaster management context, the participants would come from multiple levels of jurisdiction and multiple funding sources (Comfort 1999). Resilient administrative systems are scalable to the extent that their participants have the capacity to seek assistance from other organizations, whether vertically by level of jurisdiction or horizontally by source of funding, and to identify and acquire the information and resources they need to complete their activities. Fourth, resilient administrative systems would also be dynamic. As Ostrom (2005, p. 14) explained in *Understanding Institutional Diversity*, the operational environment, or the action arena, for a system of participants is comprised of the “social space where participants with diverse preferences would interact, exchange goods and services, solve problems, dominate one another or fight.” This suggests that the structures and processes of resilient administrative systems would evolve, as the participants seek optimal outcomes based upon their individual preferences, capacities and constraints.

Finally, resilient administrative systems would be creative, and the interactions exchanged between the participants in such a system would facilitate the development of new strategies for action. As the participants collect and exchange information, and develop an understanding of their operational environment, they will be able to identify the strategies that will moderate the constraints generated by uncertain and rapidly changing conditions. As newly created strategies may not be positive, the system must possess feedback loops and processes that can help the system to evaluate outcomes, and where necessary, shift away from a negative strategy (Ostrom 2005, p. 14). This dynamic process suggests that resilient administrative systems are actually complex adaptive systems (Axelrod and Cohen 2000; Holland 1995).

Another important characteristic of resilient administrative systems is that they operate as nested sets. In describing the concept of the nested set, Ostrom indicates that complex systems are comprised of individuals and their structures, which are parts of even larger structures (Ostrom 2005). This suggests that resilient administrative systems, which are complex systems, are like a set of Russian *matryoshka* dolls, where a series of increasingly smaller dolls can be situated (or nested) within one another. Citing Arthur Koestler, Ostrom indicates that the participants within a nested set system are connected through interactions such as communication channels, transportation lines, or chains of command (Koestler 1973; Ostrom 2005). While distinctions can be made between the governmental actors that operate at the national, state and local levels of jurisdiction, in the administrative context, these actors are tied together through various legal, financial, operational and social connections. According to Ostrom and Koestler, the challenge for researchers is to figure out how to separate these systems into their component parts so that they can be analyzed as both systems and sub-systems.

The second theoretical question asks: what situations facilitate the emergence of resilience in administrative systems? While almost every administrative system will possess some capacity for resilience, there are three situations where resilient administrative systems emerge. First, they can emerge incrementally, as policy makers adjust the organizational structure and processes of an administrative system in response to newly detected risks and threats. This process is typically reactive in nature, as policy makers seek to “muddle through” complicated and ill-structured policy problems (Lindblom 1959, 1979). An example of an incremental attempt to promote resilience occurred after September 11, 2001, when the United States moved to eliminate gaps in its domestic security apparatus through the creation of the Department of Homeland Security. Considered one of the most significant attempts to reorganize the federal bureaucracy, this administrative adjustment brought twenty-two separate agencies under the control of the Department of Homeland Security. While this Department has been the focus of criticism, the purpose behind this reorganization was to coordinate the design and implementation of a comprehensive strategy to secure the United States against terrorist attacks.

Resilient administrative systems can also emerge in heterogeneous situations with open information exchange. Ostrom discusses the emergence and operation of such forms of administrative systems in her analysis of how communities can manage common-pool resources (Ostrom 1990, 2005). In common-pool resource situations, neither the government nor the free market can help a diverse community of individuals sustain the long-term use of natural resources such as water, timber or fish. To overcome this problem, the individuals that have an interest in a common-pool resource can self-organize to form institutions that can successfully manage the resource in evolving conditions. Although a full discussion of this process is beyond the scope of this chapter, Ostrom has identified eight principles that are critical to the emergence

of resilient institutions: “(1) clearly defined boundaries; (2) proportional equivalence between costs and benefits; (3) collective-choice arrangements; (4) monitoring; (5) graduated sanctions; (6) conflict-resolution mechanisms; (7) minimal recognition of the right to organize; and (8) nested enterprises” (Ostrom 2005, p. 259).

The third situation that facilitates the emergence of resilience in administrative systems occurs when organizations have access to a high degree of technical infrastructure that can be used for information management. If the technical infrastructure is properly designed and implemented, it can be used to support the collection, exchange and interpretation of the information needed for decision making. Resilient administrative systems would be sociotechnical in their design, meaning they use technology to support the information processes that facilitate action (Coakes, Willis, and Clark 2002). One of the most effective ways to utilize technology to facilitate administrative action is to integrate information collection and distribution processes into a unified decision support system that can enable decision makers to develop situational awareness in uncertain and rapidly changing conditions. Without discussing sociotechnical systems directly, Aaron Wildavsky argued that technology can support the development of administrative resilience. According to Wildavsky, resilience “does not mean waiting for the event to strike before trying to respond to it. Rather, it means preparing for the inevitable – the approach of a new, surprising event – by expanding general knowledge and technical facility, and generalized command over resources” (1998, p. 221).

The third theoretical question asks: what would be the rate of change within resilient administrative systems? Theorists indicate that networks can encourage a diverse community of organizations, whether public, private or non-profit, to interact and engage in public policy strategies as a collective entity (Bardach 1998; Goldsmith and Eggers 2004; Radin et al. 1996;

Salamon 2002). Networks are critical to the process of change because they facilitate system learning, adaptation and self-organization (Carley and Hill 2001; Strogatz 2003; Watts 2003). As the organizations in an administrative system utilize their networks to respond to changes in operational conditions, the patterns of interactions exchanged amongst organizations will also change (Kenis and Knoke 2002). The rate of change within resilient administrative systems, however, will differ from system to system. In some systems, for example those that adopt incremental adjustments or manage common pool resources, the rate of change may be extremely gradual, occurring over periods of months, years or even decades. Change within these types of systems can be driven by shifts in the nature of the threat or the quantity of the resource being managed, the measured movement of critical organizations into or out of the system, or the gradual modification of the interactions that are exchanged among critical organizations. Other resilient systems, such as those that manage surprising and system-shocking events, will have the capacity to undergo rapid change, occurring over a period of just hours or days (Comfort 1999). The change that occurs in these systems can be driven by the need to rapidly scale up operations, the need to absorb and incorporate a diversity of organizational actors, and the need to rapidly adjust interactions in response to constantly changing operational conditions.

The fourth theoretical question asks: what are the conditions that influence the capacity of resilient administrative system to adapt and self-organize? There are three general ways to improve administrative resilience. Administrative resilience can be influenced through the promotion of organizational learning. Researchers indicate that organizations can learn to modify their internal and external behavior (Argyris and Schon 1978, 1996). Like individuals, networks of organizations can be encouraged to engage in behavior that facilitates self-organization (Comfort 1999). The process of organizational learning is not automatic, and the degree to which

it occurs depends upon factors such as the operational environment (Fiol and Lyles 1985), the structure of the organization (Morgan 2006), how information is interpreted (Daft and Lengel 1986; Huber 1991), organizational memory (Prahalad and Hamel 1994), the use of appropriate technologies (Brown and Duguid 1991; Dodgson 1993), and the acquisition and dissemination of information (Dodgson 1993). While not all seven factors need be present for organizations to learn, as the number of factors increase, so too does the chance that organizations, and the systems in which they operate, can adjust to their operational environment.

Second, the availability of information can also influence the capacity of resilient administrative systems. Officials in contemporary administrative systems often struggle to make effective decisions in crisis situations (Rosenthal, Boin, and Comfort 2001). The consequences generated by ineffective decisions can not only undermine the capacity of individual organizations, they can also undermine the capacity of an entire administrative system (Comfort 1999). This problem can be managed through technology, which can be used to overcome the challenges of information collection, analysis and dissemination, and enable a heterogeneous collection of organizations to act as a collective entity (Comfort 2005; Quarantelli 1997).

Two veins of literature explore how information technology can improve the capacity of an administrative system to operate in uncertain and rapidly changing conditions. The first vein explores the types of technology available to officials, for example, sensor technologies for event detection and information collection, database and server technologies that can track organizational resources and personnel, and communication technologies such as cellular phones, satellite phones, email and software-defined radios (Meissner et al. 2002; National Research Council 2007). The second vein considers how the integration of technology improves decision making, for example, by folding the technologies into a unified decision-support system

that bridges the gap between the decision making officials and their operational environment (Wallace and Balogh 1985). Through the effective use of technology, officials would not only improve their situational awareness, they would also improve their ability to make effective decisions (Comfort 2005; Pourvakhshouri and Mansor 2003).

Finally, technology alone will not resolve the administrative problems created by uncertainty. Rather, administrative systems must employ technology to transform information into the knowledge that organizations need to facilitate action (Coakes, Willis, and Clark 2002). The solution to the problem of information deficiency is the sociotechnical approach, which examines “the relationships and interrelationships between the social and technical parts of any system” and how these relationships can enhance organizational knowledge and effectiveness (Coakes, Willis, and Clark 2002, p. 5). The sociotechnical model requires that administrative systems be designed to balance five elements: its personnel; its structure; its technology; its task; and the environment in which it operates (Coakes, Willis, and Clark 2002).

The design for an effective sociotechnical system has remained relatively unchanged since first outlined by Albert Cherno in 1976. The system’s design must be compatible with the organizational goals, meet some minimal criteria to ensure that it obtains its goals, control variance, perform multiple functions, and ensure that organizational boundaries promote information flows (Cherno 1976, 1987). Equally important, the organization must reward those who demonstrate and support congruence and learning behavior (Cherno 1976, 1987). Although much more distributed, power and authority continue to play an important role because those with expertise must be able to command the resources and information they need to complete the tasks to which they are assigned (Cherno 1987). Applying such a design to administrative systems, which must maintain high levels of interoperability between their technical and social

components, would help to ensure that information flows and feedback loops exist among the range of critical organizational actors (Comfort 2005; Comfort et al. 2001). By blending their technical systems and their social systems, organizations, and indeed an entire administrative system, can generate the knowledge needed to manage uncertain and rapidly changing conditions (Garvin 1993, 1998).

The preceding argument suggests that there are various approaches that policy makers can use to improve the resilience of administrative systems. Yet the inquiry into resilient administrative systems should not stop here. Another important challenge for those who seek to study, design and implement resilient administrative systems is to figure out how to identify the means to capture the dynamics between the emergence and dissolution of such systems. In other words, as a system evolves through periods of continuity and change, is it possible to identify the point where an administrative system tips into dysfunction and the point where it begins to reconfigure its structures and processes to maintain a continuity of operations?

1.4 SIGNIFICANCE OF STUDY: CONTRIBUTING TO THE UNDERSTANDING OF ADMINISTRATIVE RESILIENCE

The present study provides four contributions to the fields of public administration and disaster management. First, this study supports the conclusion that socio-technical infrastructure, properly designed and implemented, contribute to an administrative system's capacity to adapt to the spectrum of uncertainties generated by disruptive events. Second, this study bridges gaps that exist in the public administration and disaster management literatures by expanding upon the theoretical and empirical understandings of administrative resilience. Third, this study provides a

workable definition of administrative resilience. Fourth, this study validates a framework for administrative resilience, which can be used to evaluate the resilience of administrative systems in practice. This framework is designed to provide policy makers with a tool that they can use to identify strengths and weaknesses in their administrative systems and to evaluate the extent to which their systems possess the capacity to adapt and self-organize in uncertain and rapidly changing conditions. The framework is also scalable, meaning it can be used to evaluate administrative systems of a variety of sizes, including teams, organizations and communities.

1.5 ORGANIZATION OF THE STUDY

The first part of this study consists of four chapters, which appraise the theoretical underpinnings of resilient administrative systems and provide insights into the methods that can be used to investigate such systems. The present chapter reviews the impetus behind this research, which is needed to improve our theoretical and empirical understandings of administrative systems that function in rapidly evolving conditions. Chapter two reveals the dynamics that underlie resilient systems through a review of the resilience and decision making literatures, and also introduces the framework of administrative resilience. Chapter three identifies the study's primary research questions, as well as the methodological components used to address each question. Chapter four reviews the administrative system analyzed by this study, which was selected to investigate the adaptive capacity of an administrative system that operated in actual conditions.

The second part of this study consists of five chapters, which present the findings related to the administrative system under analysis. Chapter five presents the findings related to the

organizational composition, rate of growth, and activities identified in the administrative system. Chapter six presents the findings related to the structural evolution of the administrative system, using network analysis to identify and evaluate the structural changes that occurred in the administrative system. Chapter seven reports the opportunities and constraints present within the administrative system. Using the framework of administrative resilience, chapter eight presents findings that report the extent to which the system under study possessed the capacity to adapt and self-organize in uncertain conditions. Chapter nine reviews the study's primary findings, outlines a series of recommendations for improving administrative resilience, and presents an agenda for the continued examination of resilient administrative systems.

2.0 THE FOUNDATIONS OF ADMINISTRATIVE RESILIENCE

While contemporary administrative systems have the capacity to manage small, localized events, these systems can become constrained by the uncertainties generated by large, disruptive events. The previous chapter indicated that the capacity of administrative systems that are constrained by conditions of uncertainty could be improved by developing the decision making capacity of the individuals and organizations that operate within such systems. This chapter explores this contention in two ways. First, it identifies how uncertain conditions constrain administrative action. Second, it identifies how contributions from the resilience and decision making literatures may assist policy makers to develop administrative systems that can adapt and self-organize.

2.1 UNCERTAINTY AND RAPIDLY CHANGING CONDITIONS AS CONSTRAINTS FOR ADMINISTRATIVE ACTION

The events that transpired after Hurricane Katrina indicate that uncertain and rapidly changing conditions not only degrade the capacity of an administrative system, which can lead to a cascade of failures, they also undermine the capacity of the system to function as a cohesive entity. While administrative constraints can be created by a wide variety of conditions, those that occurred after Hurricane Katarina were generated by: 1) the disruption of critical infrastructure; 2) community heterogeneity; 3) information and resource asymmetries; and 4) the dynamic and

non-linear nature of the operational environment. These constraints create problems for both the individuals and organizations that participate in conventional administrative systems by reducing their situational awareness, undermining their decision making capacities and inhibiting their ability to take timely and targeted action.

First, disruptive events create problems by destroying the critical infrastructure that communities need to support their day-to-day operations (International Strategy for Disaster Reduction 2005). Critical infrastructure include life-line systems such as transportation systems, electrical systems, communication systems, water and sanitation systems, and public works systems (Tierney 1997; Webb, Tierney, and Dahlhamer 2000). A community affected by a disruptive event is unable to initiate the processes of response or recovery until its life-line systems are reestablished or external support is received. Likewise, the administrative systems that operate in an affected community will be constrained by the destruction of infrastructures that they need to conduct operations. The disruption of communication infrastructures, for example, can inhibit decision makers from collecting and disseminating the information they needed to facilitate effective action after a disruptive event.

Disruptive events also expose the heterogeneity that exists within a community (Katrina 2006). Most communities are comprised of a diverse collection of individuals, who differ in terms of their age, sex, race, level of education and socio-economic status. The segments that exist within these communities will undoubtedly have different capacities and different needs. After a disruptive event, decision makers who operate in conventional administrative systems often struggle to identify the capacities and needs of the affected communities. Administrative systems can be strengthened by providing decision makers with the tools they need to identify the capacities and needs of those living and working within a community. Additional steps can

be taken to ensure that these tools provide decision makers with the ability to match specific capacities with specific needs. The problems caused by heterogeneity, however, are not limited to those affected by disruptive events. For instance, heterogeneity can exist with respect to response organizations, which will represent different levels of jurisdiction and different community interests. These organizations must be successfully integrated, because they will form the administrative system that will identify and implement the response strategies, even though their missions and goals will often overlap or come in conflict with each other.

Disruptive events also reveal the disconnections and discontinuities that exist among response organizations (Comfort 2007). Some response organizations possess information about the needs of certain segments of a community, but not the resources to meet those needs. Other organizations possess substantial resources, but not the information they need to deliver those resources effectively. Such information asymmetries are particularly problematic, and are caused by factors such as information overload, which occurs when organizations are bombarded with so much information that their managers are unable to identify a course of action. In other instances, information asymmetries are caused by information shortages due to inadequacies in information collection, information storage, and information dissemination. Disconnections and discontinuities are also caused by the lack of organizational interaction, which inhibits the distribution of information throughout an administrative system. Similar challenges exist with the distribution of resources. For example, the capacity of response organizations to deliver resources varies, with some organizations capable of conducting activities without assistance.

Finally, the dynamic and non-linear nature of disruptive events may prevent organizations from identifying and responding adequately to an ever-shifting spectrum of opportunities and constraints (Comfort 1999; Mileti 1999; Ostrom 2005). Employing traditional

methods of decision making, many organizations do not act until they have the information that allows them to make the “best” possible decision. In an uncertain and rapidly changing operational environment, traditional organizations may freeze, doing nothing when action is most needed (Banks 2006/2007). Other organizations may acquire the information they need to by interacting with organizations that are operating effectively within the operational environment. Depending on the nature of the disruption, the variety of organizational needs, and the capacity of the organizations in the administrative system, it can be difficult, if not impossible, for decision makers to anticipate the sequence, frequency and purpose of inter-organizational interactions in the operational environment. In such situations, decision makers are simply unable to predict whether their actions will lead to their desired outcomes.

2.2 THE RESILIENT ADMINISTRATIVE SYSTEM

The concept of resilience has developed traction in the public policy arena as a solution to the problems generated by disruptive events (International Strategy for Disaster Reduction 2005). Initially applied to the management of uncertainty, Aaron Wildavsky defined resilience as “the capacity to cope with unanticipated dangers after they have become manifest, learning to bounce back” (Wildavsky 1988, p. 77). Alternative definitions construe resilience as “the capacity to adapt existing resources and skills to new situations and operating conditions [that] appear directly related to the degree of access to, and exchange of, information in systems seeking change” (Comfort 1999, p. 21). Although the focus of significant discussion, especially in the fields of ecology, engineering and economics, scholars and practitioners have yet to formulate a consensus as to what resilience actually means (Gunderson et al. 2002).

Conceptualizations of resilience generally fall within one of three broad themes. The first theme is structural resilience, where systems are resilient to the extent that they can maintain a constant state of operations during a system-shocking event (Bruneau et al. 2003; Bruneau and Tierney 2006). Systems that are structurally resilient have the capacity to resist a disturbance, and their resilience can be improved through the fortification and strengthening of critical infrastructure. The second theme is social resilience, where systems are resilient to the extent they can absorb a system-shocking event without losing their core operational capacity (Bruneau and Tierney 2006; Wildavsky 1988). Systems that are socially resilient have the capacity to “bounce back” from a disturbance. The resilience of these systems can be improved by promoting flexibility through social and technological development. The third theme is cognitive resilience, where systems are resilient to the extent that the decision makers that operate in the system have sufficient information to adapt and self-organize to the constraints and opportunities found in the post-disaster environment (Comfort 1999). Systems that are cognitively resilient have the capacity to manage a disturbance through adaptation and self-organization. The resilience of these systems can be improved by promoting their ability to learn.

While this research is primarily framed under the theme of cognitive resilience, all three themes are applicable to systems of public administration. When a disruptive event occurs, a resilient administrative system must demonstrate the stability needed to maintain the effectiveness of the social, political and economic systems of the community in which it operates, and the flexibility needed to absorb the shock of the event, rapidly scale up response activities, and adapt to the opportunities and constraints encountered in the disaster environment. The development and implementation of an administrative system with such a capacity would represent a quantum leap in humankind’s ability to manage the disruptions caused by events such

as natural disasters, the spread of infectious diseases, and terrorist attacks. While the construct of administrative resilience is relatively simple to comprehend, the manner in which resilience is actually facilitated, measured or maintained is not fully understood (Manyena 2006).

Promoting the implementation of resilient administrative systems will require a fundamental reorganization of the manner in which societies are structured and governed (Kettl 2002). While not ignoring the value of administrative hierarchy, scholars have long suggested that complex public policy problems are best resolved through collaborative multi-organizational arrangements (Radin et al. 1996). By taking advantage of governance models based upon decentralized networks, resilient administrative systems would engage the full spectrum of organizations in a community, whether public, private or non-profit in character, and encourage them to use their resources and expertise simultaneously to respond to public policy problems as a collective entity (Bardach 1998; Goldsmith and Eggers 2004; Salamon 2002).

While decentralization may improve an administrative system's capacity to operate in uncertain and rapidly changing conditions, the system nevertheless needs a certain degree of hierarchy to preserve transparency and accountability (Goldsmith and Eggers 2004). Striking a balance between flexibility and stability not only improves an administrative system's access to expertise, resources and information, it also improves the system's capacity to scale up operations quickly and adjust to meet the demands of the operational environment. In this sense, the processes that guide the operation of resilient administrative systems are similar to the processes that guide the operation of complex adaptive systems. Complex adaptive systems are unique in that they possess both the structural stability and structural flexibility needed to manage disruptive stimuli. Actors that participate in a complex adaptive system make decisions by exploiting preexisting rules and building blocks, while at the same time, exploring new and

unique opportunities (Gell-Mann 1994; Kaufmann 1993). Complex adaptive systems manage disruptive stimuli because they strike a balance between order and disorder. If the system is too ordered, the interactions between actors are rigid and there is little if any opportunity to initiate change (Kaufmann 1993). If the system is too disordered, the interactions between actors are too chaotic and they have little if any opportunity to contemplate change (Kaufmann 1993). When order and disorder are appropriately balanced, a complex adaptive system will operate along the “edge of chaos,” which is the point at which the actors in a system can successfully exchange information and identify an effective course of action in response to disruptive stimuli (Axelrod and Cohen 2000; Comfort 1999; Kaufmann 1993). The closer a system is to the “edge of chaos,” the more it is capable of self-organization and adaptation (Kaufmann 1993). The challenge is to identify the conditions than push administrative systems towards the “edge of chaos.”

2.3 EFFECTIVE ADMINISTRATIVE DECISION MAKING IN UNCERTAIN AND RAPIDLY CHANGING CONDITIONS

To operate along the “edge of chaos,” policy makers who participate in resilient administrative systems will need to possess the capacity to make effective decisions in uncertain conditions (Rosenthal, Boin, and Comfort 2001). Developing such capacity will be difficult, given that operational environments constrained by uncertainty are in a constant state of flux and present decision makers with an unlimited and unpredictable stream of obstacles and opportunities. The solution is not to require that policy makers make the very best decisions during an administrative crisis. Such a threshold would be impossible to meet. Rather, policy makers must be encouraged to make good decisions, which help to promote effective administrative action.

To make good decisions, decision makers need to have the capacity to adjust, where necessary, the processes behind their decision making behavior. Such a capacity can be difficult to establish in conventional administrative systems, which require managers to follow strict protocols, even in emergency situations. If the goal is to move away from protocols that constrain decision making, an important question is whether it is possible to identify the decision making conditions that influence the capacity of administrative systems to adapt? This question can be explored through a review of traditional and non-traditional models of decision making.

2.3.1 The Traditional Model of Decision Making

In his seminal work, *Administrative Behavior, A Study of Decision Making Processes in Administrative Organizations*, Herbert Simon outlined the processes of rational decision making within administrative organizations (Simon 1997). According to Simon, decisions are rational “if in fact it is the correct behavior for maximizing given values in a given situation” (Simon 1997, p. 85). This implies that the “subject molds all his behavior into an integrated pattern by (a) viewing the behavior alternatives prior to the decision in a panoramic fashion, (b) considering the whole complex of consequences that would follow on each choice, and (c) with the system of values as criterion, singling out one from the whole set of alternatives” (Simon 1997, p. 93).

The emphasis on rational decision making has not been without criticism. Even Simon pointed out that, because of its dependence on complete knowledge, the requirements of rational decision making are almost impossible to fulfill. In making this argument, Simon detailed the specific limitations of rational decision making processes. First, “[r]ationality requires complete knowledge and anticipation of the consequences that will follow on each choice. In fact,

knowledge of consequences is always fragmentary” (Simon 1997, p.93). Second, “[s]ince these consequences lie in the future, imagination must supply the lack of experienced feeling in attaching value to them. But values can only be imperfectly anticipated” (Simon 1997, p.93). Finally, “[r]ationality requires a choice among all possible alternative behaviors. In actual behavior, only a few of all these possible alternatives ever come to mind” (Simon 1997, p. 94).

Simon also argued that the rational decision making process was impossible to complete due to the limited cognitive capacity of human beings, who can only manage a handful of items at any time. Rather than seeking to maximize the value of any given decision, decision makers follow the principles of bounded rationality and satisfice, using the information that is currently available to them to make decisions that are “good enough” for the circumstances (Simon 1997, p. 119). In the context of public policy, this process is known as disjointed incrementalism, where policy decisions are made in stages, and each decision is based only on the information that is available to policy makers at the time the decision is made (Lindblom 1959, 1979).

2.3.2 Non-Traditional Models of Decision Making

Ever since Herbert Simon began to challenge decision making models based upon rationality, researchers have sought to understand how humans actually go about making decisions in uncertain conditions. Recent research on decision making can be organized into three general categories. The first category considers decision making at the individual level. In *Sources of Power: How People Make Decisions*, Gary Klein explores the processes of naturalistic decision making, which enable humans, who are limited in time, knowledge and capacity, to make effective decisions under uncertain conditions (Klein 1999). According to Klein, “the features

that help define a naturalistic decision making setting are time pressure, high stakes, experienced decision makers, inadequate information (information that is missing, ambiguous, or erroneous), ill-defined goals, poorly defined procedures, cue learning, context (e.g., higher-level goals, stress), dynamic conditions, and team coordination” (Klein 1999). These are the very conditions that make administrative decision making in uncertain environments difficult.

To explain how effective decisions are made in dynamic and uncertain environments, Klein developed the recognition-primed decision model. Unlike the rational based model of decision making, Klein’s model suggests that decision makers do not spend time looking for the “best option” when confronted by a problem, but rather, they search for and select the first “workable option” through a dynamic and nonlinear process (Klein 1999, p. 30). Initially, an experienced decision maker is confronted with a problem. The decision maker then determines whether that problem is “typical,” meaning that it can be related through “analogy or prototype” to a previous experience (Klein 1999, p. 24). If not, the decision maker attempts to organize the incoming information into a workable framework. Once the framework is established, the decision maker understands “what types of goals make sense (so the priorities are set), which cues are important (so there is not an overload of information), what to expect next (so they can prepare themselves and notice surprises), and the typical ways of responding in a given situation” (Klein 1999, p. 24). By selecting a course of action in this manner, the decision maker quickly evaluates, through “mental simulation,” whether the action is appropriate given the circumstances (Klein 1999, p. 27). If the decision maker decides that the action is inappropriate, she quickly modifies and reevaluates the course of action. Once an appropriate course of action is identified, it can be quickly implemented. This process of decision making not only allows for

the rapid selection of strategies in an uncertain environment, but more importantly, it enables decision makers to adapt and adjust their strategies when necessary.

The second category considers decision making at the group level. In *Cognition in the Wild*, Edwin Hutchins introduces the framework of distributive cognition, which explains how individuals form cognitive groups to resolve problems as a collective entity (Hutchins 1995). Hutchins argues that groups can develop into cognitive systems that have the capacity to resolve complex problems by separating the problem into component tasks, which can then be resolved through the coordination of knowledge and action. Such collaboration enables groups to resolve problems that individual decision makers could not (Hutchins 1995, p. 175).

Groups that engage in distributive cognition can be organized socially to form a computational architecture, which is separated into computational organization and social organization (Hutchins 1995, pp. 185-186). The computational organization of a group is “defined by the computational dependencies among the various parts of the computation” (Hutchins 1995, pp. 185-186). These dependencies are shaped by the requirements of the problem, or more precisely, the calculations or resources needed to resolve the problem.

A group’s social organization “structures the interactions among the participants to the computation [problem]” in different ways (Hutchins 1995, p. 186). First, when confronting a complicated problem, the tasks that are performed by the members of the group will occur in parallel. The overlapping of some of these tasks enables the creation of a “complex functional system” (Hutchins 1995, p. 189). Second, the processes of information flow in groups utilizing distributive cognition will be both “top-down” and “bottom-up” (Hutchins 1995, p. 190). Top-down processes can represent information requests or feedback reports. Bottom-up processes can represent the information that is requested by the decision maker. The simultaneous operation of

both processes ensures that all of the actors in the system have the information they need to make decisions that are both necessary and appropriate. Third, the group members themselves will also have different responsibilities. Some members will be “daemons,” who observe the operational environment for “specified conditions” which requires a “specified action” (Hutchins 1995, p. 191). Other group members will be “buffers,” who introduce slack into the cognitive process by filtering information that flows through the system (Hutchins 1995, p. 194). Buffers play a critical role because they prevent system failure by ensuring that critical information reaches the daemons at the appropriate time, and that the activities of the daemons do not come in conflict with each other in performing ongoing or yet-to-be initiated tasks (Hutchins 1995, p. 198).

Fourth, the sequence in which the tasks taken by the group to resolve the problem is also important. Some procedures will be “sequentially unconstrained,” meaning that the task can occur at anytime because it will not conflict with other ongoing or yet-to-be initiated tasks (Hutchins 1995, p. 198). Such tasks can be accomplished through a “swarm of ants” strategy where the group members, acting in isolation, will take action in the appropriate circumstances. Other procedures must be “sequentially constrained,” which means that the task can only occur at a certain time or else it will conflict with other ongoing or yet-to-be initiated tasks (Hutchins 1995, p. 198). To avoid such errors, the sequencing of tasks can be regulated through the implementation of rules within the group.

Fifth, there must be a “fit” between the “computational dependencies and the social organization” of the group (Hutchins 1995, p. 203). This means that a group’s organization determines the extent to which the group can obtain its goal. Hutchins elaborates this point by indicating that “[w]hen a problem has a deeply nested goal structure, a social hierarchy can provide a mechanism for distributing the attention to various parts of the goal structure”

(Hutchins 1995, p. 203). Ensuring that the group obtains its goal requires the management of the social relationships within that group. Finally, also helping to tie together the computational organization and the social organization are the tools that are used by the members of the group. Tools, which themselves can be the result of cognitive processes distributed across time, are a critical element because they transform the tasks that have to be completed by decision makers. According to Hutchins, “tools permit the people using them to do the tasks that need to be done while doing the kinds of things [that] people are good at: recognizing patterns, modeling simple dynamics of the world, and manipulating objects’ in the environment” (Hutchins 1995, p. 155).

Groups that engage in distributive cognition have the capacity to structure information so that the members of the group understand, and respond to, anticipated as well as unanticipated problems. This is because the processes and interactions that are exchanged among the group members and their set of tools enable the development of a common knowledge base that contains information about the system’s status. This knowledge base is “inter-subjectively shared among the members of the” group and forms the basis for a learning system (Hutchins 1995, p. 219). When a problem is encountered by the group, or part of the group fails due to the lack of information or communication disruptions, the group members can collaborate to adjust their processes and organizational structures to ensure that their goals will still be met.

The third category includes scholars that suggest that large groups of independent actors can come together to create a *complex adaptive system* (Axelrod and Cohen 2000; Gell-Mann 1994; Holland 1995). Complex adaptive systems are non-linear *systems* of *agents*. These agents possess *detectors*, which enable them to receive information *inputs* from the environment in which they operate. When these actors attempt to make a decision, they analyze information according to *internal models* of rules, which inform them about the type of action they should

take in a given circumstance. These rules are based upon *building blocks*, which enable the agents to simplify their complex environment. To understand observed phenomena, the agents apply preexisting building blocks, modify a building block, or generate a new building block (Gell-Mann 1994). After an agent makes a decision, they use *emitters* to *output* a signal back to the environment. The agents in the system can detect this information and the processes of analysis and reaction will begin anew. If the actors detect and adopt a successful building block, its transmission throughout the system can create a powerful opportunity for change (Gell-Mann 1994; Holland 1995). The continuous interaction between agents creates a system optimized to operate within complex environments, in large part, because the actors can rapidly adjust strategies, ensuring not just their own survival, but also the survival of the entire system.

2.3.3 Harnessing the Complexity of Uncertain Environments

What can policy makers do to ensure that the administrative system in which they operate can automatically adapt in response to uncertain conditions? As suggested by Robert Axelrod and Michael Cohen, policy makers can harness the complexity generated by these conditions by:

“deliberately changing the structure of a system in order to increase some measure of performance, and to do so by exploiting an understanding that the system itself is complex. ... [T]he idea is to use our knowledge of complexity to do better. To harness complexity means living with it, and even taking advantage of it, rather than trying to ignore it or eliminate it” (Axelrod and Cohen 2000, p. 9).

According to Axelrod and Cohen (2000), there are a variety of strategies that policy makers can follow to harness the complexity found in such systems. For example, policy makers can modify the *variation*, *interactions* and *selection processes* that exist within a system. To do so, policy makers can encourage the organizations within a system to embrace variety by allowing them to

exploit opportunity and rewarding them when they identify novel solutions (Axelrod and Cohen 2000). Second, policy makers can modify interaction patterns by making adjustments within organizations or by making adjustments to the environment in which organizations operate. Interactions are important because they connect the organizations and resources and help to develop the “networks of reciprocal interaction that foster trust and cooperation” (Axelrod and Cohen 2000, p. 156). Finally, policy makers can ensure that organizations identify and select successful strategies by providing them with a clear understanding of what constitutes success and rewarding them when they cast aside ineffective strategies (Axelrod and Cohen 2000). By adjusting these factors, policy makers can help organizations embrace of complexity and encourage the development of resilient administrative systems.

2.4 THE FRAMEWORK OF ADMINISTRATIVE RESILIENCE

Resilient administrative systems are heterogeneous in their composition, emerge in a variety of situations, and experience structural evolution in response to disruptive stimuli. The successful operation of a resilient administrative system depends upon seven specific conditions, each of which promotes effective decision making in situations that traditionally undermine administrative action. These conditions reflect the fact that decision makers must: 1) understand their operational environment; 2) interact with the environment, as well as the individuals and organizations in that environment; 3) have access to information; 4) be able to compare patterns of action; 5) have the ability to make rapid decisions; 6) have the authority to adjust their strategies; and 7) employ technology to support decision making processes. Facilitating these conditions in an administrative context provides decision makers, and the organizations in which

they operate, with the structure and flexibility they need to manage conditions that may undermine the capacity of contemporary administrative systems. More importantly, by strengthening the presence of these conditions, policy makers could guide the activities within the system towards the “edge of chaos,” enabling the system to adapt and self-organize.

How then might policy makers develop insights into the design and operation of resilient administrative systems? Elinor Ostrom indicates that social scientists use the terms, ‘frameworks, theories, and models’ interchangeably, generating substantial confusion as to their meanings and applications (Ostrom 2005, p. 27). Moving from the general to the precise, Ostrom argues that frameworks, theories and models represent a nested set of concepts. Frameworks represent the most general level of analysis, and “identify the elements (and the relationships among these elements) ... that organize diagnostic and prescriptive inquiry” (Ostrom 2005, p. 28). By way of further explanation, Ostrom indicates that frameworks:

“provide the most general set of variables that should be used to analyze all types of settings relevant for a framework. Frameworks provide a metaphoric language that is necessary to talk about theories and that can be used to compare theories. They attempt to identify the universal elements that any relevant theory would need to include. Many differences in surface reality can result from the way these variables interact with one another. Thus, the elements contained in a framework help the analyst generate the questions that need to be addressed when first conducting an analysis” (Ostrom 2005, p. 28).

At a more specific level of analysis are theories, which “enable the analyst to specify which components of the framework are relevant for certain kinds of questions and to make broad working assumptions about those elements” (Ostrom 2005, p. 28). Finally, at the most precise level of analysis are models, which can be used to “make precise assumptions about a limited set of parameters and variables” (Ostrom 2005, p. 28).

This study develops a framework that can be used to investigate resilient administrative systems. As its name implies, the framework of administrative resilience is a conceptual device to identify the elements and the relationships among the structures and processes that facilitate adaptation and self-organization in administrative systems. The purpose of the framework is not to test casual hypothesis among a series of variables, but rather, to generate a series of questions that can guide the initial series of investigations into administrative resilience.

Scholars have already begun to develop frameworks to investigate the resilience of administrative systems. For example, in *Shared Risk: Complex Systems in Seismic Response*, Louise Comfort (1999) investigated the administrative response systems that emerged following eleven earthquakes in nine countries. Her findings indicate that there are four components that encourage adaptation and self-organization in administrative systems responsible for managing disruptions caused by natural disasters (Comfort 1999). Three of the components represented the system's technical structure, organizational flexibility, and cultural openness. These components contained a range of indicators, which received a rank of low, medium or high when identified within the system under analysis. A fourth component was also identified, information search and exchange, which represented the extent to which the organizations acquired and used information to coordinate collective action. The components were unified by a discussion of the initial conditions present in these systems prior to the earthquakes.

Using data derived from documentary reports, a content analysis of news reports, and interviews with emergency response managers, Comfort (1999) classified the administrative response systems as non-adaptive, emergent adaptive, operative adaptive or auto-adaptive. At one end of the continuum are non-adaptive systems, which possess low levels of technical structure, organizational flexibility and cultural openness. Emergent adaptive systems possess

low levels of technical structure, medium levels of organizational flexibility and an emerging openness to new conceptualizations of risk (Comfort 1999). Operational adaptive systems possess medium levels of technical structure, organizational flexibility, and openness to new conceptualizations of risk (Comfort 1999). While the operational adaptive system may demonstrate the capacity to adapt in limited circumstances, these three systems are primarily characterized by their reactive nature. At the other end of the continuum are auto-adaptive systems, which possess high technical structure, organizational flexibility and cultural openness (Comfort 1999). Auto-adaptive systems are by nature proactive, and can exhibit high levels of adaption in uncertain and rapidly changing operational environments. The higher a system ranked along this continuum, the better able it is to “adapt to sudden change, reallocate its resources and energies in response to a major threat ... without losing its basic capacity for performance” (Comfort 1999, p. 231).

Table 1: Theoretical Underpinnings of the Framework of Administrative Resilience

Decision Making Conditions	Framework of Administrative Resilience
Environment	Environmental Component
Information	Information Component
Rapidity	Organizational Component
Adjustment	
Pattern Identification	Cultural Component
Technology	Technological Component
Interaction	Interaction Component

As an extension of the research conducted in *Shared Risk*, the framework of administrative resilience accommodates recent theoretical and methodological developments in two distinct ways. Regarding the first modification, where the framework employed in *Shared Risk* emphasizes technical structure, organizational flexibility, cultural openness and information exchange, the framework for administrative resilience modifies the definitions of these components and, as indicated in Table 1, introduces the environmental and interaction components. The six components that underlie the framework for administrative resilience represent the factors that promote adaptation in systems that operate in uncertain conditions.

Further, the components used to develop the framework of administrative resilience were organized into two categories; those that reflect system structure and those that reflect system process. The environmental, technological and interaction components fell into the category of system structure. The environmental component represents the set of initial conditions in which an administrative system must operate, and evaluates the social and regulatory conditions that are present in a system prior to a disrupting event. The technological component represents the technology at use within the administrative system, and considers the extent to which organizations in the system integrate the technology to create an effective decision-support system. As its name implies, the interaction component represents organizational interaction, and considers the extent to which their interactions enable the distribution of information, resources and personnel throughout the system. In contrast, the information, organization and cultural components fell into the category of system process. The information component represents the availability of information in the administrative system, and considers whether the organizations that operate in a system use that information to facilitate action. The organizational component represents rapidity and adjustment, and considers the extent to which organizations have the

operational plans, personnel, training and resources needed to engage in adaptive and collaborative activities. The cultural component represents organizational memory and values, and considers the extent to which organizations understand the risks they confront and have the ability to identify and resolve problems through the use of previous experience.

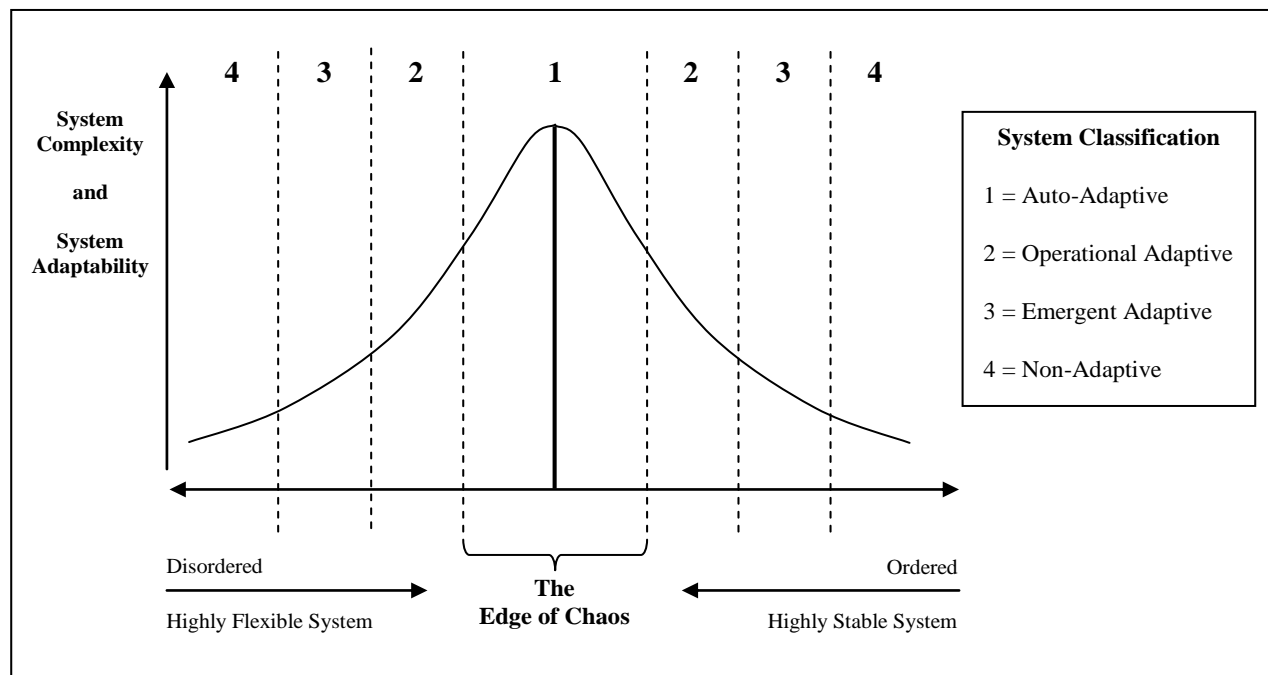


Figure 1: Graphical Representation of the Framework of Administrative Resilience¹

The second modification reflected the distinctions between order and disorder as discussed by the complex adaptive systems literature. The framework used in *Shared Risk* to classify systems did not distinguish between order and disorder. As

¹ Type of system categories adapted from Comfort, Louise K. 1999. *Shared risk: Complex systems in seismic response*. New York: Pergamon.

Figure 1 indicates, the modified continuum will provide a richer description of the structure of the administrative system under analysis. These modifications enable the framework of administrative resilience to be used to classify the adaptive capacity of an administrative system, regardless of its purpose or function, and to determine the extent to which it approaches the theoretical “edge of chaos,” the point at which system adaptation is at its highest. Equally important, the framework of administrative resilience can also be used to provide policy makers with recommendations about how to improve the adaptive capacity of an administrative system, which if implemented, might push the system closer to the “edge of chaos.” For instance, if an evaluation indicates that an administrative system is low on technical structure, and is clearly situated within the emergent adaptive category, investments in technology might improve the capacity of the system so that it becomes an operational adaptive system. The subsequent chapter introduces the specific research methods that can be used investigate the resilience of administrative systems.

3.0 RESEARCH METHODS FOR THE INVESTIGATION OF ADMINISTRATIVE RESILIENCE

What methods are appropriate for the investigation resilience within an administrative system such as the one that operated in Indonesia after the Great Sumatran Earthquake and Tsunami of 26 December 2004? Within the framework of a nested case study, I developed a mixed-methods design that employed content analysis, descriptive statistics, network analysis, as well as semi-structured interview and survey data to investigate the resilience of this administrative system, as well as its constituent domestic and international administrative sub-systems.

3.1 RESEARCH QUESTIONS

To meet the objectives of this study, I needed to identify an administrative system that had been placed under significant stress and had demonstrated the capacity to adapt after a disruptive event. Based upon these criteria, I elected to examine the administrative system that operated in Indonesia after the Great Sumatran Earthquake and Tsunami of 26 December 2004. The following research questions guided this field study:

- 1. To what extent did the organizations that conducted operations in Indonesia after the Great Sumatran Earthquake and Tsunami of 26 December 2004 facilitate the development of an administrative response system?**
 - What was size and organizational composition of the administrative system?

- What was the rate of entry for organizations in the administrative system?
 - What was the rate of growth of the administrative system?
 - What were the activities performed within the administrative system?
- 2. To what extent did the interactions exchanged among response organizations after the Great Sumatran Earthquake and Tsunami of 26 December 2004 drive the structural evolution of the administrative response system?**
- To what extent did the density of the administrative system evolve?
 - To what extent did the diameter of the administrative system evolve?
 - To what extent did the number of components in the administrative system evolve?
 - To what extent do Hamming distance statistics indicate the existence of structural evolution within the administrative system?
 - To what extent did organizations in the administrative system shift the target of their interactions from one class of organization to another?
- 3. To what extent did constraints and opportunities influence the administrative system that responded to the Great Sumatran Earthquake and Tsunami of 26 December 2004?**
- What were the primary operational constraints in the post-tsunami environment?
 - What were the primary operational opportunities in the post-tsunami environment?
- 4. To what extent did the administrative response system possess the capacity for resilience after the Great Sumatran Earthquake and Tsunami of 26 December 2004?**
- To what extent did the administrative system possess the principal components outlined in the framework of administrative resilience?
 - To what extent can the administrative system be classified as resilient, meaning it possessed the capacity to adapt in response to conditions of uncertainty?

3.2 THE NESTED CASE STUDY AND MIXED METHODS DESIGN

By combining research methods into a single design, researchers can improve their ability to understand the phenomena they elect to analyze (Creswell and Plano Clark 2007). Indeed, researchers agree that the best social science research will “often combine features” of both qualitative and quantitative methods (King, Keohane, and Verba 1994; Yin 2003). Building upon this holistic perspective of research, I employed a nested case study that utilized a mixed methods design to collect empirical evidence related to the system selected for analysis.

3.2.1 The Nested Case Study

Elinor Ostrom has argued that institutions that operate in dynamic conditions need to be analyzed as a nested set (Ostrom 1990, 2005). In *Understanding Institutional Diversity*, Ostrom revealed that there is a need to “develop the appropriate theoretical language for analyzing [multilevel complex systems]” (Ostrom 2005, p. 13). She argued that without the emergence of this theoretical lexicon, such systems will remain just outside the grasp of human understanding. Taking this argument one step further, this study argues that there is also a need to develop the methodological language that can help researchers to structure the analysis of such systems. The reason why a methodological lexicon is important for discussions about administrative resilience is that contemporary case study designs are unable to separate complex systems into their constituent sub-components without threatening the validity of the research findings.

A case study is “an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between the phenomenon and context are not clearly evident” (Yin 2003, p. 13). Contemporary case studies fall into one of four

categories: (1) holistic single-case designs; (2) holistic multiple-case designs; (3) embedded single-case designs; and (4) embedded multiple-case designs (Yin 2003). According to Yin, a study's research questions can be used to identify which case study design is appropriate. The research questions also point to the study's unit(s) of analysis and its unit(s) of observation. In many instances, the unit of analysis, the "whom or what" being studied, is a phenomena that is indistinguishable from the case itself (Yin 2003). The unit of analysis can take numerous forms, including individuals, groups, organizations or entire systems. If the study has a single unit of analysis, then the holistic case study design is appropriate, and the researcher will investigate that unit of analysis as a distinct entity. If there are multiple units of analysis, then the embedded case study design is appropriate, and the researcher will investigate and compare the units of analysis as distinct entities. In contrast, the units of observation are what researchers examine to create descriptions of the unit(s) of analysis and to explain the differences that exist between them.

Although the case study design has helped researchers generate insights into complex social phenomena, contemporary designs are constrained by two significant limitations. First, contemporary designs consider units of analysis as distinct, independent entities. This is appropriate when researchers attempt to make comparisons between distinct cases or independent units of analysis. By bounding cases and units of analysis in this fashion, researchers restrict their ability to analyze units that are non-distinct and mutually supporting. This restriction is limiting when they seek to analyze units that are organized as a component, or series of components, within which multiple nested sub-components reside. The second limitation is that contemporary case study designs prevent, or at the very least severely restrict, the simultaneous examination of certain types of phenomena from multiple levels of analysis.

Contemporary case study designs prevent researchers from moving up and down levels of analysis without threatening the validity of their empirical conclusions. In holistic case designs, a shift in the level of analysis will change the unit of analysis and the unit of observation. In embedded case designs, a shift in the level of analysis may change the unit of analysis and/or the unit of observation. In either type of case design, movement between levels of analysis threatens research validity because, as the units of analysis or the units of observation change, the empirical conclusions generated by the research may become logically incompatible with the original research questions. When selecting the appropriate case study design, researchers must avoid inadvertent shifts in either the units of analysis or the units of observation. The failure to avoid such shifts can generate Type III errors, whereby the researcher collects data that answers the wrong research question (Dunn 2003).

These limitations are not criticisms of the case study as a research strategy, but rather, suggest that contemporary case study designs are, at times, inappropriate for addressing certain types of research questions. To overcome these limitations, some have focused on the “nested analysis,” which employs a “mixed methods” approach for comparative analysis, blending the strengths of large-N quantitative analysis with strengths of small-N qualitative analysis to enrich the analysis of complicated social problems (Coppedge 1999; Lieberman 2005). Others have focused on an alternative form of case study design, the “nested set” design (Haas 1990; Huggins 2007; Kamolvej 2006; Ostrom 1990, 2005). While the nested set has been discussed in relation to the analysis of social systems, little work has been done to develop the concept into a methodologically sound case study design for social science research.

Building upon the nested set discussion, the nested case study design is an alternative case design that not only overcomes the limitations discussed above, but can also be used to

systematically analyze the resilience of administrative systems. In contrast to the holistic and embedded designs, the nested design frames units of analysis as non-distinct and mutually supporting entities. The first characteristic of the nested case design reflects the significance of the nested set, which is an enclosed system that is comprised of a series of concentric domains. Within the nested framework, data can be organized into a primary component, the system under analysis, and a collection of ever-smaller nested sub-components.

Second the components and sub-components in a nested case can be organized hierarchically. Some hierarchies take the form of a regular pyramid, where a small, but powerful, unit controls or influences the actions of, and interactions within, a series of increasingly larger sub-components. Examples of such systems might include military or corporate organizations, which possess a strict “chain of command” form of administrative structure. Alternatively, other hierarchies can take the form of an inverted pyramid, where a large, but powerful, unit controls, or at the very least influences, the actions of, or interactions in, a series of increasing smaller sub-components. An example of such a system would be the international system, made up of international, national and sub-national actors. While international actors such as the United Nations do not have direct control over national governments, they do have the capacity to exert significant influence over actors at the national and sub-national level of jurisdiction. Even in nations where the governmental system is decentralized, the national level government, with its large bureaucracy, budget and regulatory power, can have a significant influence over the activities of provincial and local actors. Regardless of the type of hierarchy, the structure of these systems is derived from the sub-components present in the hierarchy. Researchers who wish to understand how such systems operate must not study one sub-component to the exclusion of all others. They must examine all of the sub-components in the system simultaneously.

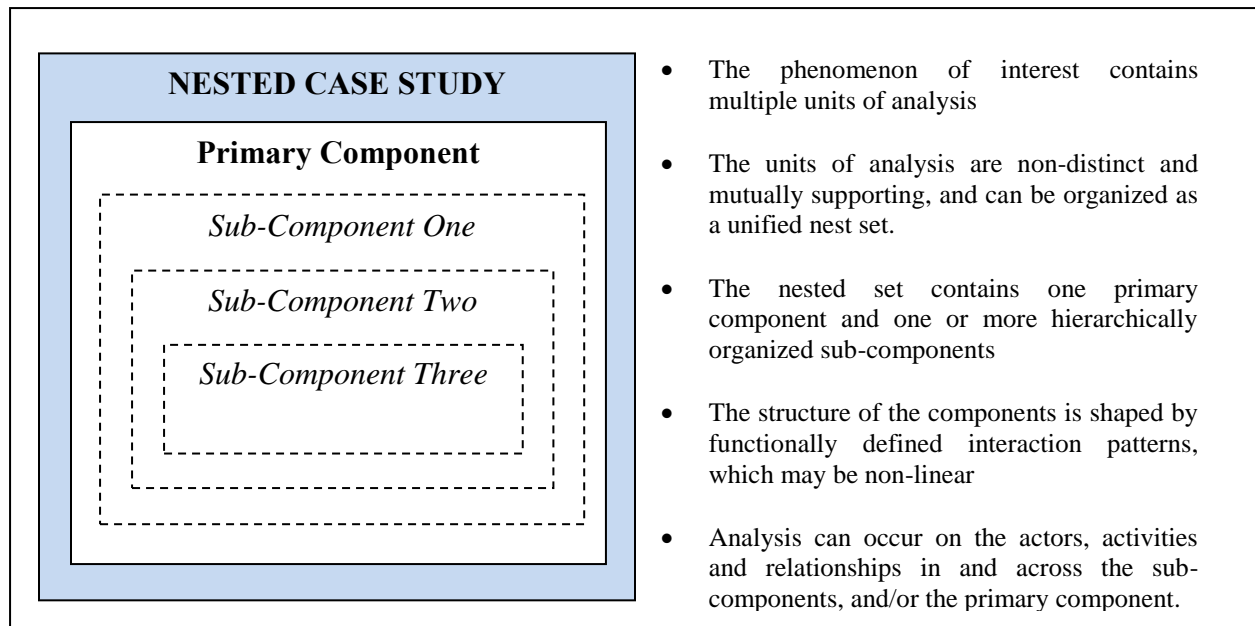


Figure 2: Nested Case Study Design

Third, the structure of the primary component and its sub-components is shaped by the patterns of interaction exchanged in the system under analysis. These interactions, defined by function, are exchanged between the actors that operate in and across the sub-components that make up the primary component. By distinguishing between the primary component and its constituent sub-components, the nested case design, as summarized in Figure 2, enables researchers to analyze comparatively a system's sub-components, or combine the sub-components to form a primary component, which can be analyzed as a single, unified system. In this fashion, the nested case design provides researchers with a conceptual framework that enables them to move up, down or across sub-components without shifting the unit of analysis or the unit of observation. The flexibility provided by the nested case design makes it the appropriate choice for the analysis of resilient administrative systems.

The field study examined in this study is the administrative system that operated in Indonesia after the Great Sumatran Earthquake and Tsunami of 26 December 2004. I separated the system into two non-distinct and mutually supporting sub-components and one primary component. The first sub-component is the domestic administrative system (hereafter domestic administrative sub-system or domestic sub-system), which represents the domestic organizations that participated in system under analysis. The second sub-component is the international administrative system (hereafter international administrative sub-system or international sub-system), which represents the international organizations that came from jurisdictions outside of Indonesia and participated in system under analysis. These two sub-components were integrated to form the primary component (hereafter core administrative system or core system), which represents all of the organizations that engaged in critical response related interactions with other organizations during the period under analysis. The interactions that were used to generate the structure of these systems were taken from the daily record of inter-organizational exchanges that took place following the tsunami, including but not limited to, the transfer of information, personnel and resources among response organizations. By organizing the study in this fashion, it is possible to evaluate the adaptive capacity of both the international and domestic administrative sub-systems. It is also possible to investigate how the non-linear series of interactions among the organizations that operated within, and across, the sub-components influenced the adaptive capacity of the core administrative system.

3.2.2 Mixed Methods Design

Within the framework of a nested case study design, I employed mixed methods to collect and organize the data needed to investigate the theoretical questions outlined in chapter one, as well as the research questions asked of the field study under analysis. These methods included content analysis, descriptive statistics, network analysis, semi-structured interviews and surveys.

3.2.2.1 Content Analysis

Complicated research questions can be answered through a content analysis of relevant source materials (Fontana and Frey 2003). The data that I collected for this study came from newspaper articles, organizational documents such as situation reports, archival materials located on websites, and after action reports. The use of these materials ensured that the data collected addressed the research questions, which consider the conditions under which the administrative system under analysis emerged, its organizational composition, its rate of development, the extent to which its structures evolved, and the factors that influenced its adaptive capacity.

3.2.2.2 Descriptive Statistics

The content analysis generated an extensive amount of quantitative data on the organizations and interactions identified in the administrative system. These data will be presented as descriptive statistics to identify the numbers, jurisdictional levels, sources of funding and frequency distributions of organizations detected in the system. These statistics will also plot, by date, the rate at which organizations were reported as entering the system, as well as the number and type of interactions detected within the system. These data are relevant because they address the first

and second research questions, which consider the organizational composition of the administrative system under analysis and the rate at which this system developed.

3.2.2.3 Network Analysis

Network analysis is used to identify the patterns in relationships among interacting units in a social environment (Wasserman and Faust 1994). I used data collected during the content analysis to analyze the interactions among organizations that participated in the Indonesian response system. The network analysis revealed the structure of the system, the characteristics of the organizations that operated and interacted in the system, and extent to which the system's structure evolved. These data are relevant because they address the second research question, which considers the rate of structural change within the administrative system under analysis.

3.2.2.4 Semi-Structured Interviews and Surveys

I collected data from experts who possessed knowledge about the administrative system under analysis through the use of semi-structured interview and survey instrument. The qualitative and quantitative data that were collected were used to address the third and fourth research questions. These questions seek to identify the primary operational constraints and opportunities that were present in the post-tsunami environment, as well as, the extent to which the administrative response system possessed the components of administrative resilience.

3.3 THE UNIT OF ANALYSIS AND UNITS OF OBSERVATION

The character of the nested case study design is shaped by its unit of analysis and units of observation. The unit of analysis is the administrative response system which emerged to operate in Indonesia after the Great Sumatran Earthquake and Tsunami. The unit of analysis is derived from two separate units of observation. The first unit is the “organizational actors” that participated in the system. The organizational actors included public organizations, non-profit organizations, private organizations and special-interest organizations. The second unit is the “inter-organizational interactions” exchanged among the organizations that participated in the system. I defined an interaction as any linkage between response organizations, which represented channels for the transfer resources or information (Wasserman and Faust 1994).

3.4 DATA COLLECTION, DATA CODING AND DATA ANALYSIS

The investigation of administrative systems under stress can be accomplished through the careful application of multiple research methods. I employed the following processes of data collection, data coding, and data analysis to address the research questions at issue in this study.

3.4.1 Data Collection

To develop an accurate representation of the system under consideration, I collected three categories of data. The first category came from the documentary sources that I used to identify the organizational actors and interactions in the administrative system. Listed in Table 2, these documents were published in English between 26 December 2004 and 17 January 2005, and

were gathered from electronic databases, organizational websites, and email correspondence. The second category was related to the administrative system that was responsible for disaster management in Indonesia prior to 26 December 2004. These materials included disaster management laws and regulations collected from archives, legal databases, governmental and non-governmental organizations, and officials with knowledge of the administrative response to the 2004 tsunami. The third category was collected from a series of surveys and semi-structured interviews with experts who participated in, or had knowledge of, the administrative response to the tsunami. The review of the primary documentary source materials enabled me to identify the organizations that operated in the Indonesian system. The semi-structured interview and survey questions used to complete this study are detailed in Appendix A.

Table 2: Documentary Source Materials²

Source One	Source Two	Source Three	Source Four	Source Five
Newspapers: The Jakarta Post	<u>Situation Reports:</u> United Nations Office for the Coordination of Humanitarian Affairs - Geneva	<u>Emergency Updates:</u> Center of Excellence in Disaster response and Humanitarian Assistance	<u>Situation Reports:</u> United Nations Office for the Coordination of Humanitarian Affairs - Jakarta	<u>Situation Reports:</u> Center for Health Emergency Preparedness and Response; Indonesian Ministry of Health; and World Health Organization – Indonesia

² Interviews revealed that the content of the situation reports produced by BAKORNAS PBP was translated and included in the daily situations reports from the United Nations Office for the Coordination of Humanitarian Affairs.

3.4.2 Data Coding

I began data coding by identifying the organizations and interactions reported in the documentary source materials. These data were stored in an *Excel* spreadsheet.³ The coding rules employed in this process are listed in Appendix B and Appendix C. Second, I used the network analysis software *Ora* to convert the data contained in the spreadsheet into three sets of relational matrices.⁴ These matrices were symmetric and non-directional, and represented the chronological record of the organizations and interactions detected in the core system and its sub-systems. This process created a total of sixty-six distinct matrices; twenty-two matrices for the core system and each sub-system. Third, I prepared the interview and survey data for analysis. Using the software *MAXQDA*, I coded the interview transcripts using the “open coding” process of grounded theory (Corbin and Strauss 2008, p. 3).⁵ The coding schema that was employed in this process is described in Appendix D. The survey results were entered into the software *SPSS*. These data were separated into two categories: international respondents and domestic respondents. For my final step, I scored the components of the framework of administrative resilience for the core system and its sub-systems. As described in Appendix E, each of the components in the framework is comprised of six sub-components. Using the data collected from the surveys, the coded interview transcripts, and other relevant materials, the sub-components were scored on an ordinal scale (1 = low; 2 = medium; 3 = high) to “distinguish the gross differences [with]in the

³ The organization that was listed first in a transaction was coded as the initiating organization.

⁴ *Ora*, Copyright © 2001-2010, is a software tool for the analysis of social networks. *Ora* was developed by Dr. Kathleen M. Carley, Director of the Center for Computational Analysis of Social and Organizational Systems (CASOS), Carnegie Mellon University. For more information, visit: <http://casos.cs.cmu.edu/>.

⁵ For more information on *MAXQDA*, visit: <http://www.maxqda.com/>.

... response system” (Comfort 1999). To generate the final score that would be awarded to each of the components, I averaged the scores awarded to each component’s sub-components.

3.4.3 Data Analysis

Data analysis corresponded with the sequence of the research questions. The first step of the analysis considered the extent to which the response organizations facilitated the development of the core system and its sub-systems. I addressed this question by generating descriptive statistics from the data stored in the *Excel* spreadsheets to evaluate the number, category and frequency distribution of the organizations and interactions detected in these systems. I also used these results to evaluate the size and organizational composition of the systems, as well as the nature of the transactions detected within the systems. My analysis continued after I plotted the data longitudinally, by date, to evaluate rates of organizational access and system growth. The second step considered the extent to which organizational interactions drove the structural evolution of the system. I addressed this question using the matrices that I created to generate network statistics that would identify the response system’s density, distance, and number of components. These statistics, created using *Ora*, were plotted longitudinally, by date, for the evaluation of structural change using the Hamming distance statistic (Hamming 1950). I also examined the extent to which response organizations shifted their choice of organizational partners.

Table 3: Resilience Assessment Components and Indicators

	Environmental Component	Information Component	Organization Component	Cultural Component	Technology Component	Network Component
Auto-Adaptive	High	High	High	High	High	High
Operative Adaptive	Medium	Medium	Medium	Medium	Medium	Medium
Emergent Adaptive	Medium	Medium	Medium	Medium	Low	Low
Non-Adaptive	Low	Low	Low	Low	Low	Low

The third step of my analysis evaluated the constraints and opportunities present in the response system. Focusing again on the core system and its sub-systems, I reviewed the survey data and the coded interview transcripts to identify the principle constraints and opportunities. I supported this analytical process with excerpts culled from the interview transcripts. The final step considered the extent to which the core system and its sub-systems possessed the capacity for resilience. This analytical step began with a review of the scores awarded for the components of the framework of administrative resilience against the set of resilience indicators identified in Table 3. By way of example, if all of a system's components received a medium ranking, then it would be interpreted as operational adaptive. I continued the analysis with an evaluation of the structural stability of the systems, which sought to identify the extent to which the systems could be interpreted as operating along the "edge of chaos," and if not, whether they were constrained by an excess of structure or flexibility. The data used to address this question was extracted from the survey results and interviews transcripts. These results enabled me to situate the core system and its sub-systems in the framework of administrative resilience as identified in Figure 3.

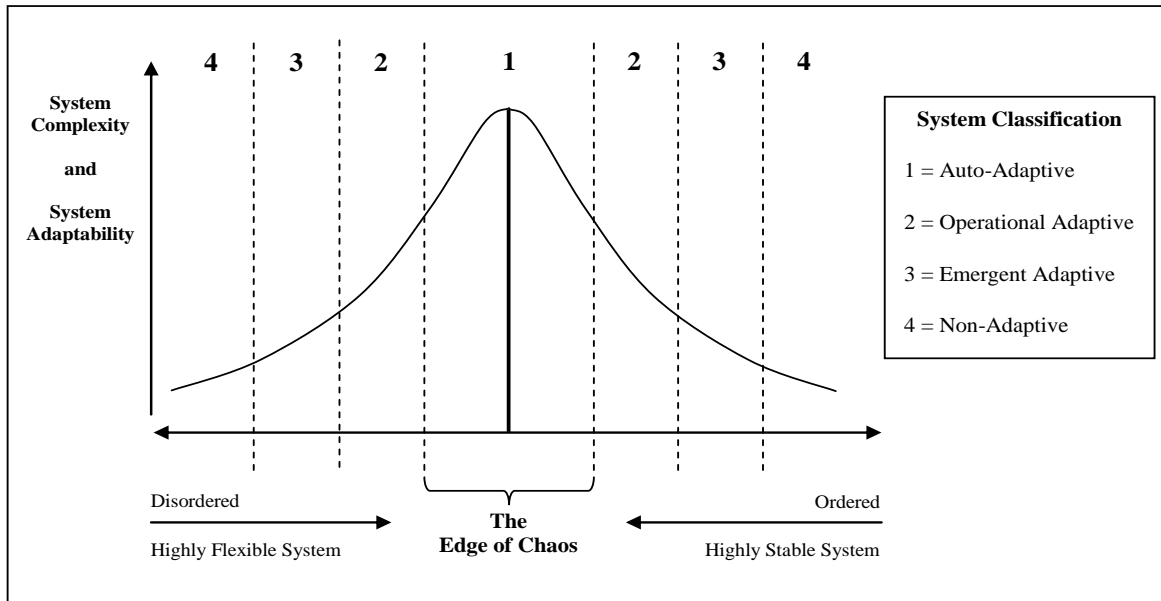


Figure 3: Graphical Representation of the Framework of Administrative Resilience⁶

3.5 THREATS TO VALIDITY AND RELIABILITY

I did not attempt to identify or test a series of casual hypotheses derived from theoretical propositions in this study. Rather, my goal was to acquire a better understanding of, through the use of descriptive statistics, social network data and qualitative data collected from surveys and semi-structured interviews, the phenomenon known as administrative resilience. The remainder of this section identifies the threats to validity and reliability present in my study; specifically construct validity, internal validity, and general reliability.

⁶ Type of system categories adapted from Comfort, Louise K. 1999. *Shared risk: Complex systems in seismic response*. New York: Pergamon.

3.5.1 Construct Validity

In social science parlance, “construct validity refers to the degree to which inferences can be legitimately be made from the operationalizations in your study to the theoretical constructs on which those operationalizations were based (Trochim 2001, p. 64; Trochim 2006). The theoretical construct at issue in my study is administrative resilience, which I defined as the capacity of an administrative system to demonstrate the stability needed to maintain the effectiveness of the social, political and economic stability of the community in which it operates, and the flexibility needed to absorb the shock of the event, rapidly scale up response activities and adapt to the opportunities and constraints generated by conditions of uncertainty. This construct was based upon a review of the resilience literature (Bruneau et al. 2003; Bruneau and Tierney 2006; Comfort 1999; Gunderson et al. 2002; Wildavsky 1988).

According to Lee Cronbach and Paul E. Meehl, “constructs may vary in nature from those very close to ‘pure description’ (involving little more than extrapolation of relations among observation-variables) to highly theoretical constructs involving hypothesized entities and processes...” (Cronbach and Meehl 1955, p. 300). To evaluate the resilience of administrative systems, I developed and employed the framework of administrative resilience, which is an accurate description of the construct of resilience in the administrative context. As an exploratory framework, the framework for administrative resilience seeks to capture descriptively the process and structures of interaction, information exchange and information processing that promote adaption and self-organization in administrative systems.

A variety of methods can be employed to establish construct validity in quantitative studies that use independent and dependent variables to evaluate and test theories or models.

These methods include “interitem correlations, intertest correlations, test-“criterion” correlations, studies of stability over time, and stability under experimental intervention” (Cronbach and Meehl 1955, p. 300). Methods such as exploratory factorial analysis and confirmatory factorial analysis can also be used to establish construct validity (Thompson and Daniel 1996). One of the limitations of the present study is that I did not frame administrative resilience as a dependent variable for the purpose of hypothesis testing. As a result, I am unable to employ quantitative methods to establish construct validity. Future research will advance the construct of administrative resilience beyond “pure description” by framing it as a variable that can be measured and evaluated using positivistic techniques.

Construct validity also requires that the components and sub-components operationalized within my framework of administrative resilience represent an accurate reflection of the resilience in the administrative context. There are five reasons why this is the case. First, the organization of the framework is supported by the literature on non-traditional decision making, which indicates that there are seven specific conditions that promote effective decision making in uncertain environments (Axelrod and Cohen 2000; Gell-Mann 1994; Holland 1995; Hutchins 1995; Klein 1999). Second, the theoretical premise of the framework is supported the literature on complex adaptive systems, which suggests that the non-linear nature of heterogeneous systems of interacting actors, from which emergent phenomenon arise, are difficult to model using linear methods of scientific inquiry (Miller and Page 2007). While not yet a computational model, in its current form, the framework of administrative resilience captures descriptively the factors that promote administrative adaptation and self-organization. Third, the components and sub-components identified in the framework of administrative resilience were developed using the growing body of theoretical and empirical literature on the subject of complexity and

resilience in administrative systems responsible for disaster management activities (Comfort 1999; Comfort 2007; Mileti 1999; Rosenthal, Boin, and Comfort 2001). Indeed, research on the measurement and monitoring of risk and vulnerability has used many of the same indicators that are employed in the sub-components of the framework of administrative resilience, for example, levels of training, emergency response planning, availability of resources, and capacity for coordination (Birkmann 2006; Bruneau et al. 2003; Bruneau and Tierney 2006; Cardona 2007). Finally, the framework passed the “common-sense” check known as face validity, as a preliminary version of the framework was reviewed and approved for use in the study by a group of disaster management experts from Indonesia.

3.5.2 Internal Validity

The exploratory nature of this study also gave rise to concerns about internal validity. These concerns centered on issues related to selection bias. To ensure that data would be collected on the core system, as well as its constituent sub-systems, the selection of interview subjects was organized according to levels of jurisdiction, and took into account the differences between public, private and non-profit organizations. A list of potential interview subjects was generated during the review of the documentary source materials. This list was roughly balanced between international subjects and domestic subjects. In this sense, the selection of subjects was biased.

There are two reasons why this study balanced the subjects in this fashion. First, the tsunami wrought such devastation that, in many areas, the wave destroyed the infrastructure designated for local and provincial actors. Consequently, domestic organizations were unable to coordinate a response (Telford, Cosgrave, and Houghton 2006). Second, Indonesia responded to

the void in domestic authority by creating the “*SuperSakorlak*, (the Provincial Coordinating Committee established for Aceh Province and supported by the Indonesian National Government in Jakarta) and the *SuperSatlak* (the Municipal Coordinating Committee established for the Municipality of Banda Aceh and supported by the Indonesian National Government in Jakarta)” (Comfort 2007). With authority to manage millions of tons of aid and billions of dollars worth of financial assistance, these committees ensured that many of the organizations present in the core administrative system were international, meaning they came from outside of Indonesia.

A second concern about selection bias arose during the process of data collection. In some situations, the subjects that were initially selected were not available to participate in the study; the result of time constraints or the fact that the subjects were no longer in the country. When such a situation was encountered, replacement subjects were identified through the use of snowball techniques or through discussions with personal Indonesian contacts. Both situations created the potential for selection bias, which meant the data would not be representative of the system and sub-systems under analysis, but rather specific groups of closely related actors in those systems. Such concerns about bias were moderated by avoiding subjects that would result in oversampling and subjects that did not possess knowledge related to the focus of the study.

3.5.3 External Validity

The results generated in this study were also threatened by issues of external validity. The major issue was whether the sample of subjects that provided data was representative of the administrative system that operated in Indonesia. This problem was only partially related to the size of the sample, which was restricted due to financial and time constraints. Although I

collected data from a relatively small number of subjects, I also moderated the problem of non-representative sampling by separating the semi-structured interview questions and the survey questions into two distinct areas of focus. The questions that fell into the first area of focus asked the subjects to report on the administrative system as a whole. The questions that fell into the second area of focus asked the subjects to report on their specific organization, whether domestic or international in status. Organizing the focus of the instruments in this manner ensured that my analysis was representative of the administrative response system as a whole.

3.5.4 General Issues of Reliability

Questions about reliability consider the extent to which the methods and instruments employed by the study generate results that are dependable, lack distortion, or are free of measurement error (Kerlinger and Lee 2000, p. 642). Given the exploratory nature of the study, I was primarily concerned with generating results that were dependable, meaning “if [I] measure the same set of objects again ... with the same or comparable measuring instrument, would [I] get the same or similar result” (Kerlinger and Lee 2000, p. 642)? The following sub-sections review the major issues of reliability relevant to my study and the steps I took to moderate these issues.

3.5.4.1 Network Data

There were various issues related to the reliability of the network data used in my study. For example, it is often difficult to know whether the data collected for analysis is representative of the actual, “real world” network or just the perceived network (Borgatti, Carley, and Krackhardt 2006; Kossinets 2006; Linton, Romney, and Freeman 1987). The network data used in my study

were susceptible to the constraints of missing and inaccurate data. While it would be almost impossible for me to have completely identified the “real-world” characteristics of the administrative system under consideration, I took a series of steps to ensure data reliability.

First, I collected data from multiple sources to moderate concerns about selection bias, which ensured that my representation of the tsunami response system did not reflect the priorities of a single organization or a single jurisdictional level. Second, I cross-checked the organizations and interactions identified in one set of documentary sources with the organizations and interactions identified in the other sets of documentary sources to ensure that the events recorded in database actually occurred on the reported dates. If I was unable to identify a specific date for an activity using the documentary materials, I would attempt to locate the date using reports or news articles published on the internet. Third, if organizations or interactions were suspect, for instance, they could not be confirmed through cross-referencing or external searches, I would flag them for elimination from the database. Finally, I would identify and eliminate duplicate organizations and interactions from the database to prevent double-counting.

3.5.4.2 Semi-Structured Interview Instrument

I traveled to Indonesia to conduct semi-structured interviews for my study, and the majority of the interview subjects were Indonesian nationals. Such cross-cultural interviews present a litany of challenges, one of the most difficult being “the attribution of different meanings to the use of language” (Marshall and While 1994, p. 568). An example of such meaning confusion in the Indonesian context relates to the use of the word disaster. Prior to the Great Sumatran Earthquake and Tsunami, the manner in which Indonesians thought about, and prepared for, disaster differed from those in other countries. The pre-tsunami consensus in Indonesia was that

disasters were “acts of God,” for which preparation was impossible. The policy consequence of this perspective was that Indonesia’s disaster management institutions were focused on response, often to the exclusion of prevention and mitigation activities.

I implemented various procedures to moderate the threats e generated by cross-cultural interviews (Marshall and While 1994). First, I conducted the majority of the interviews with subjects who had a strong command of the English language. Second, when the interviews were conducted with subjects who only spoke a local language, I arranged to have an official from an Indonesian university to participate in the interview for the purposes of translation. Third, if there was confusion during an interview, for example, the subject had difficulty understanding a question, I would restate the question using a predetermined set of substitute words. If I had difficulty understanding a subject’s response, I would request clarification. Throughout the entire interview process, I would probe the subject to “provide validation of the meaning of meaning of [words and concepts]” (Marshall and While 1994, p. 568). Finally, I recorded and transcribed each of the interviews, which were presented to the subjects for review and clarification.

3.5.4.3 Survey Instrument

Survey instruments must be designed to ensure consistency in the responses provided by the participants, not just within the survey instrument itself, but also in the event that the survey is administered multiple times (Creswell and Plano Clark 2007). I took the following steps to ensure data reliability. First, to ensure that the organizations that participated in the system and sub-system were adequately represented, I selected the survey subjects through purposeful sampling. When, purposeful sampling was ineffective, due to the unavailability of the potential subject or time constraints, I relied upon snowball sampling. Second, I standardized the survey

instrument to overcome problems related to the heterogeneity of the potential subjects. Third, to overcome linguistic difficulties, I drafted the survey instrument using neutral language.

The nested case study design and research methods discussed throughout this chapter provide researchers with the means to investigate the presence of resilience in administrative systems. As discussed in the opening sections of this chapter, I elected to use this study to examine the resilience of an administrative system that had been placed under significant stress and had demonstrated the capacity to adapt and self-organize after a disruptive event. The system that I selected for examination was administrative response system that operated in Indonesia after the Great Sumatran Earthquake and Tsunami of 26 December 2004. The subsequent chapter explains why this particular administrative system was selected for analysis.

4.0 INDONESIA AS A FIELD STUDY FOR ADMINISTRATIVE RESILIENCE

The methods outlined in the preceding chapter provide a framework for the analysis of resilient administrative systems. To adequately address the theoretical and research questions posed by this study, I needed to identify a field study of an administrative system that not only operated in uncertain conditions, but also demonstrated the capacity to adapt and self-organize after a disruptive event. I selected the system that operated in Indonesia following the Great Sumatran Earthquake and Tsunami of 26 December 2004, an event that caused tremendous damage to life and property and generated an expansive international response. While this disaster had an impact on many countries, I focused on Indonesia because it large and heterogeneous country.

While subject to significant domestic debate, Indonesia's territory is comprised of more than 17,000 distinct islands, 3,000 of which are inhabited (Bresnan 2005). Equally interesting is the fact that Indonesia's official national language is Bahasa Indonesia, yet its citizens represent more than more than three hundred distinct ethnic groups and speak more than seven hundred distinct languages (Grimes et al. 2005). After the tsunami, Indonesia's disaster management system, which suffered substantial disruptions, was replaced by a system that lacked formal administrative structure. The critical question is how did this system manage the uncertainty? This chapter demonstrates how the physical events generated by the earthquake and tsunami of 26 December 2004 interacted with Indonesia's social environment to create the complex set of initial conditions within which the administrative response system had to emerge and operate.

4.1 WHY SELECT INDONESIA AS A FIELD STUDY?

Disasters the scale of the Great Sumatran Earthquake and Tsunami are not regular occurrences, but when they do occur, such events often contain a silver lining. They provide humans with the opportunity to stretch their imaginations and to learn from their mistakes (Clarke 2006). In the interest of learning from past mistakes, this chapter reviews the reasons why the administrative response system that operated in Indonesia after the December 2004 was appropriate as a field study for the analysis of resilience. In describing these reasons, the chapter also provides the contextual background needed to understand one of the largest disaster events in recorded history. Importantly, the discussion identifies the set of initial conditions that serve as a baseline for the evaluation of a system that seemed to have adapted and self-organized in response to the opportunities and constraints present in an uncertain post-disaster environment.

4.1.1 Indonesia's Susceptibility and Vulnerability to Disaster

Indonesia's geographic location and social diversity make the country susceptible to a wide variety of hazards, and it is extremely vulnerable to the consequences of disaster. Located at the intersection of five major tectonic plates, Indonesia is one of the most seismically active regions of the world. The islands that give the country its distinctive character undergo constant transformation, being continuously shaped and reshaped by earthquakes, landslides, volcanic explosions, floods and tsunamis. In part, Indonesia's geological character has also shaped the social and cultural development of its people. Although Indonesia has more than 230 million citizens, its population is extremely diverse, and is comprised of multiple ethnicities, languages,

religions and cultures. For Indonesians, the threat of disaster is ever-present. The question for Indonesian policy makers is not whether a natural or man-made disaster will occur, but when.

After the earthquake and tsunami of 2004, the Indonesian government released the *National Action Plan for Disaster Reduction*, which initiated a national policy response to the risks of disaster. This document indicates that Indonesia would adopt the comprehensive approach to disaster management advocated by the *Hyogo Framework for Action* (Republic of Indonesia 2006). In doing so, the government recognized that the following items “may interact to cause disasters: a) natural and man-made disasters [caused by] geological hazards, hydro-meteorological hazards, biological hazards, technological hazards and environmental degradation; b) the high vulnerability of communities, infrastructure and elements in ... disaster prone-areas; and c) the low capacity of elements within the community” (Republic of Indonesia 2006). This comprehensive approach was necessary, given the range of natural and social hazards that exist in Indonesia. The following sub-sections review some of these hazards and provide some basic statistics about the consequences of disasters in Indonesia prior to 2004.

4.1.1.1 Natural Disaster Hazards

Indonesia is highly susceptible to natural disasters, given its location along the seismically active zone known as the “ring of fire.” Complicating the problem is the social diversity of Indonesia’s large and heterogeneous population, large portions of which live in high-risk urban and coastal areas. The risk increases when events generated by Indonesia’s physical environment interact with its social environment. In its *National Action Plan for Disaster Reduction*, Indonesia has identified the various natural hazards that exist in Indonesia. Some of the most significant hazards include: earthquakes, tsunamis, volcanic eruptions, floods, landslides, drought, wildfire,

and disease (Republic of Indonesia 2006). Of interest to this study are tsunami events, which are defined as “an abnormally long wavelength wave most commonly produced by sudden displacement of water in response to sudden fault movement on the seafloor” (Hyndman and Hyndman 2009). Interestingly, tsunamis are a regular occurrence in Indonesia. For example, between the years 1600 and 2000, the islands of Indonesia were struck by an estimated 106 tsunami (Latief H., N.T. Puspito, and F. Imamura 2000).

4.1.1.2 Man-Made Disaster Events

Indonesia’s *National Action Plan for Disaster Reduction* also indicates that the government must respond to technological disasters and social unrest, both of which threaten the livelihood of Indonesians (Republic of Indonesia 2006). The civil conflict that existed in Aceh at the time of the Great Sumatran Earthquake and Tsunami had seriously weakened the capacity of public agencies to respond to the demands generated by the disaster. While the source of the conflict has been lost in a fragmented historical record and constantly evolving political circumstances, some frame the conflict as one of political resistance. From this perspective, the Acehnese sought to acquire greater political and economic autonomy from the central government, which they believe had systematically exploited the natural resources found in the region (Davies 2006; Drexler 2008; Reid 2006). Others have frame the conflict as one of religious self-determination, where the local populations wanted to preserve their Islamic character through the implementation of Shari’ah law. For the purpose of this study, the source of the conflict is irrelevant. What matters is that the Great Sumatran Earthquake and Tsunami devastated communities that had already experienced more than thirty years of conflict. Pushing regions of Aceh beyond administrative collapse, the event made a difficult situation even worse.

4.1.1.3 Disaster Events and Consequences

The hazards identified above indicate that Indonesians live under a significant risk of disaster. Precisely quantifying the level of risk, and the extent to which the risk has evolved, is difficult, given that the collection of data on Indonesian disasters has only recently become a government priority. It is possible to estimate these trends using data contained in the EM-DAT database on natural and technological disasters, which includes data on world disaster events from 1900 to present. This section reviews the major disaster events that occurred in Indonesia between 1983 and 2003, the two decades that preceded the Great Sumatran Earthquake and Tsunami. The dates, names and categories of these events are reported in Appendix F.

Table 4: Disaster Statistics for Indonesia: 1983 – 2003

	Number	Deaths	Immediately Affected	Total Affected	Injured	Homeless	Costs (000') US\$
1983	9	161	433415	433532	117	0	183197
1984	10	363	375950	396147	197	20000	2500
1985	6	52	15378	15385	7	0	0
1986	7	318	578700	628700	0	50000	0
1987	10	459	72651	74686	235	1800	71700
1988	5	229	109070	111570	0	2500	4600
1989	7	144	93285	98994	209	5500	341
1990	7	280	40405	40576	171	0	14900
1991	12	524	278679	279878	199	1000	47000
1992	4	2632	46330	402157	0	104345	105400
1993	4	134	271005	271017	12	0	19301
1994	15	609	3580795	3594156	2031	11330	195921
1995	8	239	304015	352104	2404	45685	50400
1996	9	402	849969	868514	455	18090	567830
1997	6	1130	1102805	1103175	370	0	8089100
1998	7	1490	144775	147613	88	2750	1500000
1999	8	162	34645	37567	222	2700	5700
2000	16	573	752656	816949	3148	61145	241106
2001	10	587	92500	122116	16	29600	20000
2002	15	290	607682	609377	1695	0	351600
2003	17	534	687506	688007	361	140	4961
TOTAL	192	11312	10472216	11092220	263419	356585	11475557

The data presented in Table 4 indicates that disaster events have taken a large toll on Indonesia. In just two decades, Indonesia experienced at least 192 major natural disasters. While distributed throughout Indonesia's archipelago, these events have caused tremendous suffering for those who were directly and indirectly affected. Indeed, the data indicate that, of the Indonesians that were directly affect by disaster, over 11,000 were killed, over 250,000 were injured, and more than 350,000 required shelter due to the loss of their homes and livelihoods. The consequences these events are troubling. Between 1983 and 2003, the number of Indonesians affected by disaster exceeded eleven million, and the costs of these disasters exceeded eleven billion dollars. Clearly, disasters place a heavy burden on the Indonesian nation.

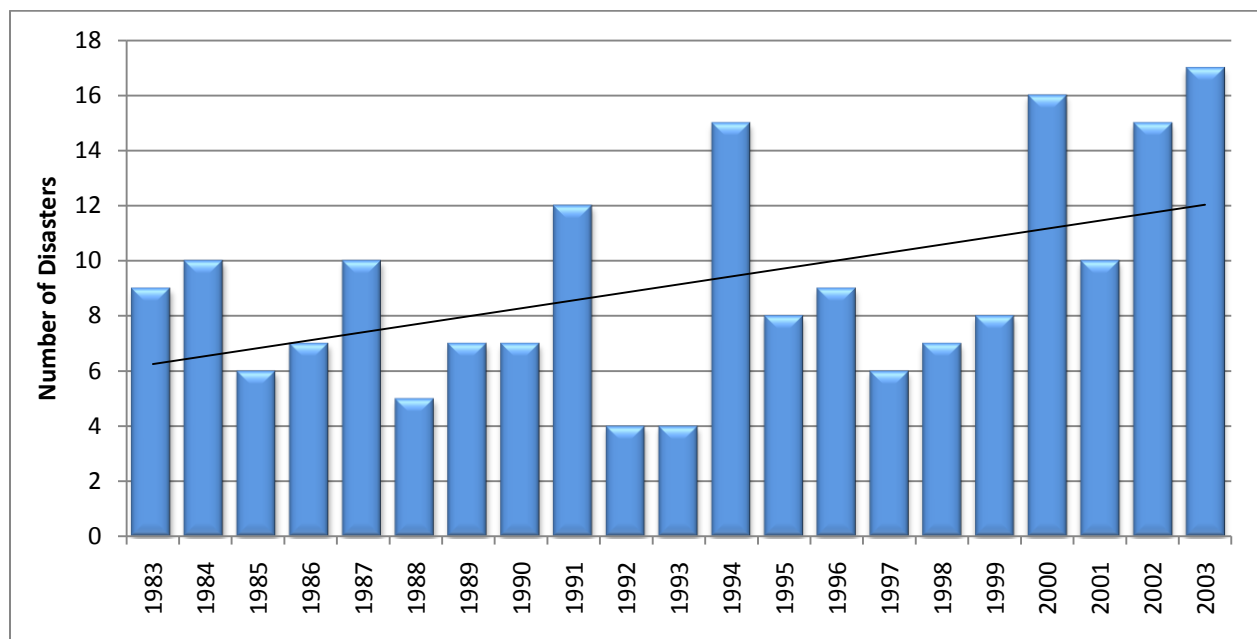


Figure 4: Total Number of Disaster Events in Indonesia: 1983 – 2003

The concern is that both the frequency and consequences of Indonesian disaster events will increase. The data contained within the EM-DAT database confirm that such a trend actually began in the early 1980s. For example, from 1983 through 2003, there were a total of 192 reported disaster events, the majority of which were the result of seismic activity or flooding. The data also indicate that there were only 9 reported natural disaster events in 1983. By 2003, the number of annual disaster events had increased to 17, the highest number reported for the period under observation. What is most revealing is that the four year period between 2000 and 2003 was particularly active, during which 58 disasters occurred. This period accounts for thirty percent of all the natural disasters that occurred in Indonesia between 1983 and 2003. The linear trend line presented in Figure 4 indicates that the number of Indonesian disasters increased steadily from 1983 through 2003.

As the population of Indonesia continues to expand in future decades, the number of disasters, the number of Indonesians affected by disasters, and the costs imposed upon Indonesian society by disasters, will also increase. Indeed, as indicated in Figure 5, such a pattern already exists. In terms of the yearly cost of disasters, the most costly year for Indonesian's occurred in 1997, when the fires in Sumatra Province and Kalimantan Province caused more than eight billion dollars of damage. While the fires represent an extreme case, the financial costs that Indonesians have to pay for disasters continue to rise. Between 1983 and 1994, the total annual cost of disaster only exceeded one hundred million dollars on two years. This is in stark contrast to the decade between 1994 and 2003, in which there were five years where the total annual costs of disasters in Indonesia exceeded two hundred million dollars.

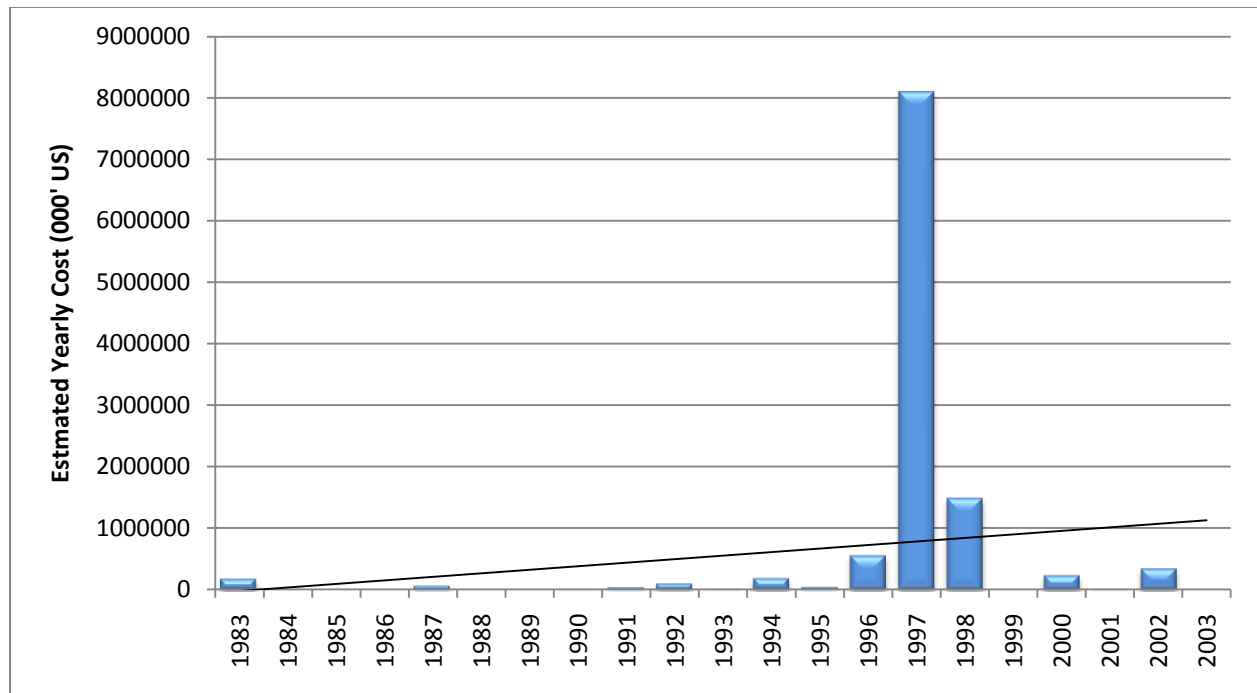


Figure 5: Estimated Yearly Costs (000' US\$) Due to Disasters in Indonesia: 1983-2003

The conflict in Aceh was also costly. According to Peiter Feith, who reviewed the Aceh peace process, reported that the conflict in Aceh was one of Asia's oldest conflicts (Feith 2007). While there is a growing literature that explores the human costs of this conflict, it fails to identify with any specificity the number of combatants and non-combatants killed between 1975 and 2004. The number of deaths that is most frequently mentioned is 15,000 (Feith 2007). Although the precise number of lives lost will be disputed by scholars in the future, what cannot be disputed is that conflict isolated the Acehnese. For instance, the Indonesian government, in its desire to manage the conflict area, restricted the media and non-governmental organizations from accessing the Province. The government also placed restrictions on the Acehnese, who could not own a radio or cell phone without official permission. The Acehnese went about their lives

trapped between the Free Aceh Movement (Gerakan Aceh Merdeka or GAM) and the Armed Forces of Indonesia, now known as Tentara Nasional Indonesia (TNI). Consequently, the Acehnese knew little about events outside their communities, and the international community knew little about events that transpired inside Aceh.

4.1.2 Indonesia's Perspective on Disaster Management

Prior to the Great Sumatran Earthquake and Tsunami, Indonesia's governments and communities lacked a comprehensive understanding of the risks generated by disaster events. The conventional wisdom was that disasters were "acts of God," often a punishment imposed upon a community for its past transgressions. This perspective led Indonesians to believe that their communities were unable to prepare for disasters, and more importantly, that there was little if anything that could be done to prevent disasters. Given this premise, the Indonesian government had few formal mechanisms for disaster management in place in 2004. Only when a disaster actually occurred, would Indonesian policy makers mobilize resources to conduct response operations. Equally difficult was the fact that Indonesian citizens did not recognize or understand disaster risks such as those generated by tsunamis. For instance, many who lived in the coastal communities that were struck by the tsunami did not know that they should move towards higher ground after the earthquake. The lack of awareness about the risks generated by disaster resulted in the development of an administrative system in Indonesia that was better prepared to respond to small disasters, such as fires and floods, than large, multi-jurisdictional disasters.

The events of 26 December of 2004 caught Indonesian policy makers unprepared. Focused primarily on the development of Indonesia's political and economic institutions, policy makers had yet to embrace the comprehensive notion of disaster management, which assumes

that disaster consequences can be reduced through pre-event planning in areas related to mitigation, preparation, response and recovery. Rather, Indonesia's governmental institutions would simply respond to disaster events within their particular areas of responsibility. The legal and regulatory structures in place in Indonesia when the tsunami came ashore reflected this perception. Prior to December of 2004, legislation that addressed disaster issues within Indonesia was not integrated into a coherent policy, but rather, was distributed across a diversity of individual acts, for example, Act No. 6 / 1974 on the Basic Arrangement of Social Welfare; Act No. 23 / 1992 on Health; Act No. 24 / 1992 on Spatial Planning; Act No. 2 / 2002 on Police Institution; and Act No. 3 / 2002 on State Defense (Bannon, Andrade, and Abai 2006; Siahaan 2006). Summaries of these and other relevant pieces of legislation are provided in Appendix G.

A review of this legislation indicates the degree of incongruence in Indonesian disaster management policy prior to the tsunami. At a general level, Indonesia's laws and regulations created the potential for institutional confusion over issues of disaster management. The country's legal structure had no unified definition of disaster. Instead, the legislation would make reference to specific categories of disaster, including floods, earthquakes or disease. More often, the legislation would refer to "social or natural disasters," but did not elucidate the specific types of events for which the government and communities should prepare. Equally important, the legislation did not identify the institutions that would execute these responsibilities, while referring to either the Indonesian government or Indonesian communities as the stakeholders who possessed the responsibility to respond to disasters. So, with whom did the responsibility for disaster management reside? Was it with the central government, or given Indonesia's emphasis on decentralization, did the responsibility fall upon officials at the regency or district levels?

Even if specific institutions were identified, in many instances, the processes by which their responsibilities were to be carried out were not (Bannon, Andrade, and Abai 2006).

While efforts had been taken to clarify Indonesia's disaster management policy, constraints prevented the adoption of the necessary legislation (National Coordinating Board for Disaster Management and Internally Displaced People Affairs 2004). These constraints fell into two primary categories. First, given the range of issues before the Indonesian Parliament prior to the tsunami, disaster management reform was not considered an issue of national priority (National Coordinating Board for Disaster Management and Internally Displaced People Affairs 2004). Second, even had it been a national priority, there remained the challenge of determining how to draft legalization that would weave together the patchwork Indonesia's disaster management laws, many of which were vague and only indirectly relevant to the issue (National Coordinating Board for Disaster Management and Internally Displaced People Affairs 2004).

4.1.3 Indonesia's Disaster Management System

The patchwork system of laws and regulations did not mean that the Indonesian government was ignorant of the threats posed by disasters. At the very least, these laws and regulations demonstrated that the Indonesian government had acknowledged that disasters could have detrimental political, social and economic effects. The Indonesian government admitted to the participants to the 2005 World Conference on Disaster Management that efforts had been made to pass legislation that would effectively regulate disaster management issues, but political difficulties had prevented its development (National Coordinating Board for Disaster Management and Internally Displaced People Affairs 2004). The largest pre-tsunami issue was that BAKORNAS PBP, the organization responsible for disaster management in Indonesia at the

time of the tsunami, was at most an ad hoc coordinating body which lacked the legal and budgetary authority to direct and formulate disaster management policy throughout the country.

The institutional framework behind Indonesia's disaster management system first emerged in 1979; when President Suharto issued Presidential Decree No. 28 in 1979 and established BAKORNAS PBA as the country's central disaster management agency. Directly answerable to the President of Indonesia, BAKORNAS PBA was designed to operate as a coordinating board. This board had three specific responsibilities: 1) to formulate the policies and guidelines needed for the effective coordination of natural disaster management activities; 2) to formulate the national government's natural disaster management program; and 3) to direct the natural disaster management activities at the provincial and district levels (Siahaan 2006).

Over the next thirty years, BAKORNAS PBA underwent three additional structural changes. In 1990, President Suharto issued Presidential Decree No. 43, which changed the institution's name to BAKORNAS PB and brought the military into the arrangement. In 1999, President Megawati issued Presidential Decree No. 106, which expanded the institution's responsibilities beyond natural disasters to include events caused by social unrest and human activity. President Megawati also expanded the board membership to include 13 ministers and provincial governors. The institution was restructured again in 2001, when the Coordinating Minister for the People's Welfare was assigned to be the Deputy Chairman of what became BAKORNAS PBP (Badan Koordinasi Nasional Penanggulangan Bencana Dan Penanganan Pengungai), also known as the National Coordination Board for Disaster Management.

Although these changes situated BAKORNAS PBP as Indonesia's principal disaster management institution, it was primarily a coordinating body amongst a community of powerful line ministries. This meant that BAKORNAS PBP suffered from two primary limitations. First,

BAKORNAS PBP did not possess the power to implement policy at the national level. Rather, BAKORNAS PBP could only coordinate, but not direct, the activities of the line ministries. Second, and even more problematic, was that BAKORNAS PBP was constrained by a lack of budgetary support. So, while the Indonesian President had charged BAKORNAS PBP with the responsibility to develop a comprehensive strategy for disaster management that included policies for preparedness, mitigation, response and recovery, it could do little, if anything, to prepare Indonesia for the event that would occur in just under three years time.

From an administrative perspective, BAKORNAS PBP could be separated into horizontal and vertical governance structures. The horizontal component of Indonesia's disaster management system in October of 2004, as reported by the Indonesian government to the 2005 World Conference on Disaster Reduction, was comprised of national level ministers and officials (National Coordinating Board for Disaster Management and Internally Displaced People Affairs 2004). The actors that comprised the structure of BAKORNAS PBP, as identified by Presidential Decree No. 111 of 2001, is provided in Figure 6. BAKORNAS PBP was designed to be a "non-structural" organization which would meet following a disaster event, receive orders directly from the President of the Republic of Indonesia, and coordinate the government's response activities. The responsibilities of BAKORNAS PBP were actually much broader, and according to a report written for the *Asian Disaster Reduction Center* included: 1) the formulation of national disaster management policies and strategies; 2) the coordination and implementation of disaster management activities before, during and post-disaster; and 3) the rendering of guidance and directives on policies related to the management of disaster prevention, mitigation, response, rehabilitation and reconstruction efforts (Triutomo 2003).

Chairman:	Vice President of the Republic of Indonesia
Vice Chairman / Director:	Coordinating Minister of People's Welfare
Members:	Minister of Home Affairs Minister of Social Affairs Minister of Health Minister of Settlement and Regional Infrastructure Minister of Communications Chief Commander of Indonesian Armed Forces Chief Commander of Police Governor of Affected Areas
Secretary:	Secretary of the Vice President

Figure 6: Horizontal Structure of BAKORNAS PBP, October 2004

The vertical component of BAKORNAS PBP delineated disaster related responsibilities among the jurisdictional levels. At the provincial level was the SATKORLAK, the non-structural body responsible for coordination activities with the jurisdiction, as well as the execution of tasks directed by BAKORNAS PBP. The SATKORLAK was typically chaired by the provincial governor. At the district level was the SATLAK, which was the non-structural body responsible for coordination activities within the jurisdiction, as well as the execution of tasks directed by the SATKORLAK. The SATLAK was designed to operate at the municipal level, and was often chaired by either the district head or the mayor of a local community. At the sub-district level were the SATGAS task forces, responsible for carrying out previously planned disaster response activities. These task forces were also responsible for the execution of the activities that were directed by the chair of the SATLAK.

At the time of the tsunami, the SATKORLAK and SATLAK were the primary bodies responsible for the design and implementation of disaster management plans and policies at the provincial, district and municipal levels. Indonesia's laws actually encouraged governors and mayors to design their disaster management structures as they saw fit (Presidential Decree No. 3 of 2001). Yet since the national government had not emphasized disaster issues, disaster management activities were not a policy priority for many of Indonesia's local communities. The limitations of this administrative structure became clear after the earthquake and tsunami. In Aceh, for example, the event devastated the capital city, and disrupted the capacity of both the SATKORLAK and SATLAK to function in the post-disaster environment.

4.1.4 Indonesia's Disaster Management System in Disaster

The earthquake and tsunami of 26 December 2004 disrupted the administrative systems that were responsible for disaster management activities in Indonesia and destroyed many of the offices, personnel and resources that communities had to initiate response activities. Due to the character of the disaster, the national government, particularly BAKORNAS PBP, found that they did not possess the administrative capacity needed to fill the void. Reports indicate that it took officials in Jakarta a several days to comprehend what had happened and to decide to open the affected regions to the international community (Telford, Cosgrave, and Houghton 2006).

4.1.4.1 Characteristics of the Disaster

The earthquake and tsunami of 26 December 2004 are considered to be distinct, but interdependent geologic events, which generated the uncertain conditions that undermined decision making in the administrative system that operated in the post-disaster environment.

Earthquake

The earthquake that occurred on the morning of 26 December 2004 was located off the western coast of Sumatra, Indonesia. While this region had a long record of seismic activity, the earthquake occurred in a fault region that had not been particularly active during the preceding forty years (Hudnut 2006). Known as the Sunda Mega-Thrust Plate Boundary, this fault zone separates two massive tectonic plates, the Indo-Australian Plate and the Eurasian Plate. The Indo-Australian plate is in constant motion, and creeps northward at a rate of approximately 40 to 50 mm / year (Lay et al. 2005). The region's lack of recent seismic activity meant that scientists did not consider it as particularly dangerous for ruptures that would generate tsunamis.

According to Hiroo Kanamori (2006), a seismologist from the California Institute of Technology, the duration of the earthquake was more than eight minutes, and generated one of the largest seismic events ever recorded. The fault rupture began at "3.3°N, 96.0°E, at a depth of about 30 km, and then moved north at a speed of 2.5 km/s for a distance of 1200 to 1300 km (Ammon et al. 2005; Lay et al. 2005). In some areas, the slip distribution of the plates was extensive, with estimates that range from between ten and twenty-three meters (Ammon et al. 2005; Tanioka et al. 2006). This disruption heaved large sections of the ocean floor upward, which in some areas is estimated at approximately 10 meters (Ghobarah, Saatcioglu, and Nistor 2006). The energy released during this rupture, with a moment magnitude scale of 9.2, was enormous (Kanamori 2006). To place the size of this earthquake into perspective, the United States Geological Survey (2005) estimates that the earthquake was equivalent to the detonation of 474 megatons of TNT, which is roughly the same as 23,000 Nagasaki sized atomic bombs.

Tsunami

Prior to 2004, concerns about tsunamis were directed towards regions south of Sumatra (Hudnut 2006). Yet the movement of the tectonic plates on the morning of 26 December 2004 displaced a large column of water, pushing it up towards the surface. The resulting tsunami waves quickly spread throughout the Indian Ocean, and were eventually detected around the globe (Titov et al. 2005). Charles G. Groat, Director of the United States Geological Survey, made the following statement to the Committee on Science for the United States House of Representatives:

“A great deal of that energy was transferred to the Indian Ocean’s waters and ultimately to its surrounding shores. Along the length of the rupture, the seafloor was jolted upward by as much as 15 feet, lifting trillions of gallons of sea water – a volume more than 30 times that of the Great Salt Lake – and generating a tsunami that swept both east, inundating the coast of Sumatra, Thailand and Burma, and west, crossing the open ocean at hundreds of miles per hour on its way to the coasts of India, Sri Lanka, and eventually eastern Africa” (United States House of Representatives 2005, pp. 2-3).

The scope of the consequences generated by the tsunami made it the Indian Ocean region’s first true multi-national disaster. The countries impacted most severely, Indonesia, Sri Lanka, India, the Maldives and Thailand, were victims of their geographic location. The speed and size of the tsunami made the event unique. The tsunami traveled across the Indian Ocean at speeds in excess of 500 km/h (Telford, Cosgrave, and Houghton 2006), and when the wave came ashore, for instance in Lhoknga and Banda Aceh, Indonesia, it exceeded heights of 30 meters and 9 meters, respectively (Borrero, Synolakis, and Fritz 2006). The tsunami also came as a complete surprise to those affected. In many communities, there was less than fifteen minutes between the earthquake and the impact of the tsunami. In other areas, the lack of awareness in communities about the threats posed by tsunami increased the losses (McAdoo et al. 2006).

4.1.4.2 Consequences of the Disaster

The earthquake and tsunami events of 26 December 2004 were also unique because of the consequences they generated. Although the final costs of the disaster will never be known, these events inflicted significant damage to Indonesia's population and infrastructure.

Impact to Population

The morning of 26 December 2004 began like almost any other, with families going about their daily affairs, fishermen working the coasts, and communities gathering on the beach for holiday festivities. After the shaking generated by the earthquake stopped, many people ran out into the streets. Others focused their attention on freeing the victims who had become trapped in the rubble. Lacking awareness and an integrated tsunami warning system, those who lived along the coast had no idea that the receding coastal waters meant that a tsunami was rapidly approaching their communities. The extent to which these communities were unprepared for disasters caused by tsunamis is revealed by statistics collected from the countries affected by the event.

According to the *Tsunami Evaluation Coalition Synthesis Report*, the countries that were the most affected by the tsunami were Indonesia, Sri Lanka, India, Thailand and the Maldives Islands, with a total of 227,000 deaths and 1.7 million displaced persons (Telford, Cosgrave, and Houghton 2006, p. 16). The statistics for Indonesia were particularly troubling. By the end of January 2004, officials had reported 110,229 deaths, the majority of which were located in the city of Banda Aceh, the capital of the Aceh Province (Badan Perencanaan Pembangunan Nasional and World Bank 2005, p. 5). These numbers are especially high, given that at the time of the tsunami, there were approximately 4.4 million people living in Aceh, of which 50% were affected by the disaster (Badan Perencanaan Pembangunan Nasional and World Bank 2005, p.

13). A massive number of people were also displaced from their homes. Government estimates at the time indicated that 600,000 and 700,000 Indonesians would need some form of government assistance (Badan Perencanaan Pembangunan Nasional and World Bank 2005, p. 9; Telford, Cosgrave, and Houghton 2006, p. 59). The consequences of the tsunami exacerbated the humanitarian issues that already existed in the Aceh, and made clear that external intervention would be needed to stabilize the situation and to facilitate disaster response activities.

Impact to Infrastructure

The event also destroyed large sections of Indonesia's infrastructure, particularly in Aceh. The dual nature of the disaster event meant that the damage was not limited to the coast. Rather, the earthquake destroyed infrastructure throughout the island of Sumatra. According to Indonesia's *Preliminary Damage and Loss Assessment*, "damage and losses to infrastructure totaled Rp. 8.2 trillion and were dominated by the damage to the transportation [system] (61% of total impact) and irrigation, flood control and coastal protection [systems] (25%), with 7.7% in energy [systems], 3.4% in water and sanitation [systems], and 2.5% in communication [systems]" (Badan Perencanaan Pembangunan Nasional and World Bank 2005, p. 32).

Table 5: Total Damage Estimates Across all Infrastructure Sectors (US\$ Million)

	<i>Total Impact</i>			<i>Property</i>	
	Damage	Losses	Total	Private	Public
Social Sectors	1,674.9	65.8	1,740.7	1,440.6	300.1
Housing	1,398.3	38.8	1,437.1	1,408.4	28.7
Education	110.8	17.6	128.4	9.0	119.4
Health	82.5	9.4	91.9	23.2	68.6
Culture and Religion	83.4	-	83.4	-	83.4
Infrastructure	636.0	240.8	876.8	325.9	550.8
Transport	390.5	145.4	535.9	165.8	370.1
Communications	18.9	2.9	21.8	8.6	13.2
Energy	67.8	0.1	67.9	1.1	66.9
Water and Sanitation	26.6	3.2	29.8	18.3	11.4
Flood Control, Irrigation, Protection	132.1	89.1	221.2	132.1	89.1
Productive Sectors	351.9	830.2	1,182.1	1,132.0	50.1
Agriculture and Livestock	83.9	140.9	224.8	194.7	29.9
Fisheries	101.5	409.4	510.9	508.5	2.5
Enterprises	166.6	280.0	446.6	428.9	17.7
Cross Sectoral	257.7	394.4	652.0	562.9	89.1
Environment	154.5	-	154.4	548.9	N/A
Governance and Administration	89.1	-	89.1	-	89.1
Bank and Finance	14.0	-	14.0	14.0	N/A
Total Impact	2,920.5	1,531.2	4,451.6	3,461.4	990.1

The total estimated cost of the damage inflicted to Indonesian infrastructure was reported by Badan Perencanaan Pembangunan Nasional (*hereafter BAPPENAS*), Indonesia’s State National Planning Development Agency and the World Bank. These estimates are presented in Table 5, which indicate that the damage was distributed across a wide variety of infrastructure sectors. Indonesia’s *Preliminary Damage and Loss Assessment Report* separates these data into their component elements, which are provided in Table 6 (Badan Perencanaan Pembangunan Nasional and World Bank 2005, p. 33). Four categories of infrastructure deserve specific attention. The first category is transportation infrastructure, where “19% of the primary roads,

46% of bridges and over 50% of the secondary roads were impacted in the affected area” (Badan Perencanaan Pembangunan Nasional and World Bank 2005, p. 35).

Table 6: Damage within Each Sector (Rp. Billion)

	Total	Impact		Property	
		Damages	Losses	Public	Private
Transport	4,984	3,632	1,352	3,442	1,542
Roads	1,735	1,576	159	1,635	100
Land Transport	2,944	1,803	1,142	1,503	1,442
Ports	259	237	22	259	0
Airports	46	17	29	46	0
Water and Sanitation	276	247	29	106	170
Water Supply	267	238	29	97	170
Sanitation	9	9	N/A	9	0
Energy	632	631	1	622	10
Electric Power	500	500	N/A	500	0
Petroleum	132	131	1	122	10
Communications	203	176	27	123	80
Telecommunications	194	167	27	114	80
Postal Services	9	9	0	9	0
Flood Control / Irrigation	2,058	1,230	829	1,229	829
Irrigation	542	543	120	542	0
Flood Control	1,355	687	829	709	829
Total	8,153	5,916	2,238	5,522	2,631

Equally problematic was the disruption of transportation facilities; where all 19 port facilities in the region suffered damage, as well as 4 of the region’s 7 major airports. The second category is communication infrastructure, where large portions of the fixed and cellular phone services were disrupted, which constrained communications. The third category is water and sanitation infrastructure, where both urban and rural systems suffered substantial damage. For instance, while urban systems were stressed by disruptions in its purification and distribution networks, only about 9% of those who lived in Aceh received water through such networks (Scawthorn et al. 2006). The rest of the population received water from other sources, and

estimates suggest that all affected region's wells and hand pumps were damaged or contaminated (Badan Perencanaan Pembangunan Nasional and World Bank 2005, pp. 34 & 47).

While not reported in Table 6, the final category relates to the damage inflicted to the housing infrastructure, which explains the extremely high numbers of displaced persons (Badan Perencanaan Pembangunan Nasional and World Bank 2005, pp. 33). In December of 2004, there were approximately 820,000 buildings located in the affected districts, of which 151,600 or 19% suffered "an average of about 50% damage," while an additional 127,000 or 14% were totally destroyed (Badan Perencanaan Pembangunan Nasional and World Bank 2005, p. 26). Clearly, the damage inflicted to Indonesian society and infrastructure created substantial difficulties, not just for those who lived in affected communities, but also for the organizations that would participate in the administrative system responsible for disaster response activities.

4.1.5 Indonesia's Capacity to Adapt in Uncertain Conditions

In the hours immediately following the earthquake and tsunami, Indonesia's domestic response system government did not have the administrative capacity to formulate an effective response to the disaster. The problems experienced in the post-tsunami environment reflected the destruction of communication and transportation infrastructures, the loss of governmental offices and resources, and most importantly, the loss of governmental personnel. The destruction was so vast that the local governments, especially those located in Aceh, were simply unable to function.

Under the disaster management laws that existed at the time of the tsunami, Indonesia's national military was charged with the responsibility to initiate disaster relief efforts, including the establishment of camps that would provide assistance to those affected by the disaster. Also

affected by the earthquake and tsunami, the TNI suffered damage to its equipment and personnel. Further, as a consequence of the conflict in Aceh, local populations looked upon the TNI with distrust, and were generally unwilling to receive assistance from Indonesian officials, military or otherwise (Comfort 2007). Faced with a deteriorating situation, the Indonesian government quickly recognized that it had to do something to avoid an even larger crisis.

After rejecting offers of assistance from the international community, President Susilo Bambang Yudhoyono, who had only been in office for three months, opened Aceh to external assistance. In making this decision, the Indonesian government accepted the requirement that response operations would be executed in accordance with United Nations guidelines. These guidelines set the conditions within which the response would unfold, ensuring that operations would be easier to manage. These operational boundaries, in conjunction with the inundation of international organizations, helped to release the burdens placed on domestic organizations.

The disruption of the administrative system that was responsible for disaster management in Indonesia prior to the tsunami meant that the domestic and international organizations had to respond to the disaster in an ad hoc and unscripted manner. Compounding a litany of already existing problems, when the response organizations arrived on scene, they lacked base-line information about the affected communities, mechanisms for information exchange, relevant operational procedures, and operational plans that would facilitate coordination. The heterogeneous system of response organizations had to learn how to coordinate activities vertically, across jurisdictional levels, and horizontally, across organizational sectors. Response organizations also had to develop innovative solutions to problems without resorting to the consensus-based processes of policy making that permeated Indonesia's political institutions.

These conditions indicate that the administrative system that emerged to operate in Indonesia after the 2004 Sumatran Earthquake and Tsunami represents a relevant case for the examination of administrative resilience. While the response organizations had to conduct their operations in an environment that was constrained by uncertainty, they managed to create an administrative system of unprecedented size, diversity, flexibility and capacity. More importantly, supported by the contributions of a generous international community, and the willingness of the Indonesian government to support their activities, the response organizations demonstrated the capacity to adapt and self-organize during the month after the tsunami. In just a matter of weeks, these response organizations established one of the largest disaster relief operations in history. The subsequent chapters of this study evaluate the resilience of this administrative system by examining its composition, growth and structural evolution during the twenty-two days that followed the earthquake and tsunami.

5.0 COMPOSITION AND DEVELOPMENT OF ADMINISTRATIVE SYSTEM

“Were they prepared to respond to what happened in Aceh? Probably not. Would anybody have been? I think it was an exceptional event. Did they respond effectively? Yes. Yes. They responded very effectively and very rapidly. After the first 48 hours of going, ‘we don’t know what has happened’” (Respondent 17 2009). This statement, provided by an official who worked in an international organization, indicates that after a brief period of shock, the administrative system that operated in Indonesia after the Great Sumatran Earthquake and Tsunami quickly coalesced and began to organize a response to the devastating event. While this conclusion is widely accepted among disaster management practitioners (Telford, Cosgrave, and Houghton 2006), there is little empirical data that actually tracks the development of this administrative response system. Chapter five addresses the research question: to what extent did the organizations that conducted operations in Indonesia after the Great Sumatran Earthquake and Tsunami of 26 December 2004 facilitate the development of the administrative response system? This analysis explored four sub-questions. First, what was the system’s size and composition? Second, at what rate did organizations enter the system? Third, what was the system’s rate of growth? Finally, what was the nature of the transactions that occurred in the system?

5.1 COMPOSITION OF ADMINISTRATIVE SYSTEM

The administrative system that operated in Indonesia after the tsunami was large and complex. In describing this system, an official recalled that, “during the relief, emergency relief and response, actually I think it was quite chaotic. And uh, yes, there were numerous organizations from overseas and the rest of Indonesia, who came with the idea of helping out, trying to support, and creating disaster relief and all that (Respondent 33 2009). Given the influx of organizations into Indonesia after the tsunami, what was the character of the administrative response system?

5.1.1 Full Administrative System

A total of 909 organizations were identified in the full administrative system, that is, all organizations that were reported as participating in response operations following the earthquake and tsunami. As Table 7 indicates, when categorized according to their source of funding, 591 or 65.02% of the organizations were classified as public, 141 or 15.51% were classified as private, and 169 or 18.59% were classified as non-profit. This distribution confirms that public organizations played the dominant role in the administrative response to the tsunami.

When categorized by level of jurisdiction, the distribution of the data revealed that Indonesia’s administrative response system was populated by a diverse range of organizations. Of the organizations identified in the full system, 425 or 46.75% were classified as international, meaning they came from jurisdictions outside of Indonesia. These organizations included non-governmental organizations such as the World Health Organization, and foreign governmental organizations such as the Government of Singapore and the United States Navy. The remainder of the organizations, 484 or 53.25%, were classified as domestic, meaning they originated from

inside Indonesia. Of these, 209 or 22.99% were national, 61 or 6.71% were provincial, and 214 or 23.54% were local. Each of these classifications contained a variety of organizations. For instance, national organizations included the Office of the President of the Republic of Indonesia and the Ministry of Health for the Republic of Indonesia. The provincial organizations included the Office of the Governor of North Sumatra Province and the Social Welfare Agency of North Aceh Province. Local organizations included the Medan Polonia Airport, the City of Sabang and the Cipto Magunkusumo General Hospital.

Table 7: Distribution of Organizations Identified in the Full System

		Source of Funding									
		Public		Private		Non-Profit		Special Interest		Totals	
		N	%	N	%	N	%	N	%	N	%
Level of Jurisdiction	International	282	31.02	48	5.28	93	10.23	2	0.22	425	46.75
	National	99	10.89	53	5.83	52	5.72	5	0.55	209	22.99
	Provincial	46	5.06	2	0.22	12	1.32	1	0.11	61	6.71
	Local	164	18.04	38	4.18	12	1.32	0	0.00	214	23.54
	Totals	591	65.02	141	15.51	169	18.59	8	0.88	909	100

A similar pattern existed within the source of funding categories, where 282 or 47.71% of the 591 public organizations identified in the full system were classified as international. The number of international public organizations in the system is balanced by the number of domestic public organizations, at 309 or 52.28%. Table 7 also indicates that non-profit

organizations were well represented in the full system at 169 or 18.59% of all organizations. The majority of these, 93 or 55.02% were as international. Likewise, 141 or 15.51% of the organizations in the full system were private, of which 53 or 37.58% were national. Even though the results indicate a bias towards public organizations, the full system was clearly comprised of a heterogeneous collection of organizations.

5.1.2 Core Administrative System

After the non-critical organizations and interactions were removed from the full system dataset, 560 distinct organizations remained. These organizations formed the core administrative system. As Table 8 indicates, the distribution of organizations in the core system closely matches the distribution of the organizations in the full system. In terms of their source of funding, 383 or 68.39% of the organizations in the core system were classified as public, 62 or 11.07% were classified as private, and 109 or 19.46% were classified as non-profit. In terms of their level of jurisdiction, the distribution of organizations was relatively balanced, with 258 or 46.07% of the organizations classified as international, and 302 or 53.93% classified as domestic. These data confirm that many of the organizations that operated in the core system were international, and document that Indonesia received assistance from organizations from around the world.

The core system was heavily populated with public organizations. Of the 383 public organizations, 166 or 43.34% were classified as international and 217 or 56.66% were classified as domestic. These data also indicate that domestic public organizations also had a significant presence in the core system. Interestingly, the balance between the domestic and international organizations was reversed for organizations classified as private. Of the 62 private

organizations, 22 or 35.48% of them were international. Examples of private organizations included multinational corporations like TNT Express World Wide and International Business Machines. Corporations based in Indonesia, for instance, PT Aceh Media Grafika or Garuda Indonesian represented 40 or 64.52% of the private organizations. Many of the private organizations that operated in the core system were involved in the transportation of relief supplies and personnel to the tsunami affected areas. A complete list of the organizations identified in the core administrative system is provided in Appendix H.

Table 8: Distribution of Organizations Identified in the Core System

		Source of Funding									
		Public		Private		Non-Profit		Special Interest		Totals	
		N	%	N	%	N	%	N	%	N	%
Level of Jurisdiction	International	166	29.64	22	3.93	68	12.14	2	0.36	258	46.07
	National	69	12.32	23	4.11	26	4.64	3	0.54	121	21.61
	Provincial	35	6.25	1	0.18	7	1.25	0	0.00	43	7.68
	Local	113	20.18	16	2.86	8	1.43	1	0.18	138	24.64
	Totals	383	68.39	62	11.07	109	19.46	6	1.07	560	100

5.2 RATE OF ENTRY INTO THE ADMINISTRATIVE SYSTEM

“One week after the tsunami, they started bringing in logistics, but the problem is [with] the logistics going into the airport in Medan. They have problems to bring logistics from Medan to Aceh because the roads were destroyed and they [do not have] trucks. [Even if they] have trucks, they have no road. All the bridges had been wiped out” (Respondent 5 2009). The remote location of the communities affected by the tsunami, as well as the damage to the transportation infrastructure in the tsunami affected regions, made it difficult for response organizations to access the disaster site. These findings represent the first of a series of longitudinal inquiries into the daily changes that occurred in the core system and its constituent sub-systems.

5.2.1 Domestic Administrative Sub-System

A total of 302 organizations were identified in the domestic administrative sub-system. The entry of these organizations into the response system was plotted by date, by date and level of jurisdiction, and by date and source of funding.

5.2.1.1 Entry by Date

Figure 7 indicates that the rate at which organizations entered the domestic sub-system fluctuated. The most active day occurred on 27 December 2004, when 53 or 17.55% of the organizations entered the sub-system. The least active days occurred on the 8th, 12th and 14th of January 2005, when only 2 or 0.66% of the organizations entered. The trend line of the two period moving averages for these data has a downward slope, which indicates that the rate of entry for organizations was highest immediately after the tsunami, and then began decrease.

These data indicate that the domestic sub-system experienced three distinct periods of organizational entry. The first spanned from 26 December 2004 to 30 December 2004, when 150 or 49.67% of the total number of organizations entered the sub-system. These organizations included initial responders, such as the Tentara Nasional Indoineais and Kepolisian Negara Republik Indonesia, which were concerned about conducting assessments of the affected communities and securing the impact areas. The second spanned the dates, 31 December 2004 to 7 January 2005, when 104 or 34.44% of the total number of organizations entered the sub-system. The third spanned the dates, 8 January 2005 to 16 January 2005, where 48 or 15.89% of the total number of organizations entered the sub-system.

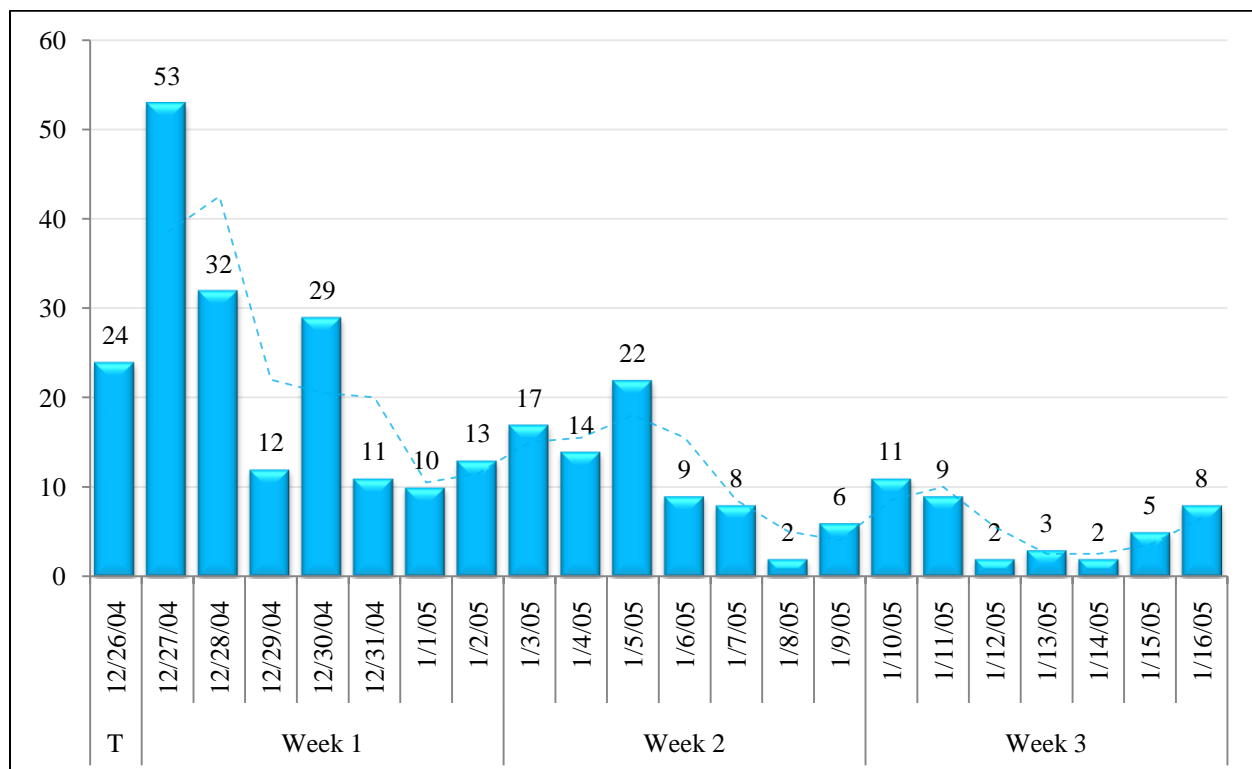


Figure 7: Number of New Organizations Entering the Domestic Sub-System by Date

5.2.1.2 Entry by Date and Level of Jurisdiction

Further analysis considered the entry of organizations into the domestic sub-system by date and level of jurisdiction. These results are presented in Figure 8, which indicate that organizations from different levels of jurisdiction entered the sub-system on different dates and at different rates. The most active day for local organizations occurred on 27 December 2004, when 30 or 9.93% of the total number of organizations were observed operating in the sub-system. The most active day for national organizations also occurred on this date, when 16 or 5.25% of the organizations were observed entering the sub-system. These data indicate that local organizations such as radio stations, military outposts, and hospitals were quick to respond to the disaster.

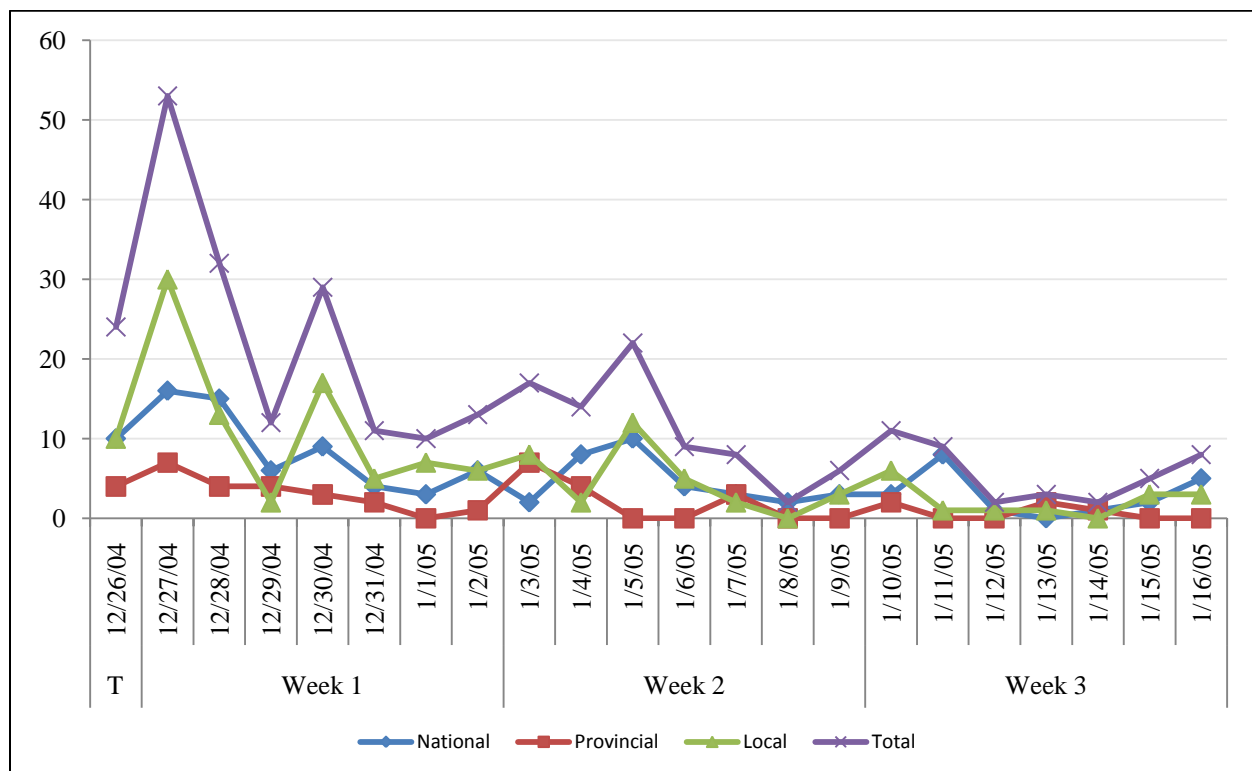


Figure 8: Entry of New Organizations into the Domestic Sub-System by Jurisdiction

The access rates for organizations classified as local had three separate spikes. The initial spike occurred on 27 December 2004, when 30 local organizations, representing 9.93% of all domestic organizations, entered the system. The second and third spikes occurred on 30 December 2004 and 5 January 2005, when the number of new local organizations identified entering the sub-system were 17 or 5.63% and 12 or 3.97% respectively. A similar access pattern is observed with organizations classified as national, where the detection rates of organizational access peaked on 27 December 2004, 30 December 2004 and 5 January 2005. During the six days that preceded the second spike, 56 or 46.28% of all national organizations, entered the sub-system. These data show that there are common patterns, in terms of entry rates, among the response organizations classified as national, provincial and local.

5.2.1.3 Entry by Date and Source of Funding

Figure 9 indicates that the domestic sub-system was comprised of a large number of public organizations. These data indicate that public organizations did not enter the domestic sub-system at the exact same time. The most active day for public organizations occurred on 27 December 2004, where 41 or 13.57% of the total number of public organizations entered the sub-system. The number of new public organizations peaked again on 5 January 2005, when an additional 18 organizations entered the sub-system. The final peak is of particular interest, given that it may suggest that the activities of the domestic sub-system may have changed, perhaps the result of a transition in focus from response activities to recovery activities. By comparison, the other three classifications of organizations entered the domestic sub-system at rates lower than the public organizations. The most active day for non-profits occurred on 30 December 2004. Even so, their numbers only represented 6 or 1.98% of all organizations identified in the sub-

system. In a similar fashion, the access rate of private organizations, which peaked on 27 December 2004, remained low during the period considered by this study. Organizations classified as special interest, which included political parties, were not represented in the sub-system in high numbers, as they were not frequently observed in the source materials.

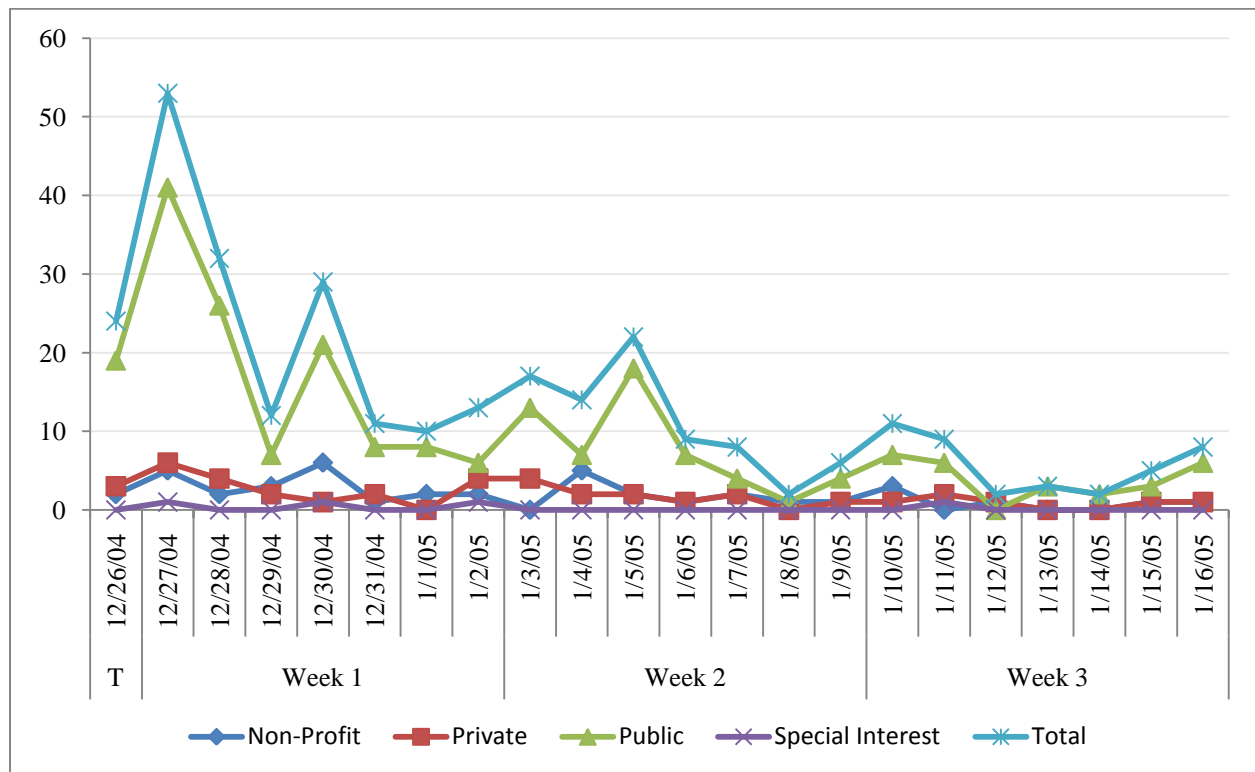


Figure 9: Entry of New Organizations into the Domestic Sub-System by Funding Source

5.2.2 International Administrative Sub-System

A total of 258 organizations were reported as participating in the international administrative sub-system. The entry of these organizations into the response system was plotted by date, by date and level of jurisdiction, and by date and source of funding.

5.2.2.1 Entry by Date

Figure 10 indicates that organizational entry into the international sub-system also fluctuated. The most active day was 27 December 2004, when 41 or 15.89% of the total number of newly identified international organizations entered the sub-system. The least active day occurred on 15 January 2005, when only 1 or 0.38% of the total number of newly identified organizations entered the sub-system. The trend line of the two period moving averages for these data also has a downward slope, which indicates that the rate of entry for organizations in the sub-system was highest immediately after the tsunami.

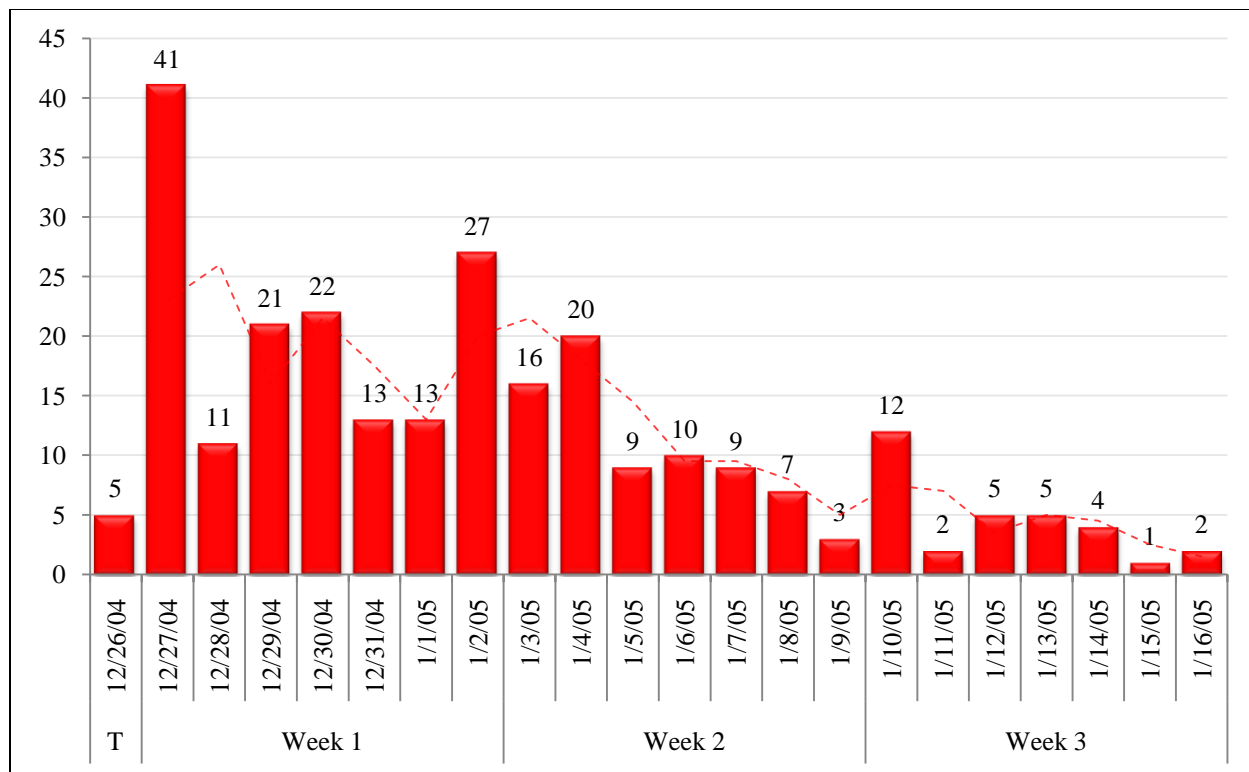


Figure 10: Number of New Organizations Entering the International Sub-System by Date

Like the domestic sub-system, the international sub-system experienced three distinct, but fluctuating, periods of organizational entry. The first spanned from 26 December 2004 to 30 December 2004, when 100 or 38.76% of the total number of newly identified international organizations entered the sub-system. The second spanned from 31 December 2004 to 4 January 2005, when 89 or 34.50% of the total number of international organizations entered the sub-system. The third spanned from 5 January 2005 to 16 January 2005, where 69 or 26.74% of the total number of organizations entered the sub-system.

5.2.2.2 Entry by Date and Source of Funding

Figure 11 indicates that, like the domestic sub-system, public organizations made up the majority of the newly identified organizations in the international sub-system. Organizations classified as public accounted for 166 or 64.34% of all identified international organizations. The most active day for new public organizations occurred on 27 December 2004, where they represented 35 or 20.08% of the all identified public international organizations. The other three classifications of organizations entered the sub-system at lower rates. Even so, peaks in organizational access rates were also observed for this classification of organizations. For example, the entry rate for newly identified non-profits was the highest from 2 January 2005 through 10 January 2005, when 40 or 58.82% of all non-profit organizations were observed entering the sub-system. During this same time, private organizations were also active; with 15 or 68.18% of all new private organizations entering the sub-system. Again, organizations classified as special interest were not well represented in the international sub-system, accounting for only 2 or 0.07% of all organizations.

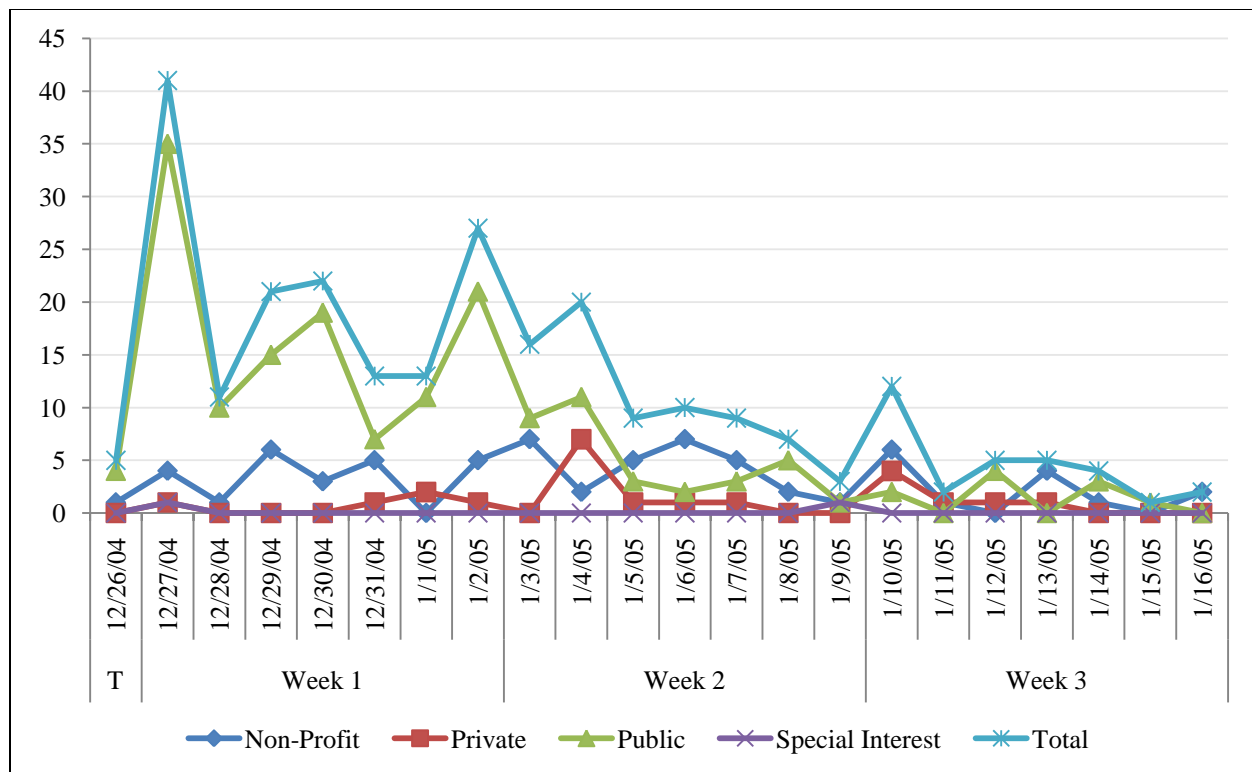


Figure 11: Entry of New Organizations into the International Sub-System by Funding Source

Further analysis indicates that public organizations entered the international sub-system during two critical periods. The first occurred during the six days after the tsunami, where 90 or 54.21% of all public organizations entered the sub-system. The second occurred between 1 January 2005 and 6 January 2005, when an additional 57 or 34.33% of all public organizations entered the sub-system. Although identified at lower rates, there were similarities in the rate at which international non-profits responded to the tsunami. For instance, during five days after the tsunami, the number of non-profit organizations operating in the sub-system stood at 15 or 22.06% of all identified non-profit organizations. A second wave of non-profits entered between 2 January 2005 and 7 January 2005, when 31 or 45.59% of all identified non-profit organizations

entered. Alternatively, the most active day for private organizations did not occur until 4 January 2005, when 7 or 31.81% of all private organizations entered the sub-system.

5.2.3 Core Administrative System

A total of 650 organizations were identified in the core administrative system. The entry of these organizations into the response system was plotted by date, by date and level of jurisdiction, and by date and source of funding.

5.2.3.1 Entry by Date

Figure 12 indicates that the rate at which new organizations entered the core system also fluctuated. The most active day was 27 December 2004, when 94 or 16.79% of the total number of organizations were identified entering the system. The least active dates occurred on 14 January 2005 and 15 January 2005, when, on each date, only 6 or 1.07% of the total number of organizations were observed entering. The trend line for the data also has a downward slope, which indicates that the rate of entry for organizations in the core system was, like its two sub-systems, the highest during the period immediately after the tsunami. These data also indicate that the core system experienced three distinct, but fluctuating periods of organizational entry. The first spanned from 26 December 2004 to 30 December 2004, when 250 or 44.64% of the total number of newly identified organizations entered the system. The second spanned from 31 December 2004 to 7 January 2005, when 221 or 39.46% entered the system. The third period spanned from 8 January 2005 to 16 January 2005, when 89 or 15.90% entered the core system.

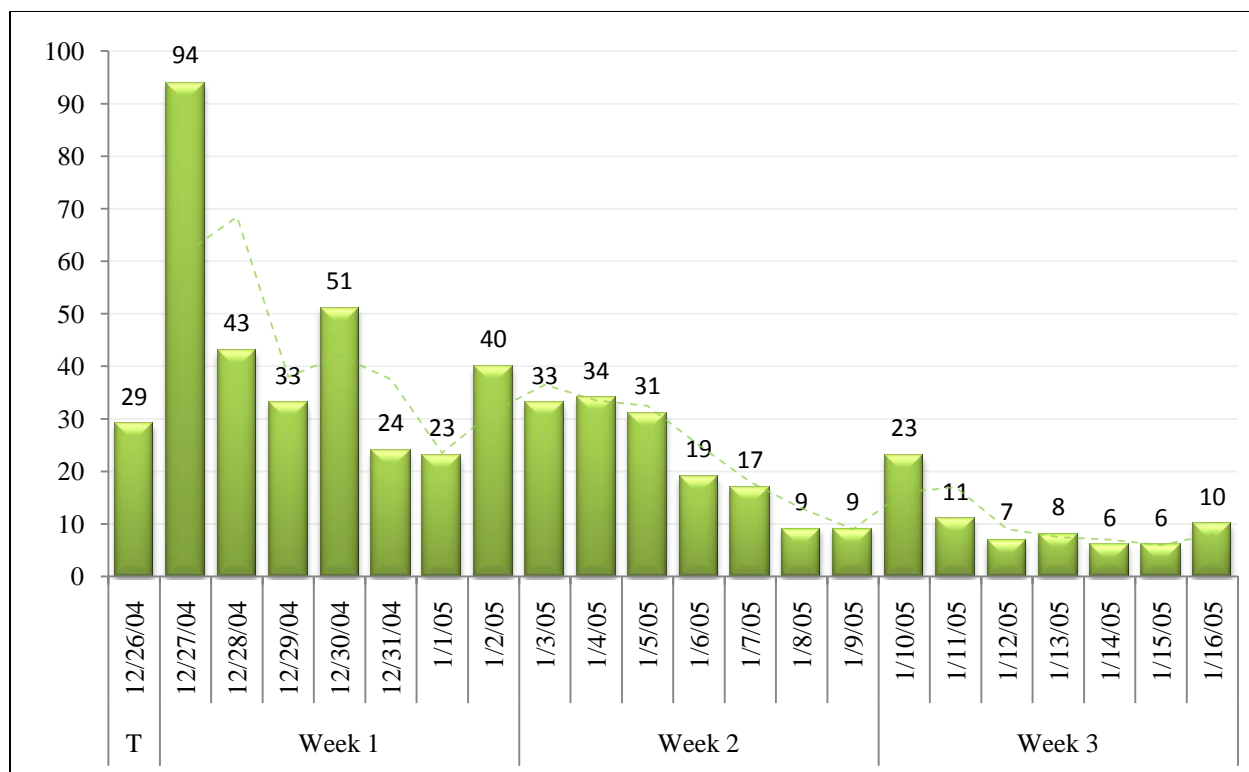


Figure 12: Entry of New Organizations into the Core System by Date

5.2.3.2 Entry by Date and Level of Jurisdiction

Further analysis separated the total number of new organizations that entered the core system by date and level of jurisdiction. These results are presented in Figure 13, which indicate that organizations from different levels of jurisdiction entered the core system on different dates and at different rates. The most active date occurred on 27 December 2004, where 41 or 15.89% of the total number of international organizations entered the system. New organizations classified as local were also active on that same date, when 30 or 21.89% of all local organizations entered the system. On that same day, the number of new national organizations also peaked, when 16 or 13.22% of the total number of national organizations entered the system. Other than a minor

peak on 3 January 2005, the number of new provincial organizations remained relatively stable. These data indicate that new organizations entered the core system rapidly, with 250 or 44.64% of the organizations entering the system between 26 December 2004 and 30 December 2004.

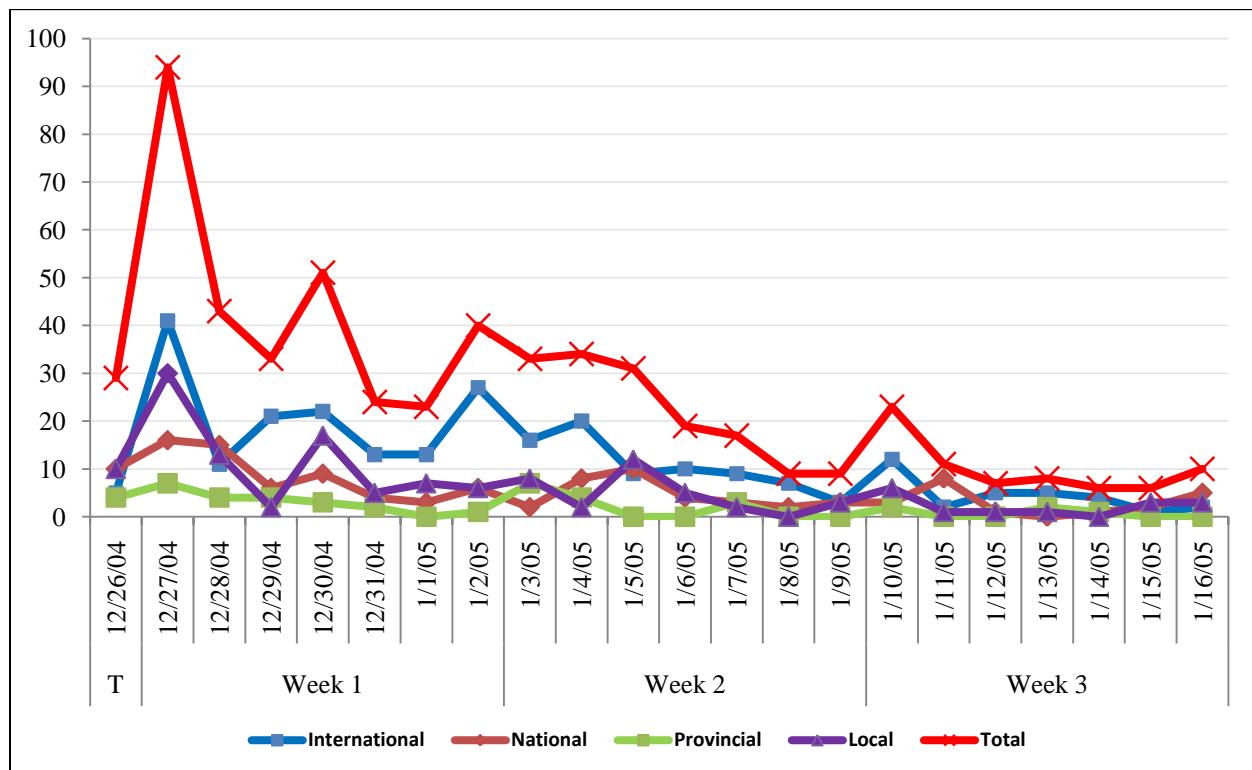


Figure 13: Entry of New Organizations into the Core System by Jurisdiction

There were also fluctuations in system entry by jurisdictional levels. The largest fluctuation occurred with international organizations, which experienced high, but inconstant, rates of entry until 4 January 2005. The new organizations classified as local, which had lower overall numbers, peaked three distinct times. The first occurred on 27 December 2004, and accounted for the entry of 30 or 21.89% of the total number of local organizations. The second

occurred on 30 December 2004, and accounted for the entry of 17 or 12.40% of the total number of local organizations. The third occurred on 5 January 2005, and accounted for the entry of 12 or 8.75% of the total number of local organizations. These three dates accounted for the entry of 59 or 43.06% of the total number of local organizations in the core administrative system.

5.2.3.3 Entry by Date and Source of Funding

The entry rates for new organizations categorized by source of funding into the core system are presented in Figure 14. Organizations classified as public accounted for 387 or 68.39% of all organizations in the system. The most active day for new public organizations occurred on 27 December 2004, when 76 or 19.84% of the total number of public organizations entered the system. Interestingly, the public organizations that joined the system on 27 December 2004 accounted for 13.57% of all organizations identified in the system. Other classes of organizations entered at substantially lower rates. For example, entry rates for new organizations classified as non-profit were the highest from 2 January 2005 through 10 January 2005, when 57 or 52.29% of all non-profit organizations were observed entering the system. During this time private organizations were also active; with 32 or 51.61% of all new private organizations entering the system. Again, special interest organizations were not represented in significant numbers.

Figure 14 also indicates that public organizations made up the majority of organizations identified in the core system. Public organizations were identified entering the system during two periods. The first occurred during the seven days after the tsunami, where 231 or 60.31% of all new public organizations entered. The second occurred during the next five days, when an additional 97 or 25.33% of public organizations entered. Although participating at lower overall rates, there were similarities in the number of non-profit organizations and private organizations

that responded to the event. For instance, during the three days after the tsunami, the number of non-profits in the system stood at 15 or 2.67% of all organizations. During the same period of time, the number of private organizations stood at 14 or 2.50% of all reported organization. These data suggest that private organizations, at least immediately after the tsunami, responded to the conditions generated by the tsunami just as quickly as their non-profit counterparts.

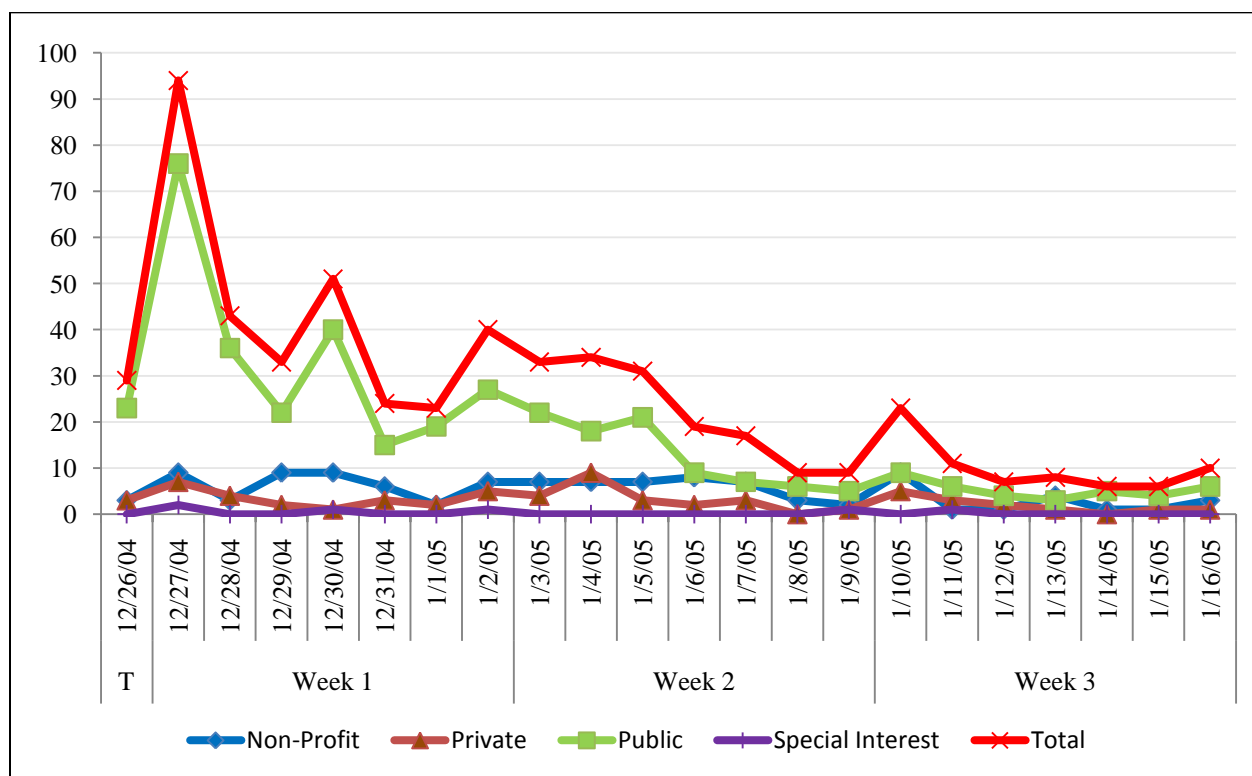


Figure 14: Entry of New Organizations into the Interacting System by Funding Source

5.3 GROWTH OF THE ADMINISTRATIVE SYSTEM

Once the Indonesian government opened up access to Aceh, thousands of response organizations immediately traveled to the tsunami-affected areas. In describing the organizational rush to provide disaster assistance, one respondent recalled that, “[organizations] just do what they do by their own. For example, when I stay in Aceh, a lot of groups on the first 7 or the first 14 days before the government set up [the] coordination, people just go spontaneously. I’m not coordinated yet, [at that time] (Respondent 52 2009). While coordination may have been lacking in the days that followed the tsunami, the organizational “rush to respond” enabled the administrative response system that operated in Indonesia to grow in both size and capacity.

5.3.1 Domestic Administrative Sub-System

The 302 distinct organizations identified in the domestic sub-system did not become active at the exact same time. Grouping the data by week indicates that the majority of growth in the domestic sub-system occurred during the week after the tsunami. During the week after the tsunami, which included the day of the tsunami, there were 184 organizations, 60.93% of all domestic organizations identified, operating in the sub-system. During the second week, 78 new organizations, or 25.83% of all domestic organizations identified, entered the system. The numbers dropped substantially during the final week, where only 40 new organizations, or 13.25% of all domestic organizations identified, entered the sub-system.

5.3.1.1 Daily Growth as Cumulative Total Number of Organizations

The daily growth rate of the domestic sub-system, measured as the cumulative total number of organizations identified in the source materials, increased steadily over time. The data presented in Figure 15 indicate that the domestic sub-system experienced periods of rapid growth and periods of slow growth. For instance, from 26 December 2004 through 30 December 2004, a total of 150 organizations entered the sub-system. These five days represent the most active period of growth. Growth then began to slow over the next three days, when only 34 newly organizations entered the sub-system. After 3 January 2005, growth began to accelerate, and 53 organizations entered the sub-system over the next three days. Around 11 January 2005, sub-system growth began to slow, as the number of newly identified organizations began to plateau.

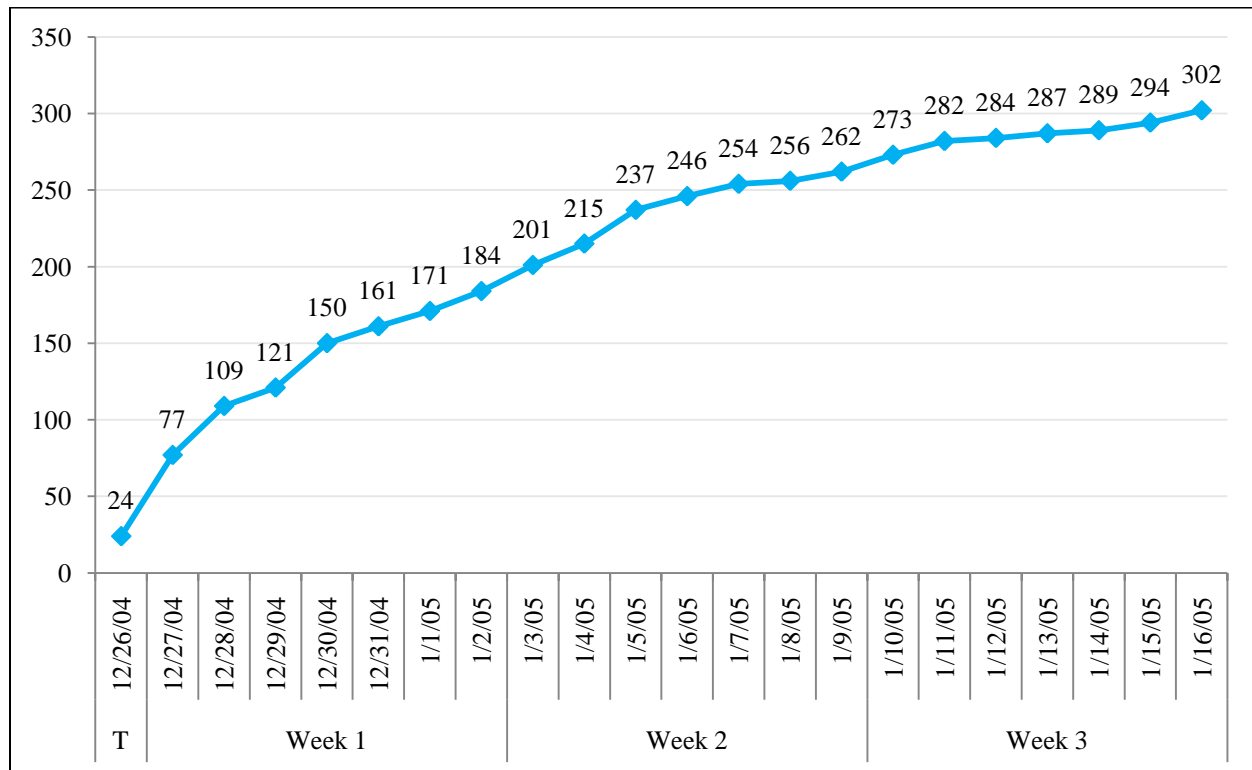


Figure 15: Growth of Domestic Sub-System as Cumulative Number of Organizations

5.3.1.2 Daily Growth as Cumulative Percentage of Organizations

The number of new organizations considered as a cumulative percentage of the total number of organizations is presented in Figure 16, which reveals two dates of significance. The first occurred on 30 December 2004, when the domestic sub-system reached 49.67% of its total size. After this date, the sub-system began to grow at a steady, but ever-increasing, rate. The second occurred on 7 January 2005, when 246 or 81.46% of all domestic organizations were identified operating in the sub-system. Since the growth that occurred after 6 January 2005 was relatively flat, these data seem suggest that the study successfully identified the majority of organizations that participated in the domestic administrative sub-system.

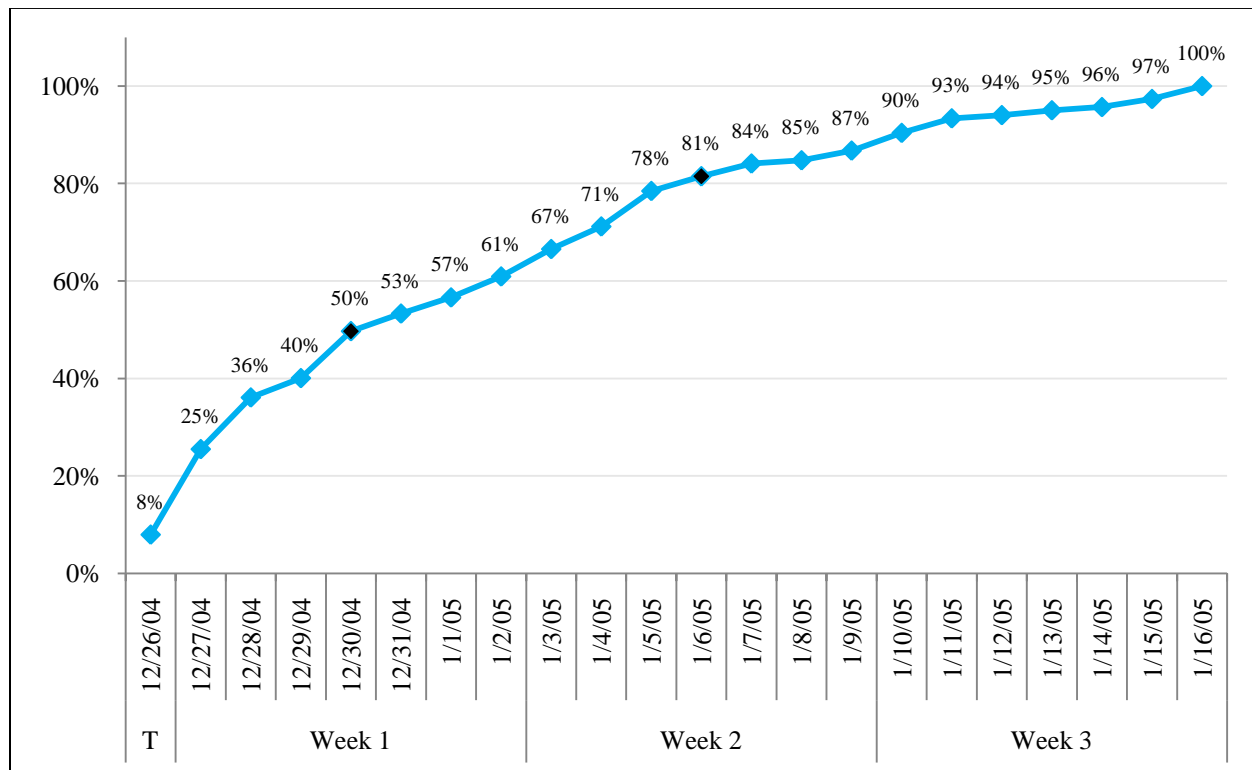


Figure 16: Growth of Domestic Sub-System as Cumulative Percentage of Organizations

5.3.2 International Administrative Sub-System

A total of 258 organizations were identified in the international sub-system. Like the organizations in the domestic sub-system, these organizations did not become active at the same time. During the week after the tsunami, which included the day of the tsunami, there were 153 organizations, 59.30% of all international organizations identified, operating in the sub-system. During the second week, 74 new organizations, or 28.68% of all international organizations identified, entered the sub-system. These numbers dropped during the third week, when only 31 new organizations, or 12.02% all international organizations identified, entered the sub-system.

5.3.2.1 Daily Growth as Cumulative Total Number of Organizations

The daily growth rate of the international sub-system, measured as the cumulative total number of organizations, also increased steadily over time. The data presented in Figure 17 indicate that the sub-system also experienced periods of rapid growth and periods of slow growth. For example, from 26 December 2004 through 30 December 2004, a total of 100 organizations entered the sub-system. These five days represent the sub-system's most active period of growth.

While the international organizations that were active in the sub-system at this time were busy preparing relief supplies, organizing financial assistance and logistics, many of them had yet to arrive in Indonesia. It was not until 30 December 2004 that the Indonesian government actually allowed international governmental and non-governmental organizations to enter Aceh. Nevertheless, many of the international organizations operated on the assumption that they would be provided access to the tsunami affected regions. This assumption worked to ensure that the international sub-system would continue to expand in both size and capacity, and the growth

rate of the sub-system continued over the next five days, albeit at a slower rate, when 89 new organizations entered the sub-system. The growth of the international sub-system did not begin to plateau until 10 January 2005, sixteen days after the tsunami.

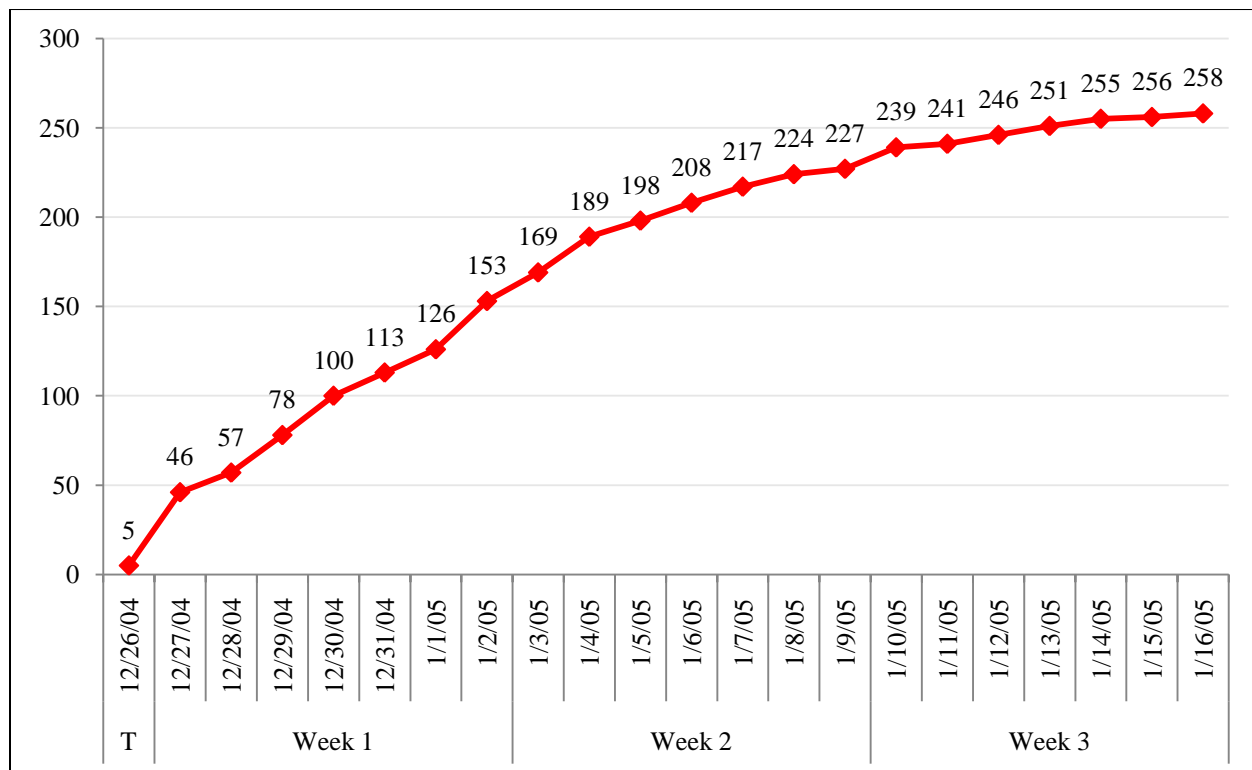


Figure 17: Growth of International Sub-System as Cumulative Number of Organizations

5.3.2.2 Daily Growth as Cumulative Percentage of Organizations

The cumulative percentage of the total number of organizations operating in the international sub-system is presented in Figure 18, which reveals two dates of significance. The first is 1 January 2005, when the sub-system reached 48.84% of its total size. After this date, perhaps due

to the change in policy by the Indonesian government towards international organizations, the sub-system began to grow at an increased rate. The second occurred on 6 January 2005, when 208 or 80.62% of all new organizations were identified operating in the sub-system. Since the growth that occurred after 6 January 2005 was at a reduced rate, this finding suggests that the study identified the majority of organizations that participated in the international sub-system.

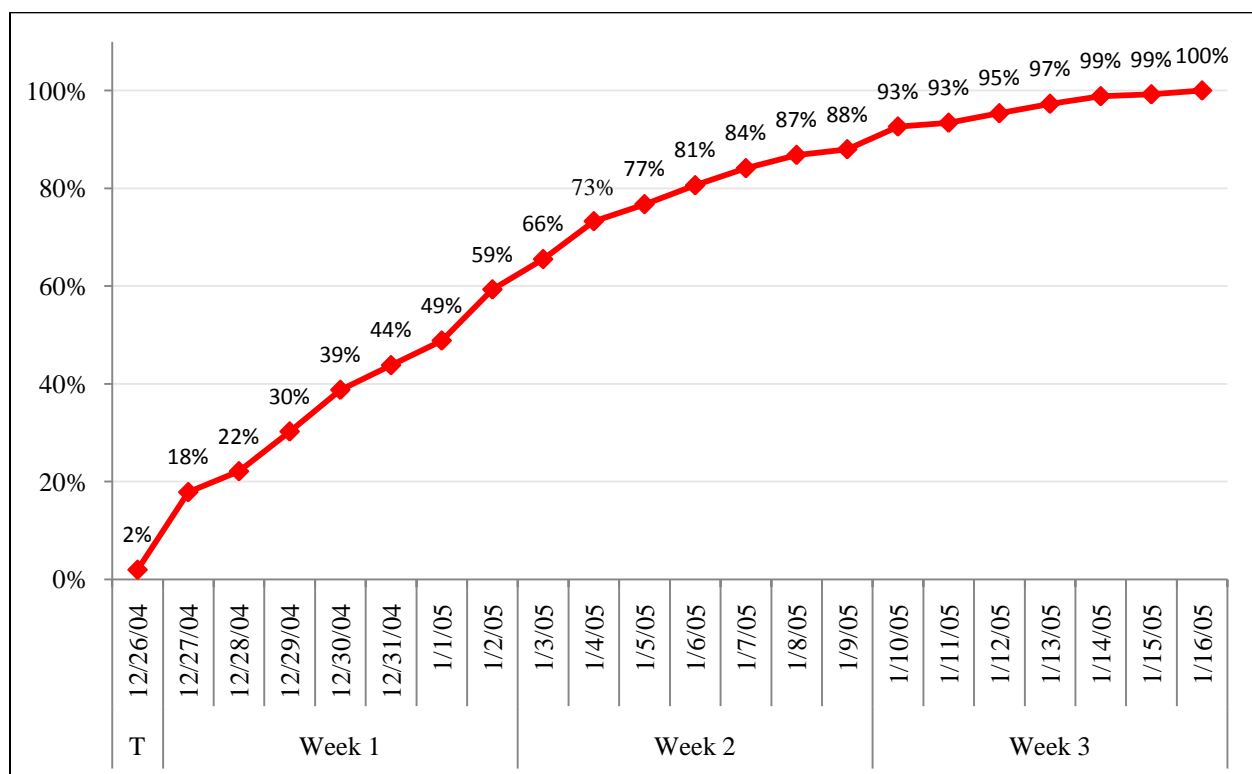


Figure 18: Growth of International Sub-System as Cumulative Percentage of Organizations

5.3.3 Core Administrative System

A total of 560 organizational were identified in the core system. Again, these organizations entered the system on different dates and at different rates. During the week after the tsunami, which includes 26 December 2004, there were 337 organizations, 60.18% of all organizations identified, operating in the system. During the second week, 152 new organizations, or 27.14% of all organizations identified, entered the system. These numbers dropped during the final week, when only 71 new organizations, or 12.60% all organizations identified, entered the system.

5.3.3.1 Daily Growth as Total Cumulative Number of Organizations

The daily growth of the core administrative system also steadily increased over time. The data presented in Figure 19 indicate that response organizations flooded into core system immediately after the tsunami. During the three days that followed the tsunami, a total of 166, or 29.64% of all identified organizations, had already entered the core system. Over the next ten days, until 7 January 2005, an additional 305, or 54.46% of all identified organizations, entered the core system. A large portion of this growth was the result of international organizations entering the system, especially after 30 December 2004. Like the domestic and international sub-systems, the growth of the core administrative system began to slow after 7 January 2005.

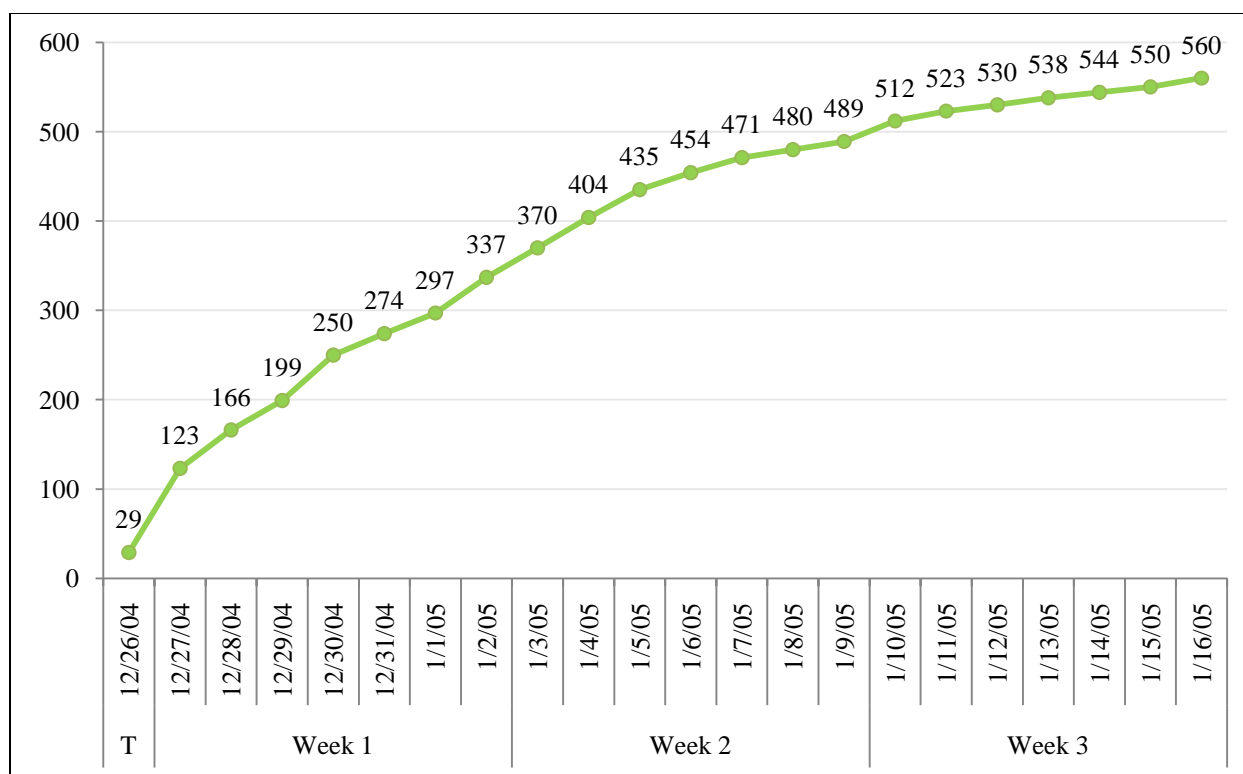


Figure 19: Growth of Core System as Cumulative Number of Organizations

The core administrative system's rate of growth seems to have been constrained on 29 December 2004, 31 December 2004 and 1 January 2005. These brief deviations from the core system's overall growth trend could be the result of distortions in the data analyzed by this study, for example, the under-reporting or over-reporting of response organizations in the source materials. Alternatively, these deviations could reflect structural or political problems within the core system, for example, the Indonesian government's hesitation to allow international organizations to access the tsunami affected regions.

5.3.3.2 Daily Growth as Cumulative Percentage of Organizations

The number of new organizations as a cumulative percentage of the total number of organizations in the core system is presented in Figure 20. These data indicate that the core system experienced two dates of significance related to system growth. The first occurred on 1 January 2005, when the system reached 53.04% of its total size. After this date, again perhaps due to the change in policy by the Indonesian government towards international organizations, the system began to grow at an increased rate. The second occurred on 6 January 2005, when 454 or 81.07% of all organizations in the system had been identified. The growth that occurred after 6 January 2005 was at a reduced rate, indicating that the study successfully identified the majority of organizations that participated in the core administrative system.

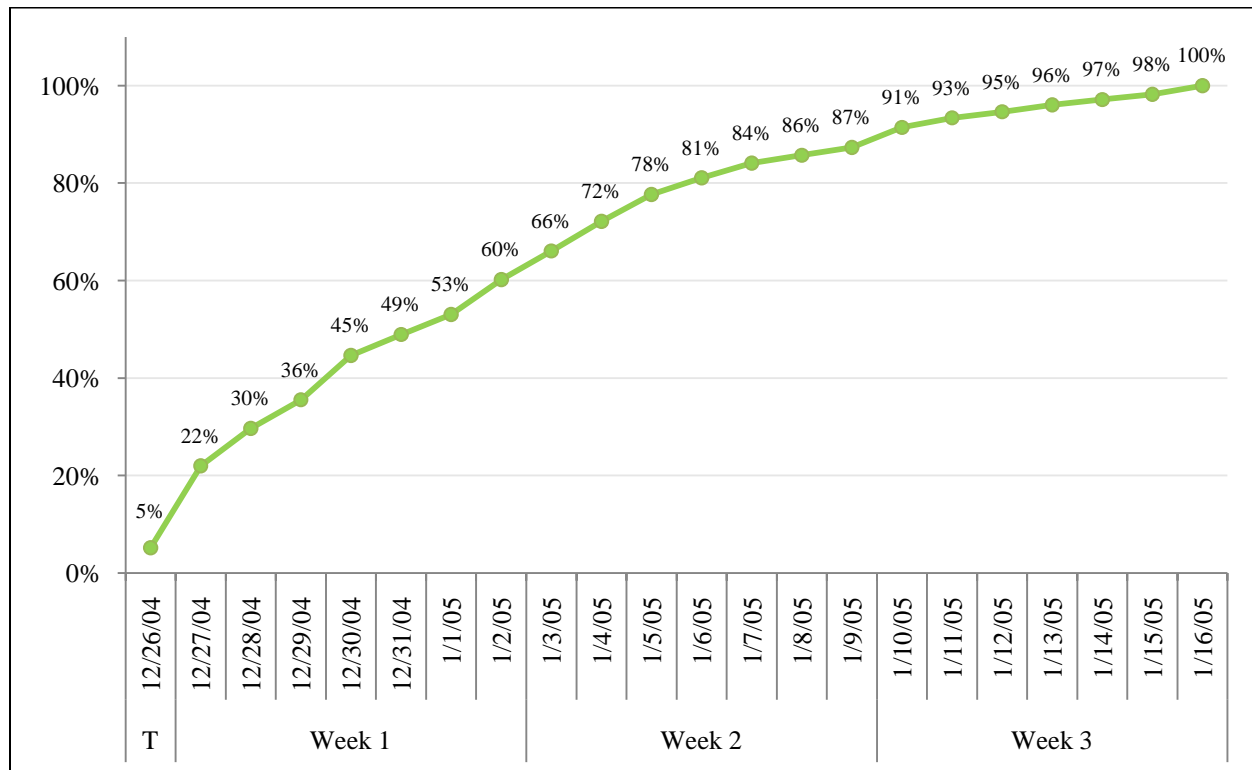


Figure 20: Growth of Core System as Cumulative Percentage of Organizations

5.4 TRANSACTIONS IN THE ADMINISTRATIVE SYSTEM

According to an official from an international non-governmental organization, the initial wave of disaster assistance was limited, “[the government] sent medicines, and the military started cleaning up. It wasn’t until the international NGOs came, that they actually brought help” (Respondent 36 2009). After the arrival of the international organizations, the administrative response system experienced an explosion of activity. This section identifies the activities that organizations were involved in after the tsunami. The transactions identified during the coding of the documentary sources were reviewed individually and classified according to whether they fell into one or more of the twenty transaction categories described in Appendix C.

5.4.1 Domestic Administrative Sub-System

The organizations identified in the domestic sub-system were observed participating in 466 individual transactions and 1,037 transaction observations, which were grouped into transaction categories and tallied. The complete set of transaction tallies is presented in Figure 21. The most frequently identified category of transactions identified the domestic sub-system involved activities related to health, at 178 or 17.16% of all transaction observations. The next most frequently identified category involved activities related to assessment, at 160 or 15.43%.

These results indicate that domestic organizations spent a large portion of their time working to resolve health related issues, for instance, the repair of medical facilities, the monitoring of infectious disease, and the delivery of doctors or medicine to affected populations. Domestic organizations also spent time assessing the damage caused by the disaster, the needs of the affected population, and the needs of the organizations that operated in the response system.

Of equal importance were the activities which fell into the transaction category of coordination and collaboration, at 146 or 14.08%, which indicates that domestic organizations did participate in activities related to the coordination of the response system. Of particular interest were the scores received for activities conducted in the areas of security, at 30 or 2.89%, and protection, at 8 or 0.77%. These low scores seem counterintuitive, given that issues related to the security of disaster response personnel and the protection of vulnerable populations received substantial media attention after the tsunami.

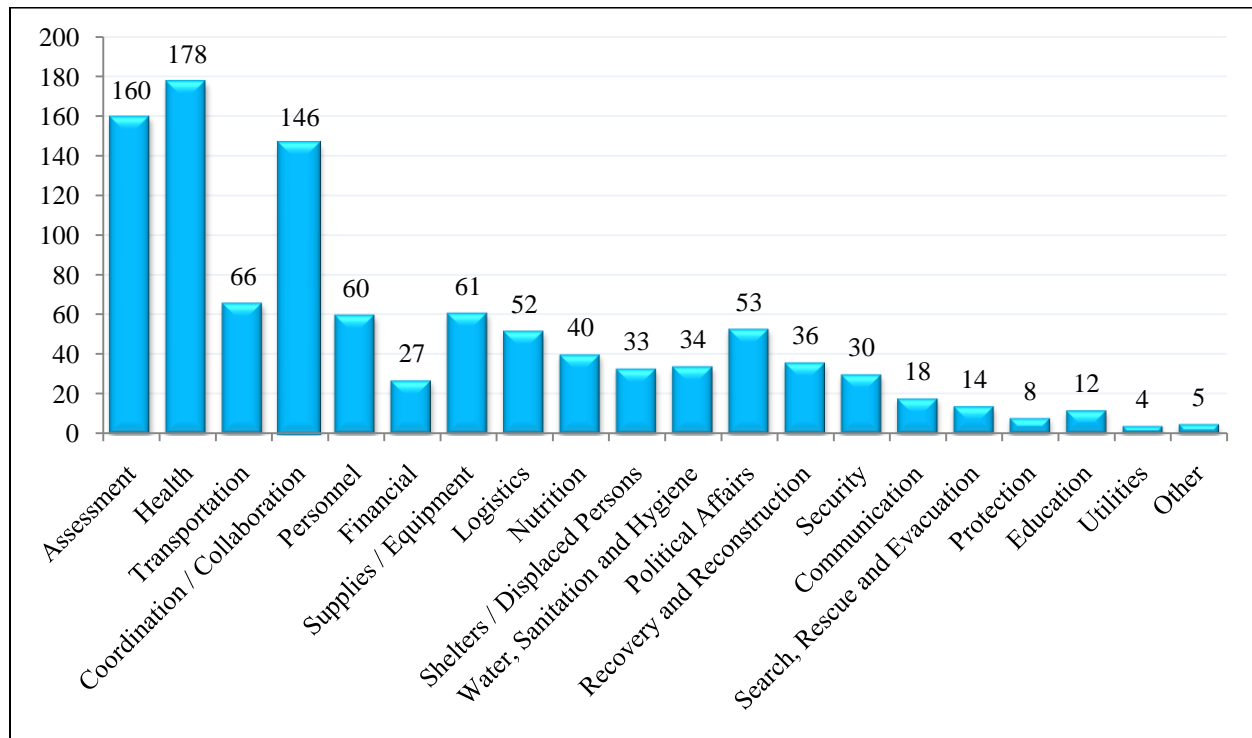


Figure 21: Number and Category of Transactions Identified in the Domestic Sub-System

5.4.2 International Administrative Sub-System

The organizations identified in the international sub-system were observed participating in 518 individual transactions and 1,337 transaction observations. The complete set of transaction tallies is presented in Figure 22. The focus of the international organizations differed from their domestic counterparts. The three most frequently identified activities that occurred in the international sub-system related to transportation, at 197 or 14.73%, coordination and collaboration, at 195 or 14.58%, and logistics, at 143 or 10.70%. These three categories represented 535 or 40.01% of all the transaction observations in the sub-system.

These data indicate that, unlike domestic organizations, international organizations were heavily involved in establishing the logistics component of the tsunami response system. Organizations such as the United Nations established logistics centers, not only for the nation of Indonesia, but for the entire Indian Ocean region. Helping to complete activities related to logistics were military units of foreign countries, which used their transportation equipment, for example, helicopters and amphibious landing craft, to distribute supplies to affected areas. International organizations, particularly the World Health Organization, were also focused on activities related to health, 153 at 11.37%, and were instrumental in the collection and distribution of medical supplies and the provision of health care services after the tsunami. Like their domestic counterparts, international organizations did not seem to be heavily involved in activities related to security, at 5 or 0.37%, or protection, at 9 or 0.67%.

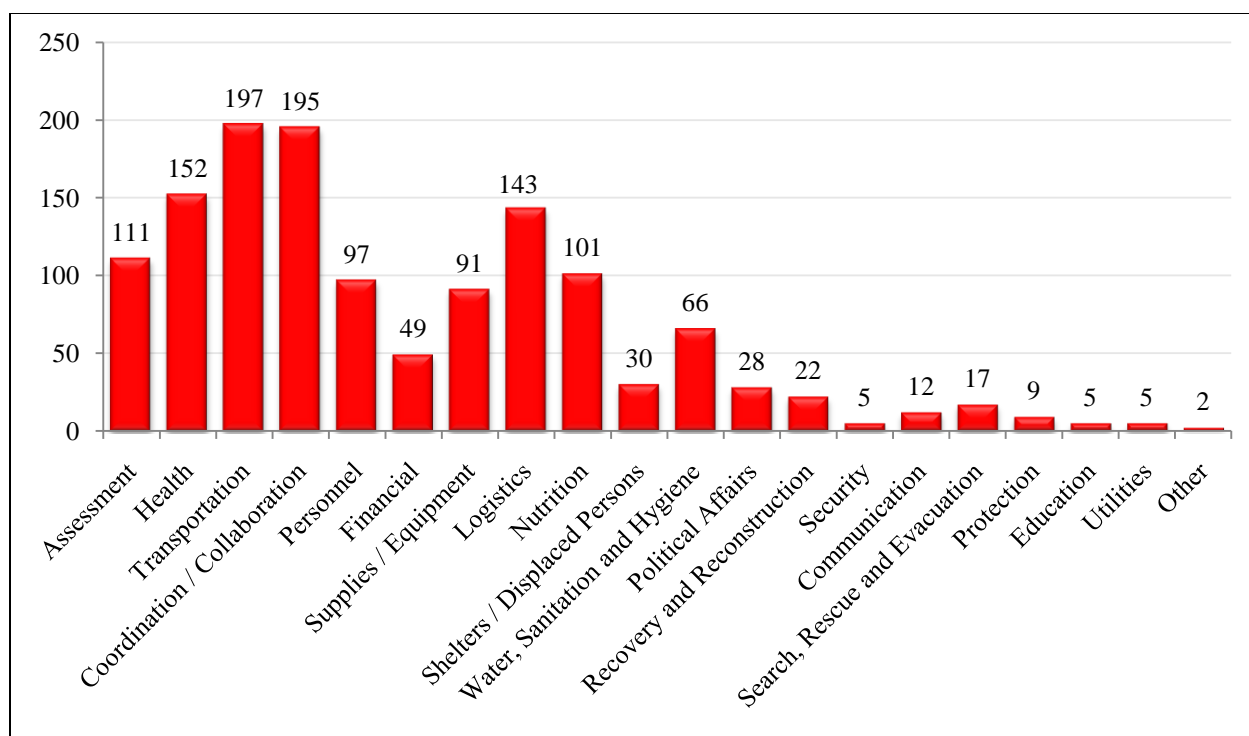


Figure 22: Number and Category of Transactions Identified in the International Sub-System

5.4.3 Core Administrative System

The organizations identified in the core system were observed participating in 984 transactions and 2,374 transaction observations. The complete set of transaction tallies is presented in Figure 23, which indicate that the organizations in the core system were involved in a diversity of activities. The most frequently identified transactions involved activities related to coordination and collaboration, at 341 or 14.36% of all transaction observations, and health, at 330 or 13.90% of all transaction observations. These data indicate that there were significant amounts of coordination within the health sector. An example of a transaction that represented health, as

well as, coordination and collaboration occurred between the Indonesian Ministry of Health, the World Health Organization and United Nation's Children Fund. The source materials indicated that these organizations were engaged in an extensive campaign to provide measles vaccinations and vitamin-A shots to vulnerable populations throughout the tsunami affected regions of Indonesia. Beyond the activities related to health and coordination, these data also indicate that the organizations in the core system were focused on the transportation of goods and supplies, at 341 or 14.36%, and the assessment of the damage caused by the disaster, at 271 or 11.42%.

The distribution of the number and frequency of transaction tallies for the organizations in the core system can be organized into three separate groups. The first group was the transactions that received the most attention from the organizations in the core system: coordination and collaboration at 341 or 14.36%; health at 330 or 13.90%; assessment at 271 or 11.42%; and transportation at 263 or 11.08%. The second group received a moderate amount of attention, and included eight categories with between 60 and 195 transactions. The most important of these transaction categories included logistics, at 195 or 8.21%, nutrition, at 141 or 5.94%, and political affairs, at 81 or 3.41%. The third group received the least amount of attention, and included transaction categories such as: utilities at 9 or 0.38%; security at 35 or 1.47%; and recovery and reconstruction at 58 or 2.44%. Again, even in the core administrative system, it is interesting to note how low the tallies are for security related transactions.

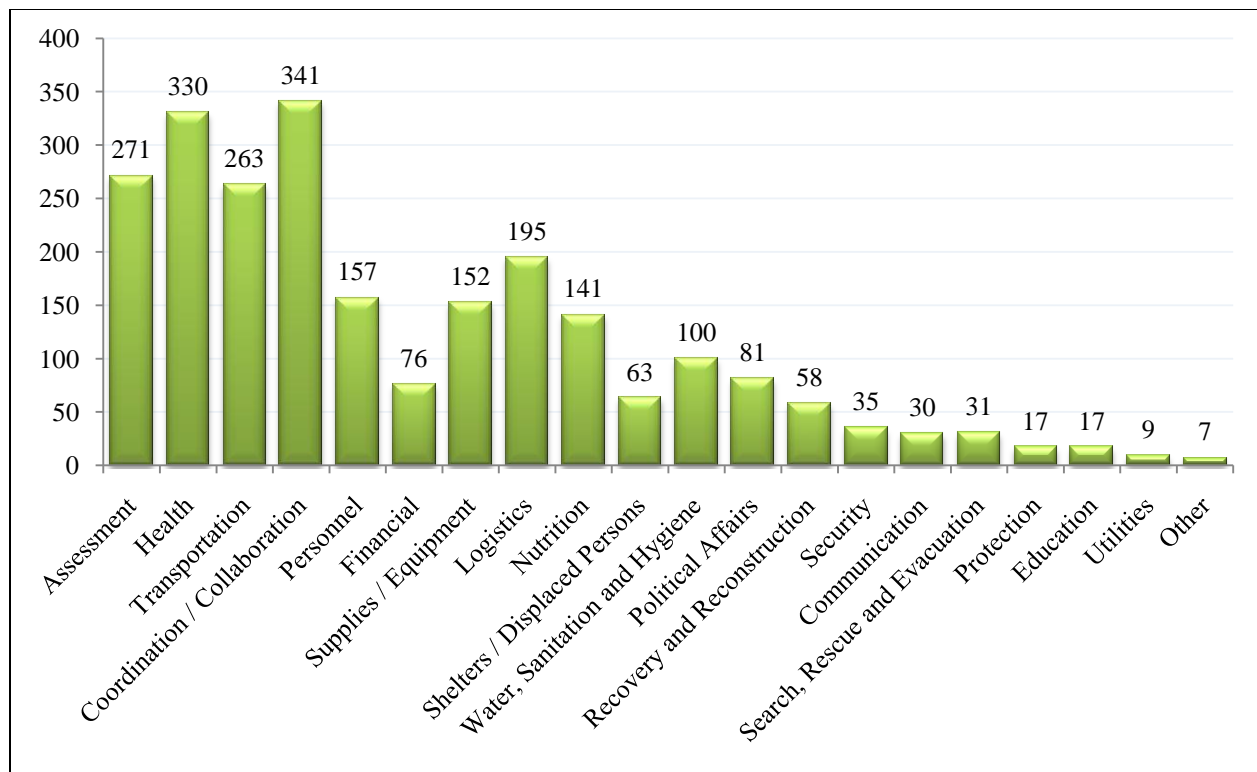


Figure 23: Number and Category of Transactions Identified in the Core System

5.4.4 Shifts in Transaction Patterns

This study also considered the extent to which the organizations in the domestic and the international sub-systems influenced the activity and focus of the core administrative system. Two sub-questions were addressed: to what extent did the rate of organizational activity in these systems differ; and to what extent did the focus of activity in these systems differ?

5.4.4.1 Rate of Organizational Activity

Figure 24 indicates that the daily number of transactions classified in the core administrative system evolved. After an initial spike on 27 December 2004, the organizations in the core system started to become involved in interactions that represented an increasing number of transaction categories, meaning that they were also becoming increasingly involved in a wider range of response activities. This rise in activity was not constant. After 5 January 2005, when the number of transactions identified in the source materials peaked at 200, the number of transactions actually began to decrease, reaching a low of 31 on 14 January 2005.

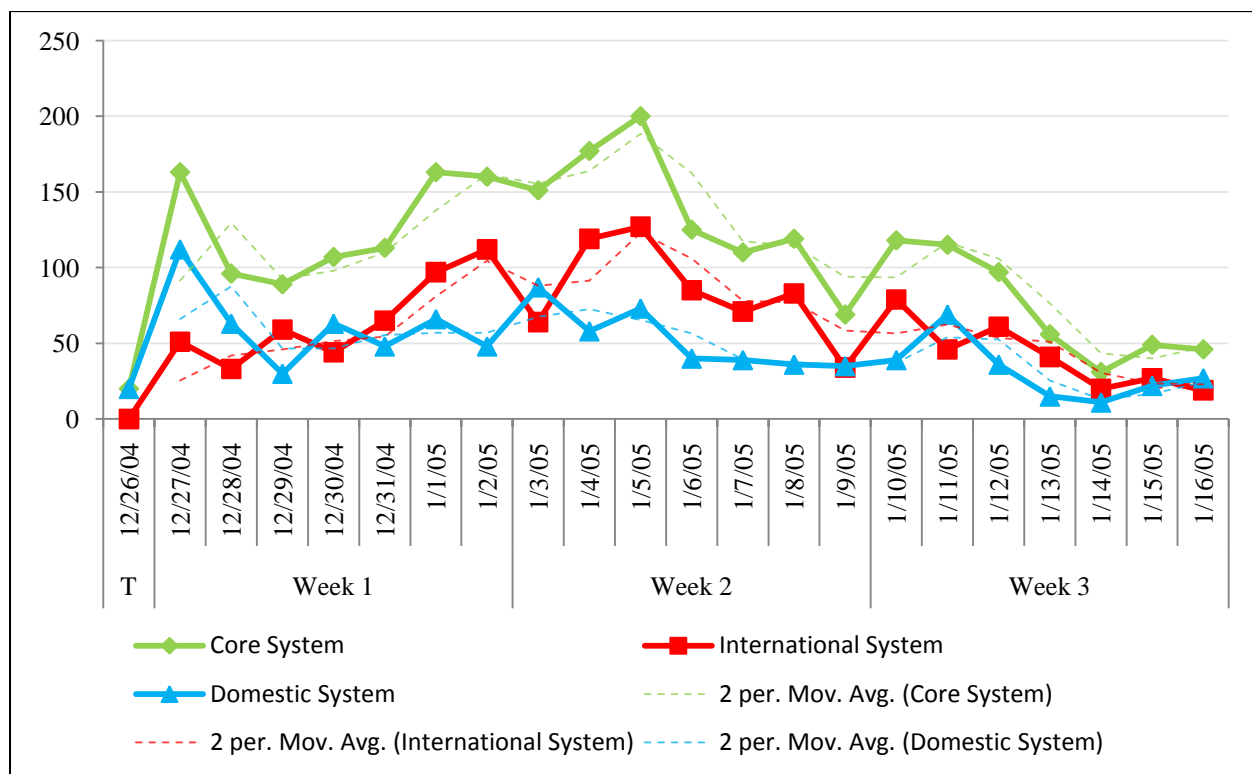


Figure 24: Number of Daily Transactions Coded in the Core System

When the data for the core system was organized by sub-system, it became apparent that the organizations that participated in the international sub-system were involved in interactions that fell into more transactions categories than the organizations that were involved in the domestic sub-system. This suggests that the international organizations may have been more active, across a wider range of activities, than their domestic counterparts. Indeed, of the 2374 transactions coded in the core system, 1337 or 60.77% fell into the international sub-system and 1037 or 47.14 fell into the domestic sub-system. These findings confirm that international organizations played a critical role in the system that operated in Indonesia after the tsunami.

5.4.4.2 Focus of Organizational Activity

A comparison of sub-system activity by transaction category is presented in Figure 25. These data indicate that the sub-systems exhibited behavioral differences in terms of the types of activities in which their constituent organizations participated. The organizations involved in the international sub-system participated in interactions related to the management of the core system, for example, transportation, collaboration and coordination, logistics, and supplies and equipment. These data also indicate that international organizations were involved in transactions coded as nutrition, which involved the delivery of food to those affected by the tsunami. Alternatively, the organizations involved in the domestic sub-system participated in interactions that were less related to the management of the core system, but more directed toward information collection (assessment), the delivery of medicine and medical services (health), handling domestic and international relations (political affairs) and planning for the activities that would occur after the conclusion of the emergency response period (recovery and reconstruction). That the domestic and international sub-systems focused on different tasks after

the tsunami should not be considered an indication of system failure. Rather, these data reveals that the organizations identified in the sub-systems simply contributed to the core administrative system according to their respective strengths and areas of expertise.

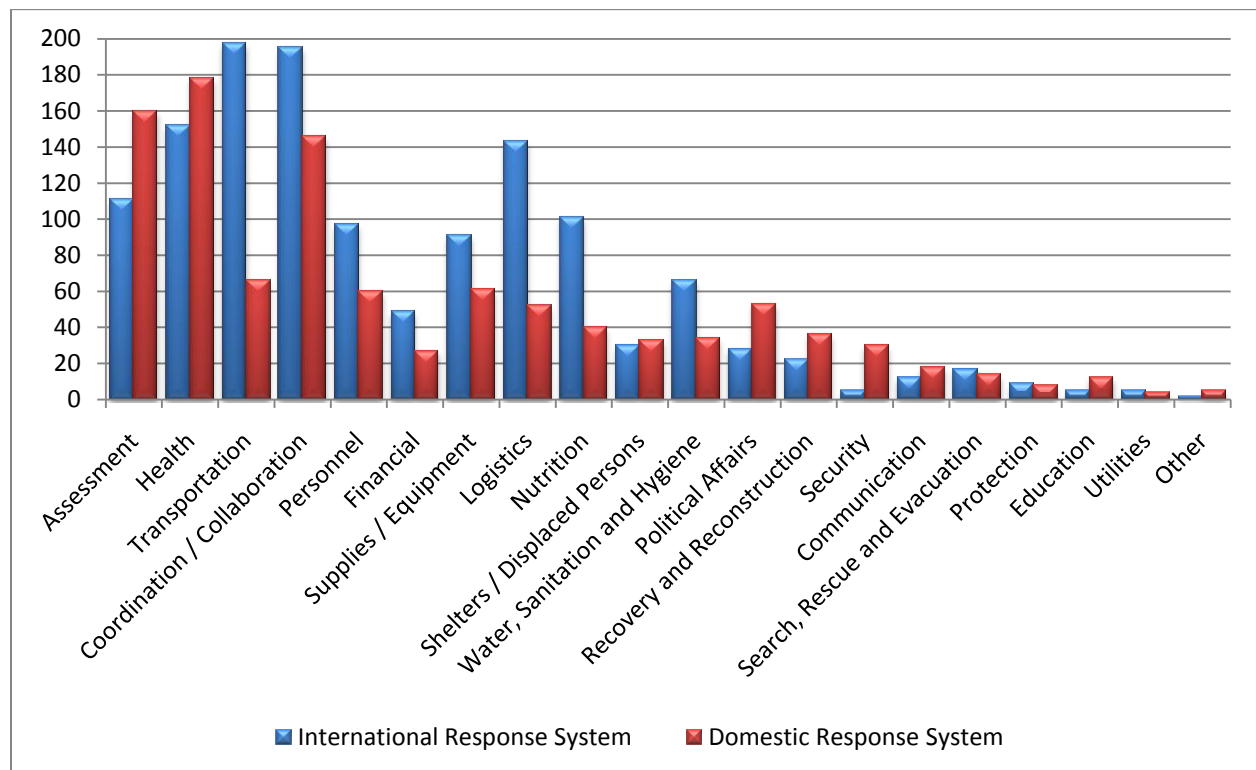


Figure 25: Breakdown of Transactions Coded in the Core System

The data presented in this chapter indicate that the administrative system that operated in Indonesia after the 26 December 2004 earthquake and tsunami was heterogeneous in its organizational composition and grew rapidly, especially in the days immediately after the tsunami. The data also indicate that distinctions can be drawn between the international and domestic sub-systems, for example, the organizations that operated in these two systems engaged

in different types of activities. While these findings provide insight into the character of this administrative system, they reveal little, if anything, about how the interactions exchanged among response organizations helped to structure the administrative system. Given the role that structural change plays in administrative resilience, the subsequent chapter considers the extent to which the interactions exchanged by response organizations facilitated the development and evolution of the structure of the administrative system and sub-systems under analysis.

6.0 STRUCTURAL EVOLUTION OF THE ADMINISTRATIVE SYSTEM

To improve the capacity of administrative systems that operate in conditions of uncertainty, the structural characteristics of such administrative systems must be analyzed. This chapter addresses the research question: to what extent did the interactions exchanged among response organizations after the earthquake and tsunami of 26 December 2004 drive the structural evolution of the administrative response system? Five sub questions will also be addressed. First, to what extent did the density of the system evolve? Second, to what extent did the diameter of the system evolve? Third, to what extent did the number of components in the system evolve? Fourth, to what extent do Hamming distance statistics reveal structural evolution within the system? Finally, to what extent did organizations in the system shift the target of their interactions from one classification of organization to another? The analysis presented in this chapter considers how the structure of this system evolved on a daily basis.

6.1 NETWORK DENSITY

When contemplating the interactions exchanged by organizations during the month after the tsunami, an official from a non-governmental organizations stated, “[t]here were thousands of NGOs there, and they were all highly funded, they were all autonomous, because of their funding, and they didn’t feel the need to collaborate” (Respondent 24 2009). This statement

indicates that the organizations that operated the tsunami response system may not have interacted as much as perhaps they could have. It is possible to evaluate the veracity of this statement, at least in terms of the structure of organizational interactions, by examining the density of the interactions detected in the administrative system during the period under analysis.

According to Stanley Wasserman and Katherine Faust (1994, p. 101), a network's density is the "proportion of the possible [links] that are actually present in a [network]." This proportion will range between 0 and 1, with 1 indicating that all of the nodes in the network are connected. A network with a density score close to 1 would be highly connected. A network with a density score close to 0 would be sparsely connected. The fact that an administrative system possesses extremely high or extremely low density scores does not, in isolation, indicate that the system was either effective or ineffective. Rather, the scores simply represent the prevalence of interactions with the system. To compare densities for the domestic and international sub-systems, as well as the, and the core system across dates, the number of organizations in these systems was set at 302, 258 and 560 respectively (Friedkin 1981; Scott 2000).

6.1.1 Domestic Administrative Sub-System

The domestic sub-system's average daily density totaled 0.000515. While such a score does not suggest that there were insufficient interactions for the system to function, it does suggest that the number of interactions between domestic organizations was extremely low. These data indicate that the daily density scores were below 0.0005 on fifteen of the twenty-two days that followed the tsunami. The date of the highest density score occurred on 3 January 2005, when 49 organizations engaged in 61 separate interactions, resulting in a density score of 0.001342. The

daily plots of the density scores for the domestic sub-system are reported in Figure 26, which indicates that the sub-system was not static in terms of organizational interactions.

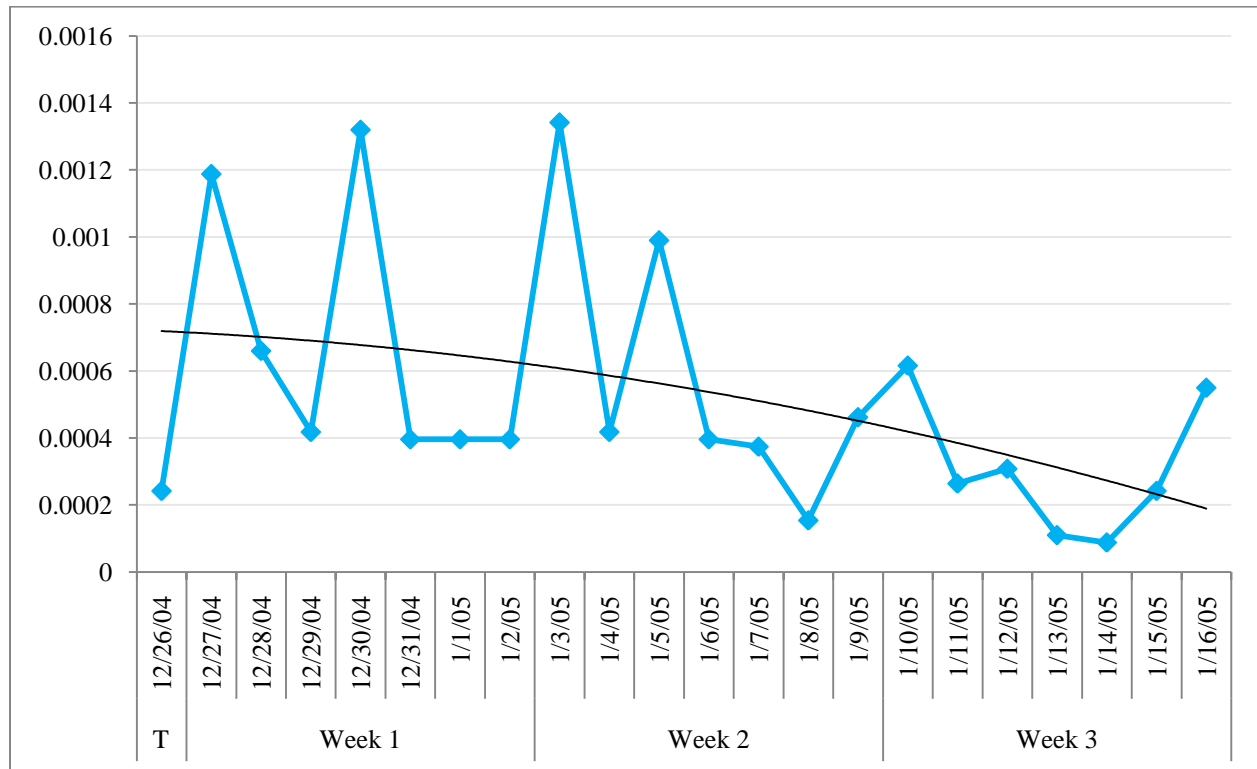


Figure 26: Daily Density Scores for the Domestic Sub-System

When the daily density scores were averaged by week, the density of the interactions in the domestic sub-system began to decrease. During the week after the tsunami, which includes the date of the event, the average density was 0.000627. During the subsequent week, the average density dropped to .000517. This decreasing pattern continued during the third week, when the averaged density dropped to 0.000272. These data indicate that, as the response unfolded, the organizations in the domestic sub-system were becoming less active, at least with

respect to their interactions with other domestic organizations. This finding runs counter to the notion that, following a disaster event, the number of interactions within the system should increase as response organizations share information and resources to facilitate the response.

6.1.2 International Administrative Sub-System

While low, density scores for the international sub-system were higher than the domestic sub-system. This indicates that the international organizations were more active than their domestic counterparts. Overall, the average density score for the international sub-system was 0.002641. As Figure 27 indicates, international organizations were not interacting with other international organizations on 24 December 2004, the day of the tsunami. The respondents that participated in the semi-structured interviews suggested that this may have been due the lack of information about the tsunami event, or because international organizations were at reduced capacity due to the holiday. Once information about the size and scope of the disaster event became available, the international organizations became increasingly active.

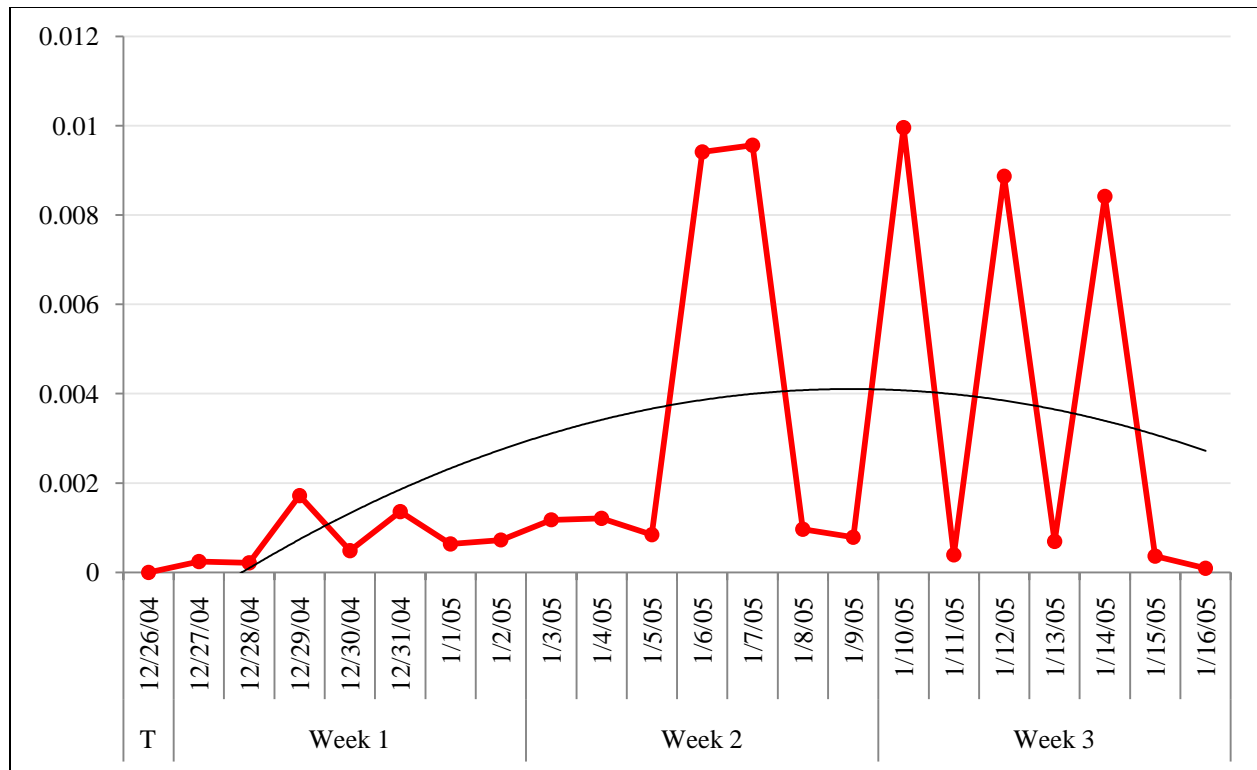


Figure 27: Daily Density Scores for the International Sub-System

The density of the international sub-system was higher during the second half of the period under analysis, indicating that international organizations increased their rate of interaction. Prior to 6 January 2005, the average daily density of the sub-system was 0.0007. After that point, the average daily density of the sub-system increased to 0.0049, and the shifts in density became more dramatic and regular in their occurrence. This appears to be an indication that the organizations in the international sub-system were not only becoming increasingly active, they were also beginning to synchronize their interactions.

6.1.3 Core Administrative System

Similar patterns were present in the core administrative system. The average density score for the core system was 0.0009, which is again low, but higher than the density reported for the domestic sub-system. It appears as if the presence of the international system, and the interactions exchanged between domestic and international organizations, improved the overall density of the core system. These findings also indicate that, while there were a low number of interactions in the core system, the extent to which organizations interacted with each other evolved. This evolution is seen in Figure 28, which reveals that the core system experienced dramatic shifts in density, especially during the second week and a half. Interestingly, these patterns match those in the international sub-system. When density was considered as a weekly average, the density of the first week, which included the day of the tsunami, totaled 0.0004. The density of the second week then increased to 0.0011. The increased trend in average density scores also continued during the third week, where the core system's density increased to 0.0012.

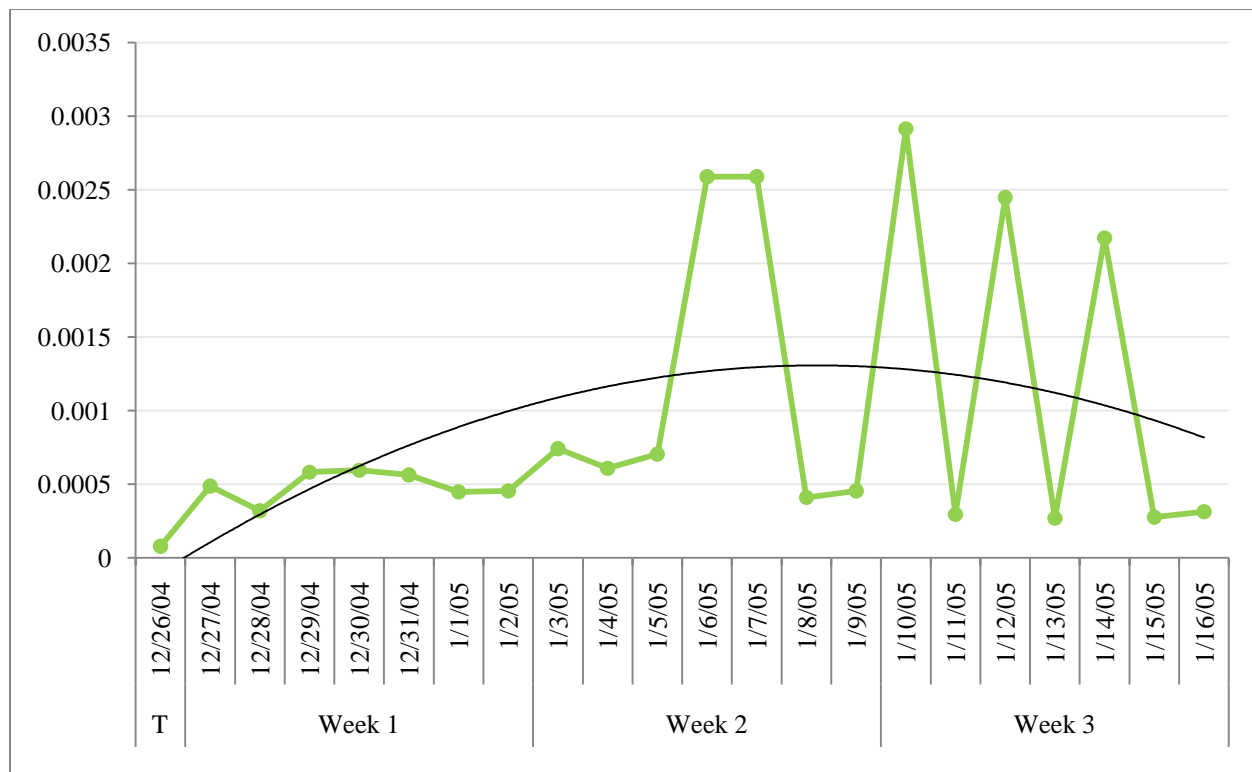


Figure 28: Daily Density Scores for the Core System

The shift towards increased density scores occurred on 6 January 2005, when 95 organizations engaged in 405 separate interactions. The source materials revealed that a significant event occurred on this date, which may explain the increase in density for the core system. The event was the first of a regular series of coordination meetings organized by the Indonesian Ministry of Health and the World Health Organization. These meetings organized the actors in the health sector into four sub-groups: 1) hospital activities; 2) emergency and primary health care; 3) psychosocial and mental health activities; and 4) information and logistics. This series of meetings seemed to bind the organizations in the system together; enabling some organizations to increase their interactions with the organizations that they already had working

relationships with, while other organizations could start to interact with organizations with which they did not have previous working relationships.

6.2 NETWORK DIAMETER

Many of the respondents that participated in this study indicated that it eventually became easier to acquire information in the administrative system. One respondent explained that this was because, “people were proactively seeking information assistance from anywhere they could find it, they were being creative in thinking about where [they] could get expertise, where they could get stuff, both within the organization and externally” (Respondent 19 2009). This may indicate that, in their search for information and resources, the distance between the organizations in the administrative system may have become smaller as the system developed. The extent to which this occurred can be evaluated by scrutinizing the “diameter” of a system, or network, which is defined as “the length of the largest geodesic between any pair of nodes (n)” (Wasserman and Faust 1994, p. 111). A network’s diameter “can range between 1 (if the [network] is complete) to a maximum of $[n]-1$ ” (Wasserman and Faust 1994, p. 112).

Wasserman and Faust (1994, p. 112) provide a description of this measure: “the graph’s diameter is important because it quantifies how far apart the two farthest nodes in the graph are. Consider a communications network in which the ties are the transmission of messages. Focus on the messages sent between all pairs of actors. Then, assuming messages always take the shortest routes (that is, via geodesics), we are guaranteed that a message can travel from any actor to any other actor, over a path of length no greater than the diameter of the graph.” The larger the diameter of the administrative system, the more difficult it might be for information

and resources to flow, both in terms of time and cost, to the interacting organizations that operate in the system. An administrative system that has a high diameter may have difficulties adapting in response to the uncertainties present in post-disaster environments.

6.2.1 Domestic Administrative Sub-System

The diameter of the domestic sub-system evolved during the period under analysis. Figure 29 indicates that the diameter of the domestic sub-system ranged between 2 and 6. The average diameter of the sub-system was 3.50. Organizing these data into three weekly periods reveals the extent to which the diameter of the domestic sub-system evolved. During the week that ended 2 January 2005, the average diameter of the sub-system was 3.86. During week that ended 9 January 2005, the average diameter decreased to 3, meaning the organizations operating in the sub-system had become closer to each other. During the final week, this trend reversed, and the diameter of the domestic sub-system increased to 3.71. One might expect the opposite to occur; that the system would become smaller as organizations locate each other and begin to interact. While the diameter for the third week was not as high as the initial week, these findings indicate organizations were having difficulties integrating themselves into the domestic sub-system.

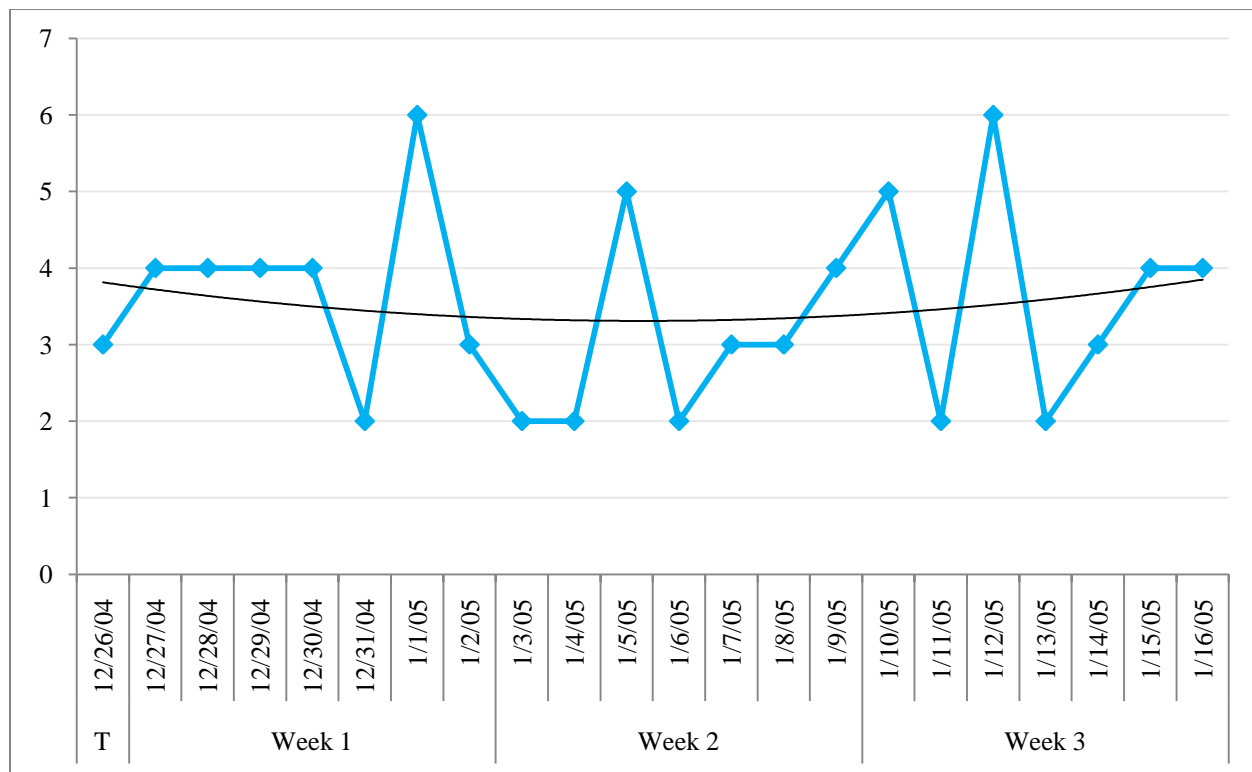


Figure 29: Daily Diameter Scores for the Domestic Sub-System

6.2.2 International Administrative Sub-System

Figure 30 indicates that the diameter of the international sub-system also evolved. Excluding 26 December 2004, the sub-system's diameter ranged from 1 on 27 December 2004 to 7 on 6 January 2005. The sub-system's average diameter was 3.82. Although change was also noted in the international sub-system, it differed from the change reported in the domestic sub-system. Where the diameter of the domestic sub-system contracted and then expanded, the diameter of the international sub-system expanded and then contracted. This pattern is clearly revealed in the

plot of the international sub-system's weekly average density scores. During the first week, which included the day of the tsunami, the sub-system's average density score was 3.43. During the second week, its average density score increased to 4.71, before dropping to 3.86 during the third week. While the organizations in the international sub-system were not able to constrain the growth of the sub-system's diameter immediately after the tsunami, these same organizations seemed to have adjusted their interactions and reduced the diameter of the sub-system and improved its capacity to distribute information and resources.

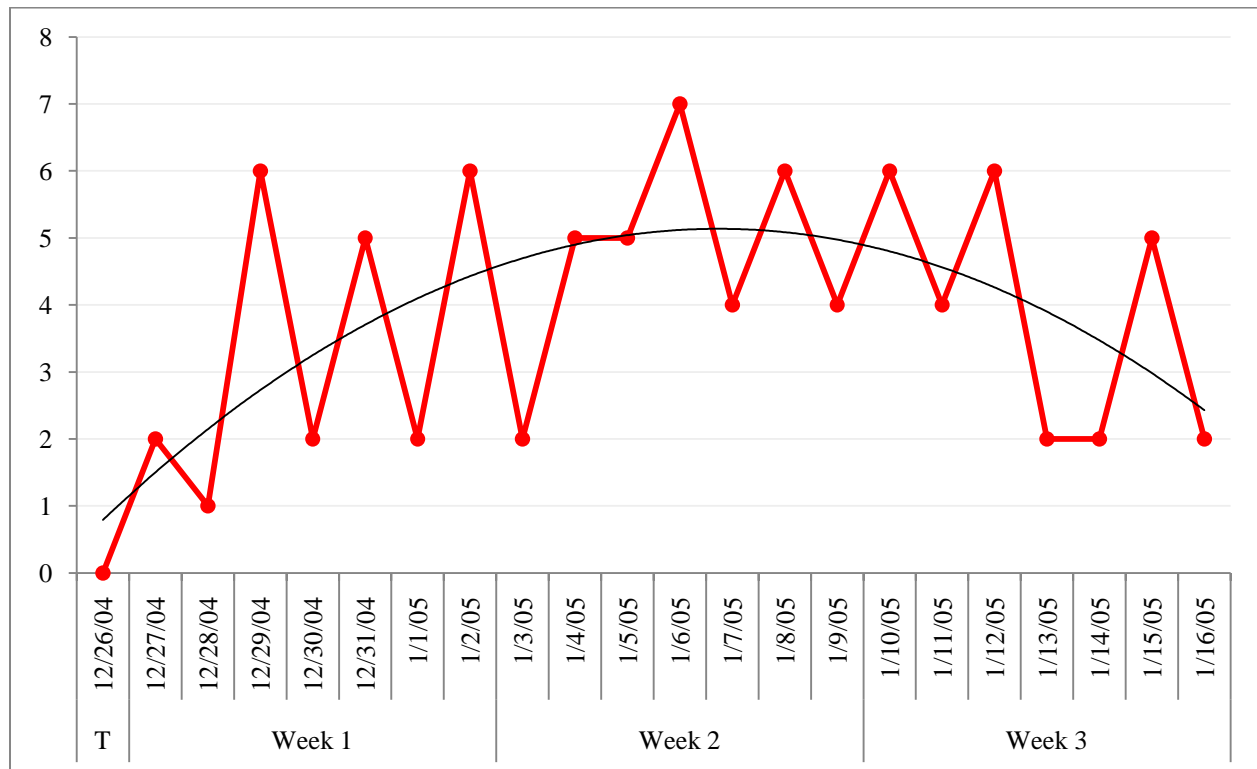


Figure 30: Daily Diameter Scores for the International Sub-System

6.2.3 Core Administrative Sub-System

The diameter of the core administrative system also evolved, ranging from a low of 3 on 26 December 2004 to a high of 11 on 12 January 2005. The system's average diameter was 6.77.

Figure 31 indicates there was also a change in the system's daily diameter. The change observed in the core system is more gradual than that identified in the international sub-system. During the first week, the average diameter of the core system was 6.57. By the second week its average diameter had increased to 7.43, before dropping to 6.96 during the third week. Although the core system had wider variance in its diameter than both of its sub-systems, their integration seems to have enabled the core system to better accommodate the response organizations. A large part of this capacity appeared to be derived from the contributions of international organizations.

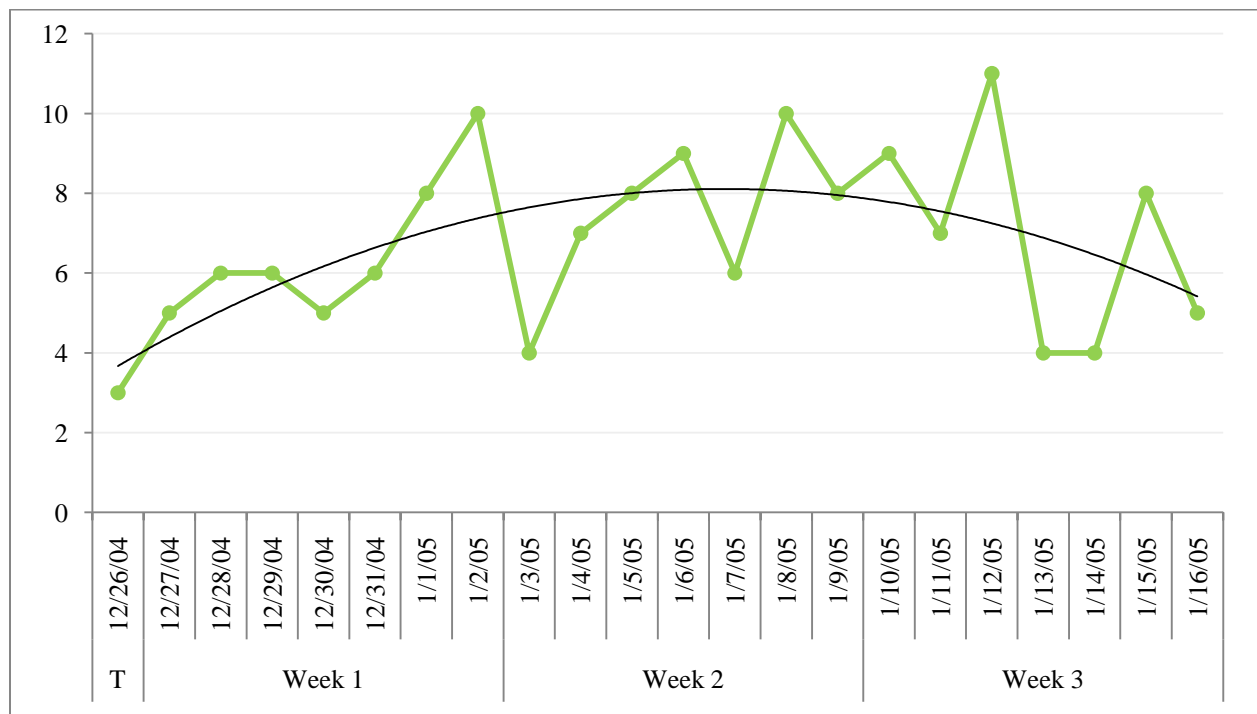


Figure 31: Daily Diameter Scores for the Core System

6.3 NETWORK COMPONENTS

When asked about collaboration after the tsunami, a respondent with local experience reported, "... [when] the tsunami happened, it was really massive, and more than 500 organizations operated here in Aceh. So, but after the tsunami, a lot of different coordination efforts were happening. Either between the local and international organizations and also among the international organizations, among the government organizations, or inter-governmental organizations. I mean, like, inter-between national, local and international, plus government, or only between international and governmental [organizations]" (Respondent 41 2009). This quotation suggests that organizational interactions occurred, not only within sub-systems, but also across sub-systems, and that such interaction may have unified the heterogeneous collection of organizations that operated in the post-tsunami environment.

Whether such a unified structured existed in the administrative system under analysis can be evaluated using social network measures. A network that is not fully connected can be separated into sub-graphs called components. According to John Scott (p. 101), "[a] sub-graph, like a graph, is 'connected' when all of its [nodes] are linked to one another through paths: all points in a connected sub-graph can 'reach' one another through one or more path, but they have no connections outside the graph. Within a component, all points are connected through paths, but no paths run to [nodes] outside the components." A single network can be composed of multiple sub-components, each of which possesses a different number of nodes and linkages.

The presence of components in an administrative system can be interpreted in various ways. An increase in the number of components in a system could mean that sub-groups of organizations are becoming increasingly isolated. While the organizations within a single

component may be exchanging resources, information and personnel, and completing their respective responsibilities, they would be doing so without interacting with the organizations that are participating in other components. Such a system structure could preclude the organizations in one component from accessing information and resources that exist in another component. Alternatively, a decrease in the number of components could mean that the sub-groups of organizations are coming together to form a single, unified component. The overall capacity of the single component would be higher than the collection of smaller, distinct sub-components.

6.3.1 Domestic Administrative Sub-System

A primary component operated within the domestic sub-system on each of the twenty-two days after the tsunami. The smallest number of components present in the sub-system was 2 and the largest number was 12. When the isolate organizations were excluded, these data indicate that an average of 24.09 organizations participated in an average of 5.23 components. The daily number of components identified in the sub-system is reported in Figure 32, which indicates that gaps separated domestic response organizations. When considered on a weekly basis, the average number of components present in the sub-system also evolved. During the first week, the sub-system had an average of 28.37 organizations operating in 5 separate components. During the second week, this number increased to an average of 27.71 organizations operating in 6.57 separate components. During the final week, the average number of components in the sub-system dropped to an average of 15.57 organizations operating in 4.14 separate components.

These findings indicate that organizations in the domestic sub-system interacted, but remained disconnected from each other as they operated in separate components. This suggests

that the information and resources possessed by the organizations in one component may not have been able to be transmitted to other components. Then, a structural change occurred in the sub-system, and the number of components began to decrease. While these data seems to indicate that organizations in the domestic sub-system managed to reach out to the organizations that were previously operating in separate components, the results may be due to the fact that the average number of interacting organizations identified in week three was actually lower than the average number of interacting organizations identified in week one (15.57 vs. 28.37).

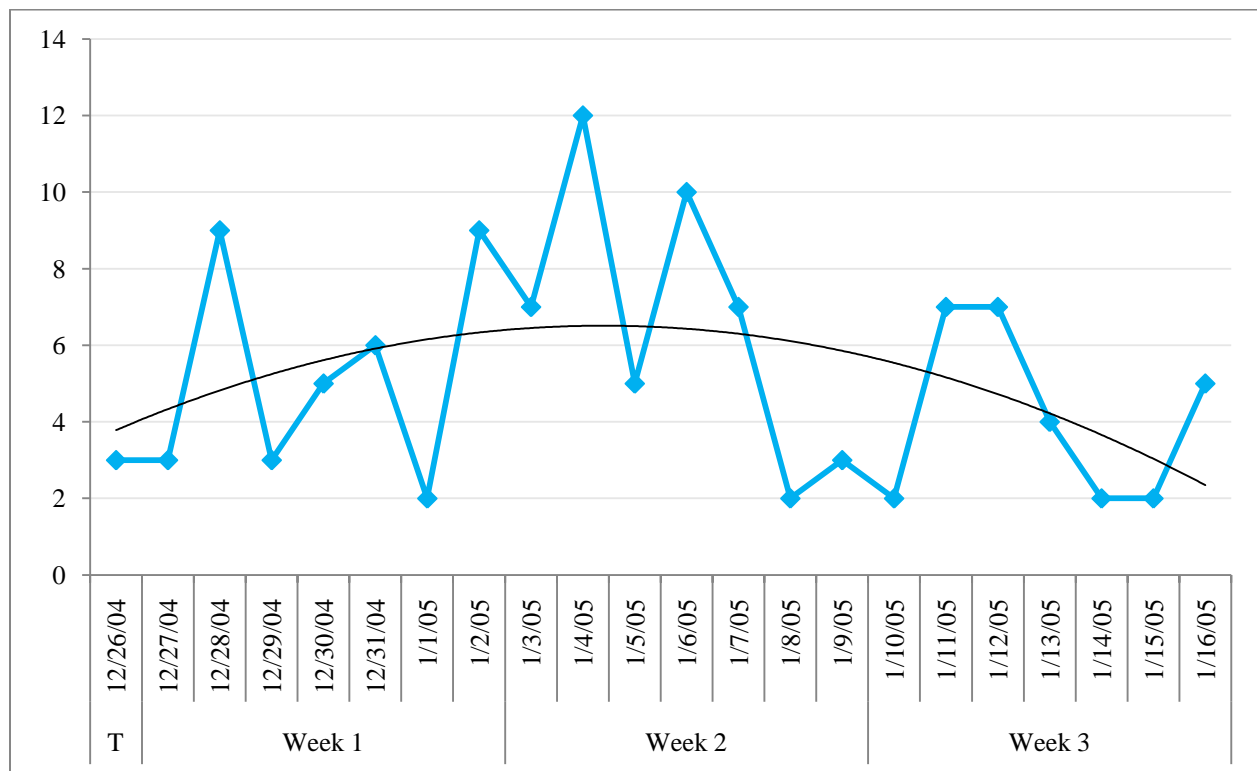


Figure 32: Daily Number of Components Detected in the Domestic Sub-System

6.3.2 International Administrative Sub-System

The international sub-system had substantially more components than its domestic counterpart. Excluding 26 December 2004, a primary component also operated in the sub-system on each of the twenty-two days after the tsunami. When the isolate organizations were excluded from consideration, the smallest number of components present in the system was 2 and the largest was 13. Figure 33 also confirms the presence of gaps between the organizations that operated in the sub-system, in which an average of 330.04 organizations participated in an average of 5.86 components. The average number of components operating in the sub-system evolved on a weekly basis. During the first week, the international system contained an average of 20.75 organizations operating in 5.63 separate components. This number then increased to an average of 38.29 organizations operating in 7.71 separate components during the second week. During the final week, the number of components decreased, with an average of 26.14 organizations operating in 4.29 distinct components.

Like the domestic sub-system, these findings indicate that the international sub-system contained organizations that engaged in interactions with other organizations, but their interactions were isolated within separate components. In contrast to the domestic sub-system, these data indicate that organizations in the international sub-system did manage to reach out to some of the organizations that were previously operating in separate components. For example, the average number of components in week three were less than the number detected in week one (4.29 vs. 5.62), even though there were on average, more interacting organizations detected in week three than in week one (26.14 vs. 20.75). An alternative explanation for why the sub-system came together could be because international organizations were more active, in terms of

their interactions, during the latter half of the period under analysis. Whatever the cause, the reduction in number of components would indicate that the international organizations may have improved their capacity to distribute information and resources throughout the sub-system.

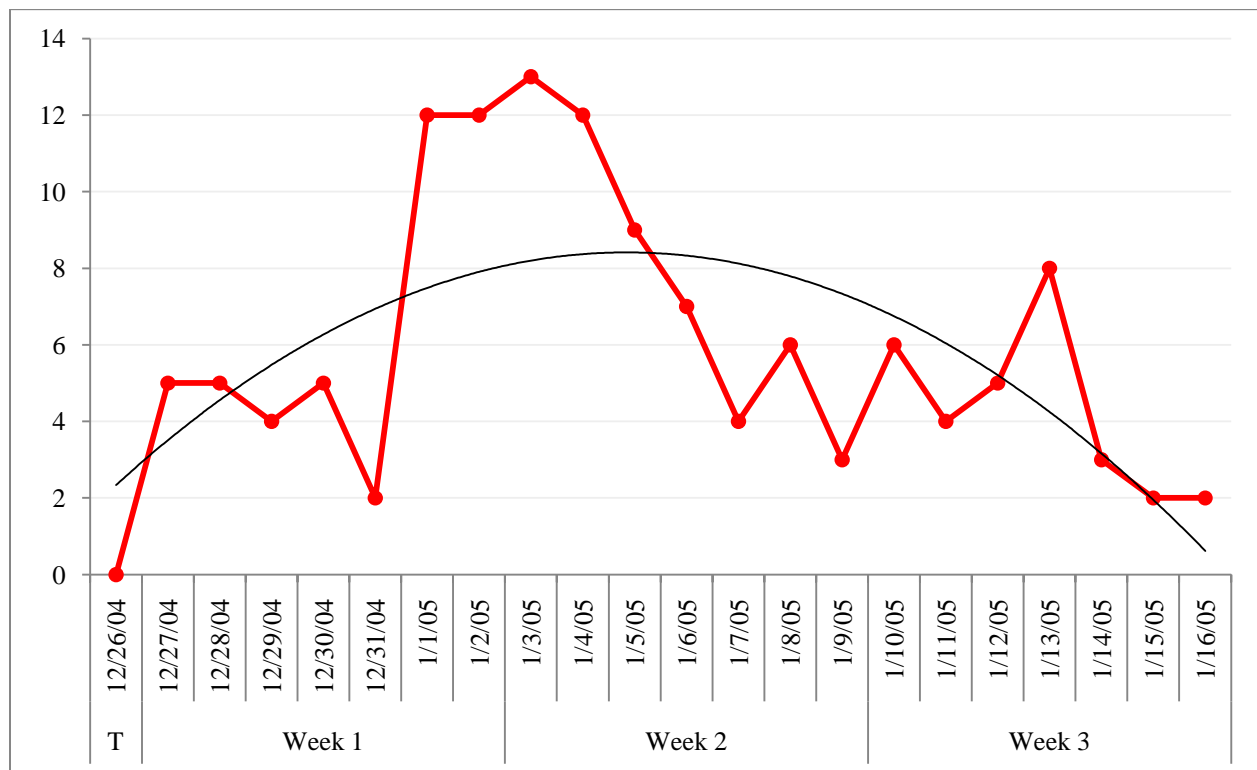


Figure 33: Daily Number of Components Detected in the International Sub-System

6.3.3 Core Administrative System

The core administrative system had substantially more components than both of its sub-systems. Although a primary component operated in the core system on each of the days under

consideration, when isolate organizations were excluded, the data indicated that an average of 65.95 organizations participated in an average of 10.05 components. This finding also confirms the presence of gaps within the core system. As Figure 34 indicates, the smallest number of components identified in the system was 4, on 26 December 2004, when 15 organizations interacted. The largest number of components identified was 20, on 4 January 2005, when 90 organizations interacted. When considered by week, the average number of components in the system evolved. During the first week, the system had an average of 60 organizations operating in 8.88 separate components. This number increased to an average of 83.29 organizations operating in 13.57 separate components during the second week. During the final week, the numbers dropped, with an average of 55.43 organizations operating in 7.86 components.

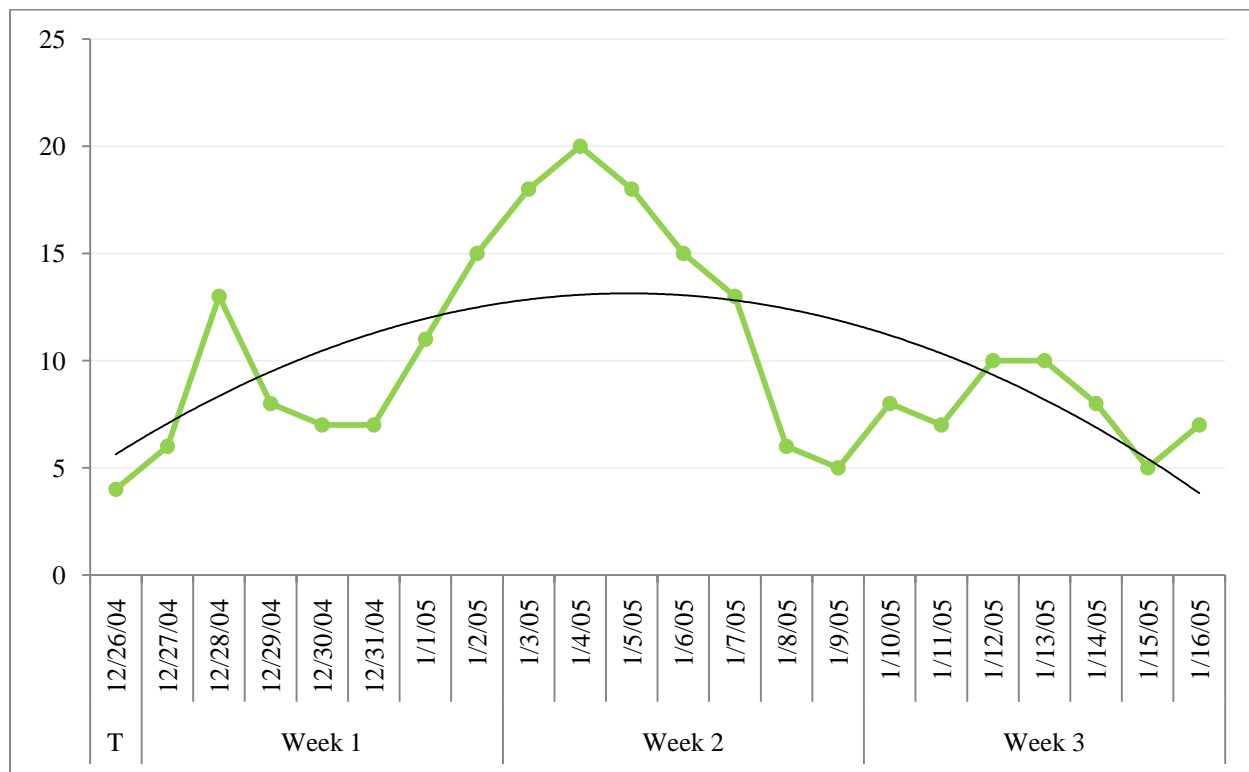


Figure 34: Daily Number of Components Detected in the Core Sub-System

Like the domestic and international sub-systems, these findings indicate that the core system contained organizations that were engaged in interactions with other organizations, but their interactions occurred within separate components. This would have created a situation where it would have been difficult for the information and resources contained in one component to have been transmitted to the other components in the system, thereby inhibiting the system's capacity to adapt to the uncertain conditions present in the post-tsunami environment. Then, on or about 6 January 2005, the average number of components in the core system began to decrease. This change is likely due to the influence of the international organizations, which increased their interactions after 6 January 2005. Another consideration is that the core system is comprised of the interactions between domestic organizations and international organizations, which may have bridged unconnected components that existed in their respective sub-systems.

6.4 STRUCTURAL CHANGE

The respondents indicated that change was a major theme in the post-tsunami environment, which reflected the willingness of response organizations to alter their activities, modify their decision making processes, and interact with organizations with which they did not have previous operational relationships. There is a growing literature on the evaluation of change within networks, and the methods used to evaluate such change include the use of the Hamming distance for binary networks (Hamming 1950; McCulloh and Carley 2008; Wasserman and Faust 1994). This study employed the Hamming distance statistic to evaluate whether change occurred in the administrative system. The Hamming distance measures the extent to which two or more un-weighted networks share similar structural characteristics. The measure tallies the number of

modifications that need to be made, in terms of addition or subtraction of links, to make one network exactly like another. According to McCulloh and Carley (2008, p. 8), “a significant change in Hamming distance may indicate network change over time.”

6.4.1 Domestic Administrative Sub-System

The Hamming distance statistics for the domestic sub-system are reported in Figure 35, which indicate that the sub-system experienced a period of structural change and a period of structural stability. What is interesting about these data is the regular nature of the fluctuations identified in the first week and a half of the response. Although less drastic, the fluctuations are also present when a two-period moving average trend line is added to the Figure. These statistics indicate that the domestic sub-system underwent two distinct periods of change. The first occurred from 26 December 2004 through 5 January 2005, when there were instances of dramatic, but regular change, likely the result of domestic organizations providing regular situation updates on the conditions that existed in the post-disaster environment. Indeed, there were a number of such updates contained within the source materials used to complete this study. After 5 January 2005 the regular fluctuations stopped, and the sub-system entered a period of relative stability, meaning the addition or subtraction of links detected in the sub-system fell within a much narrower threshold. This may indicate that the organizations within the international sub-system may have taken over a significant portion of the coordination role for the system. The full Hamming distance statistics for the domestic sub-system are provided in Appendix I.

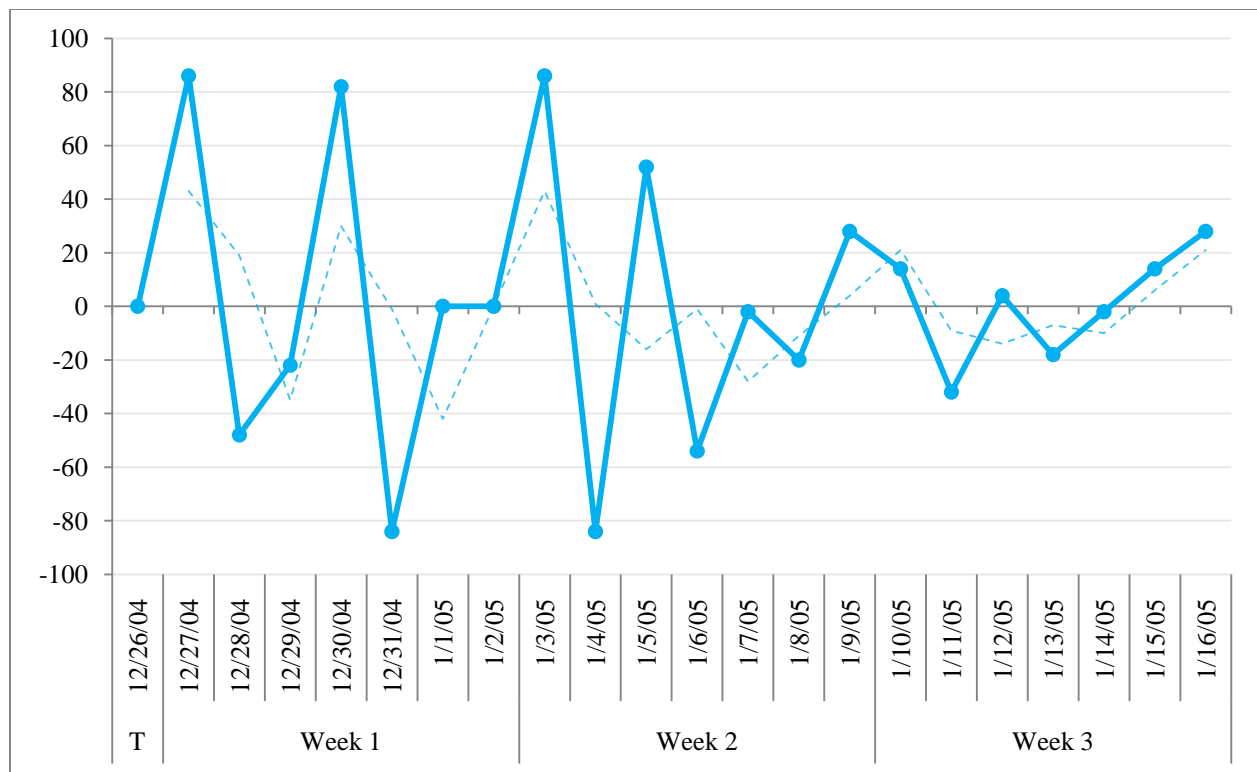


Figure 35: Daily Change of Hamming Score for the Domestic Sub-System

6.4.2 International Administrative Sub-System

The Hamming distance statistics for the international sub-system are reported in Figure 36, which indicate that the sub-system also experienced a period of structural change and a period of structural stability. These results differ from those reported for the domestic sub-system in two ways. First, the range in which fluctuations occurred in the sub-system is much wider, meaning that on a day-to-day basis, the international organizations increased or reduced their interactions in higher numbers than their domestic counterparts. That international organizations were more active in terms of their interactions, is also confirmed by the previously reported density results.

Second, the days in which the greatest fluctuations in the Hamming distance statistic occurred also differed. In the domestic sub-system, the fluctuations occurred before 6 January 2005. In the international sub-system, the fluctuations did not occur until after 6 January 2005.

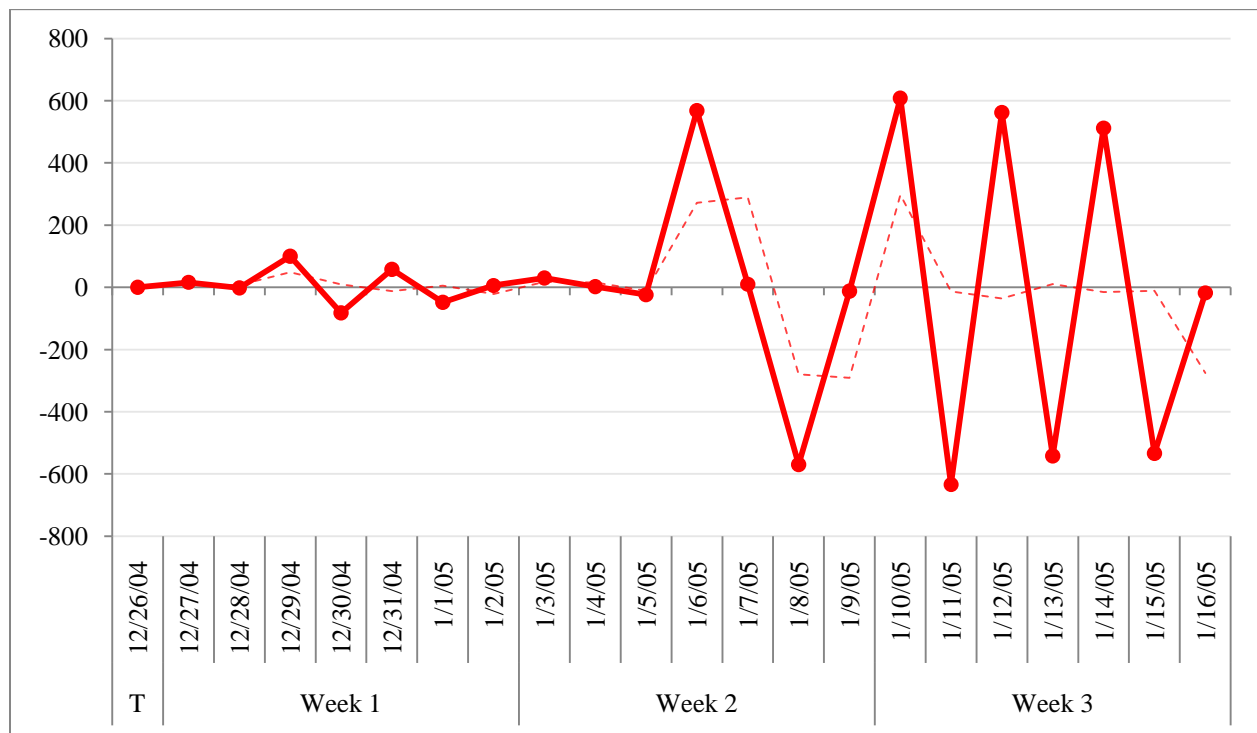


Figure 36: Daily Change of Hamming Score for the International Sub-System

Like the domestic sub-system, the international sub-system can be separated into two distinct periods. The first period occurred from 26 December 2004 through 5 January 2005, when the fluctuations seem to reveal a relatively stable period of structural change, or more precisely, a period where the addition or subtraction of links never exceeded a very narrow threshold. Following 6 January 2005, the structural fluctuations became much more dramatic. On

6 January 2005, for example, the sub-system experienced an increase of 568 edges, or 284 distinct interactions. It was on this date that the number of components in the international sub-system began to decrease, meaning the system was beginning to coalesce. After 9 January 2005, there were days where the organizations were extremely active, and days where organizations were less active. During this period, these fluctuations in organizational activity appeared to be quite regular. Although much less dramatic, these fluctuations are also present in the two-period moving trend line contained in Figure 36. The trend line identifies the period when change most likely occurred in the sub-system, between 6 January 2005 and 8 January 2005. The full Hamming distance statistics for the international sub-system are provided in Appendix J.

6.4.3 Core Administrative System

The Hamming distance statistics for the core system are reported in Figure 37, which indicate that the core system also experienced periods of structural stability and structural change. More importantly, these data indicate that the international system played a significant role in the development of the core system. Like the international sub-system, the structural change observed in the system can be separated into two periods. The first occurred from 26 December 2004 through 5 January 2005, when the fluctuations in the Hamming statistic are indicative of a relatively stable period of change and the structural change never exceeded a narrow threshold. Following 6 January 2005, the fluctuations became dramatic and regular, indicating that there were days where the organizations were extremely active, and days where they were less active. Similar patterns are also present in the two-period moving average trend line.

These data also indicate that organizations in the core system engaged in some type of synchronizing activity. The content analysis and semi-structured interviews indicate that two important events, both of which involved organizations in the international sub-system, occurred on, or around, 6 January 2005. The first was the initiation of a series of health sector coordination meetings, organized by the Indonesian Ministry of Health and the World Health Organization. The second occurred when the Secretary General of the United Nations ordered the United Nations Office of the Special Coordinator for the Tsunami Relief Effort and the United Nations Development Program to coordinate the relief efforts for the Indian Ocean region. The full Hamming distance statistics for the core system is provided in Appendix K.

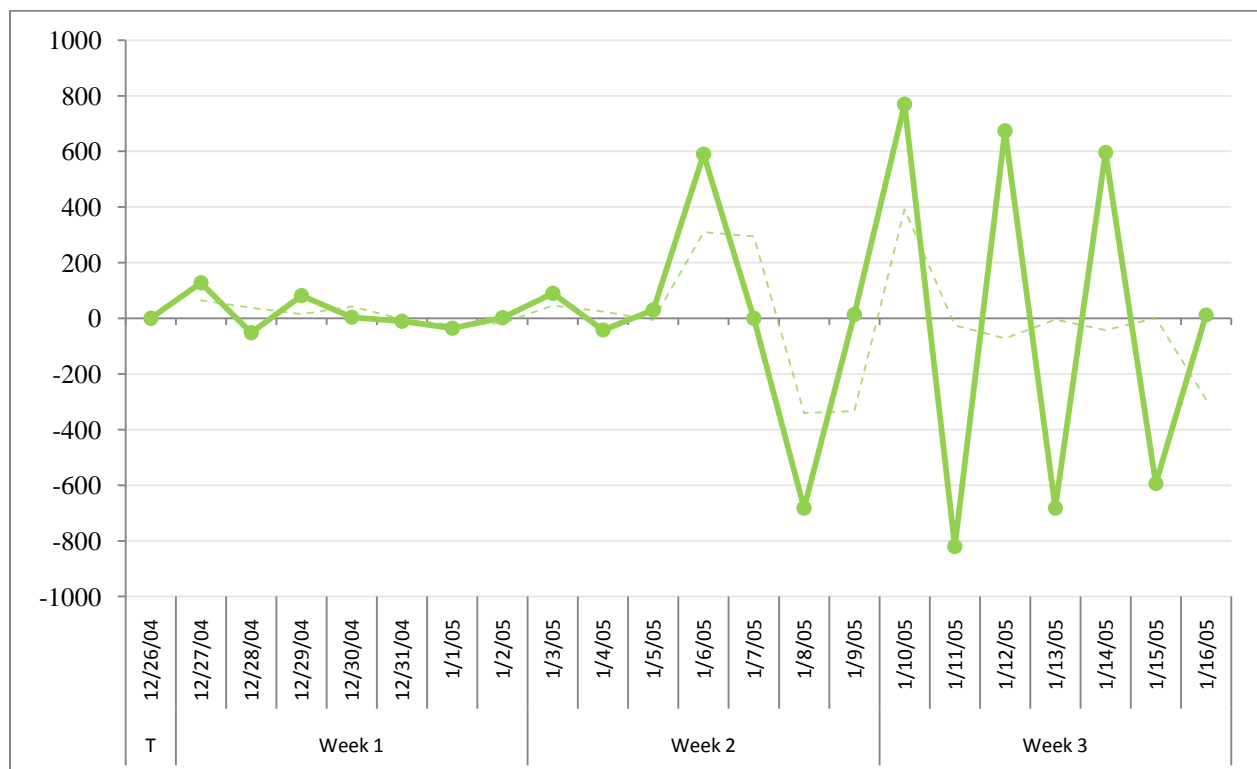


Figure 37: Daily Change of Hamming Score for the Core System

6.5 ORGANIZATIONAL TARGETS

This findings presented in this chapter indicate that the network structure of the administrative system that operated in Indonesia after the tsunami earthquake and tsunami of 26 December 2004 evolved. These findings also suggest that international organizations helped, at least structurally, to improve the core system's capacity to operate in uncertain conditions. While these findings indicate the presence of structural change, they say little about whether the organizations identified in one sub-system shifted the focus, or target, of their interactions, for instance, from working with domestic organizations to working with international organizations. If such patterns of adjustment were observed, it would provide additional support for the conclusion that international organizations played an increasingly critical role in the management and operation of the core administrative system, and more importantly, that the core administrative system experienced structural evolution.

This analysis was guided by two assumptions. First, each transaction was assumed to be initiated by a single organization. Second, the initiating organization for each transaction was the first of the organizations listed in the documentary materials. For example, if the materials contained a transaction such as, "organization A (*international organization*) scheduled a meeting with organization B (*domestic organization*) and organization C (*international organization*)," then organization A would be coded as the initiating organization. Organizations B and C would be coded as the target organizations. The numbers of distinct target organizations identified in each transaction were then categorized by level of jurisdiction. These results were summed to compute the number of domestic and international organizations that were the target of a transaction on the dates under consideration, 26 December 2004 through 17 January 2005.

6.5.1 Domestic Administrative Sub-System

Figure 38 presents the results for the shifts in organizational targets for domestic organizations. These data indicate that domestic organizations preferred to target domestic organizations. Of the 626 total organizational targets identified by this analysis, 461 or 73.64% were domestic organizations and 165 or 26.35% were international organizations. There were only three days where domestic organizations targeted international organizations more than their domestic counterparts. For instance, on 6 January 2005 and 8 January 2005, domestic organizations such as Tentara Nasional Indonesia contacted foreign militaries to coordinate the use of helicopters, the Indonesian Ministry of Health started a measles and vitamin A campaign with the World Health Organization and the United Nations Children's Fund, and the Indonesian Ministry of Education contacted the United Nations Children's Fund to request provisions for temporary classrooms for displaced children. The third date of interest, 14 January 2005, seems to be an anomaly related to data availability in that there were only 7 organizations targeted, 4 of which were international. On the remainder of the dates, domestic organizations elected to target other domestic organizations more than 55% of the time.

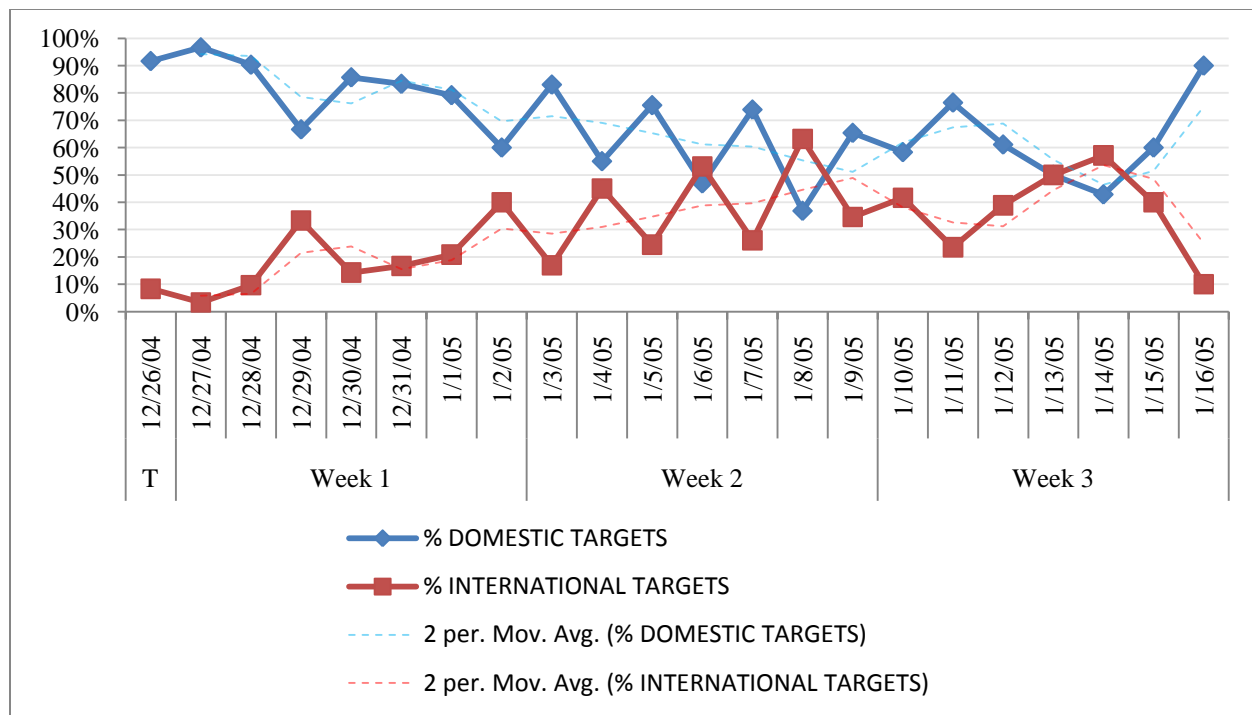


Figure 38: Shifts in Organizational Targets for Domestic Organizations

As a percentage of all target organizations, domestic organizations gradually began to increase the extent to which they targeted international organizations. Figure 38 indicates that, on 27 December 2004, only 3.33% of target organizations were international. This low number is due to the fact that international organizations had yet to arrive at the disaster scene in large numbers. Circumstances had changed by 8 January 2005, when international organizations were targeted by domestic organizations 63.16% of the time. This upward trend is also revealed by the average weekly target scores for domestic organizations. For instance, of the 252 organizations targeted during week one, which included the day of the tsunami, 15.87% were international. Of the 248 organizations targeted during week two, 33.87% were international. Even with the decrease in the number of interactions and transactions in the domestic sub-system, of the 126

organizations targeted by domestic organizations during week three, 32.53% were international. Although domestic organizations elected to work with other domestic organizations, they also demonstrated an increasing willingness to work with their international counterparts.

6.5.2 International Administrative Sub-System

International organizations differed in the types of organizations that they preferred to target. Figure 39 presents the data related to the shifts in organizational targets for the international organizations, which indicate that international organizations initially targeted domestic organizations, often to make initial contact or to make offers of assistance. For example, as a percentage of all target organizations, on the first day that international organizations were active, they elected to target domestic organizations 69.23% of the time. By 29 December 2004, international organizations elected to target international organizations 79% of the time. In fact, on all but three of the days covered by this analysis, international organizations showed a preference to target other international organizations.

On the dates that international organizations preferred to target domestic organizations over international organizations, it was only by a thin margin. For example, domestic organizations were targeted 53.33% of the time on 31 December 2004, when international organizations such as the United Nations Education, Scientific and Cultural Organization reached out to the Indonesian Ministry of Education to prepare an assessment mission to evaluate damage to schools. On 1 January 2004, when domestic organizations were targeted 54.35% of the time, international organizations were identified conducting logistics operations at local airports, delivering field hospitals, and using helicopters for rescue and relief operations. The one

exception was on 16 January 2005, when international organizations targeted domestic organizations 83.33% of the time. On this date, international organizations worked with domestic organizations by pledging funds for reconstruction activities, planning for additional food and supply distribution activities, and continuing a number of assessment activities. While it might seem as if this would represent a dramatic shift in target activity, there were very few interactions and transactions reported on 16 January 2005.

The target data indicates that, while international organizations would target domestic organizations during their daily operational activities, they overwhelmingly elected to work with international organizations. Indeed, of the 863 total organizational targets identified by this analysis, 531 or 61.52% were international organizations and 332 or 38.47% were domestic organizations. Not only do these data support the previous finding that organizational interactions were not tightly integrated, it also supports the insights provided by the respondents, who reported that it was difficult for domestic organizations, especially those at the local level, to become actively involved in the operational networks of the international organizations.

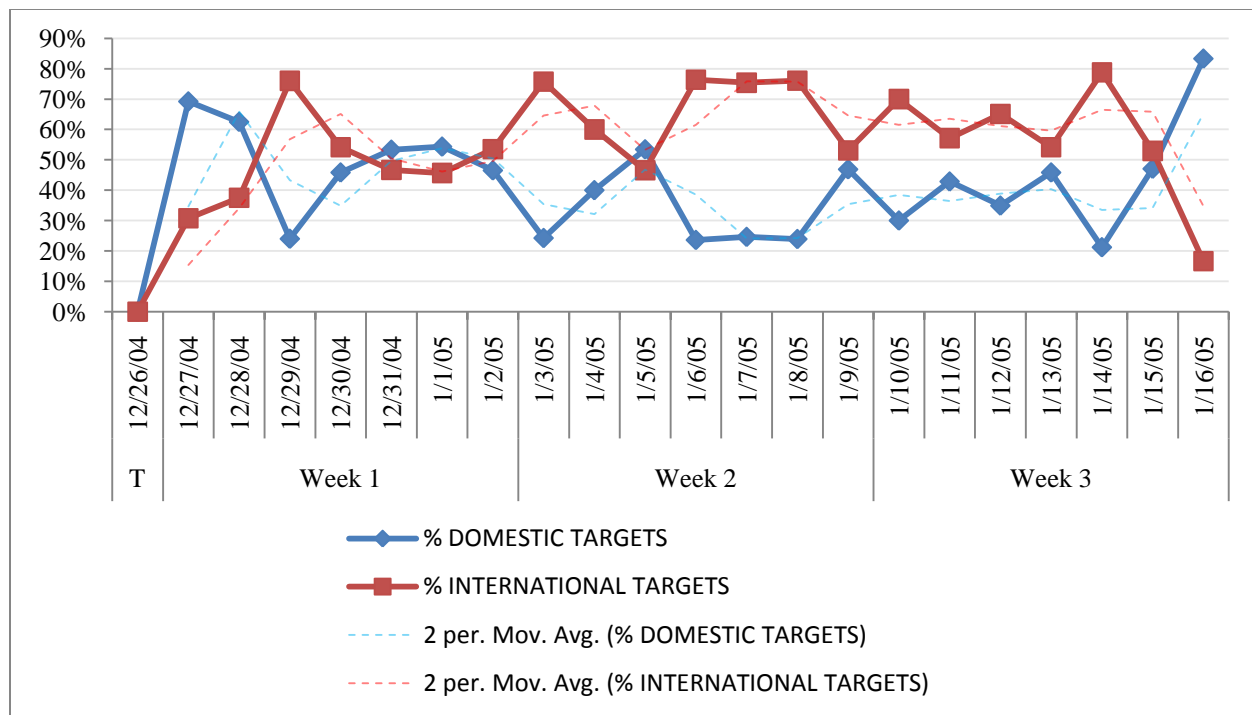


Figure 39: Shifts in Organizational Targets for International Organizations

6.5.3 Core Administrative System

Figure 40 presents the results for the shifts in organizational targets for the organizations in the core system. On each of the three days after the tsunami, as a percentage of all target organizations, domestic organizations were the target of interactions over 80.37% of the time. The first change occurred on 29 December 2004, around the time that the Indonesian government invited international organizations to participate in the response. On that date, international organizations were targeted 66.15% of the time. In the days that followed, there was a steady rise in international involvement, so much so that, by 8 January 2005, international

organizations were targeted more than 72.31% of the time. On 9 January 2005, a shift occurred, and the preferred targets of interactions began to fluctuate between domestic organizations and international organizations for a few days, which may indicate that the nature of the activities occurring within the system was evolving. Although there were substantially fewer interactions identified in the third week, by 14 January 2005, the organizations in the core system once again elected to target international organizations 75% of the time.

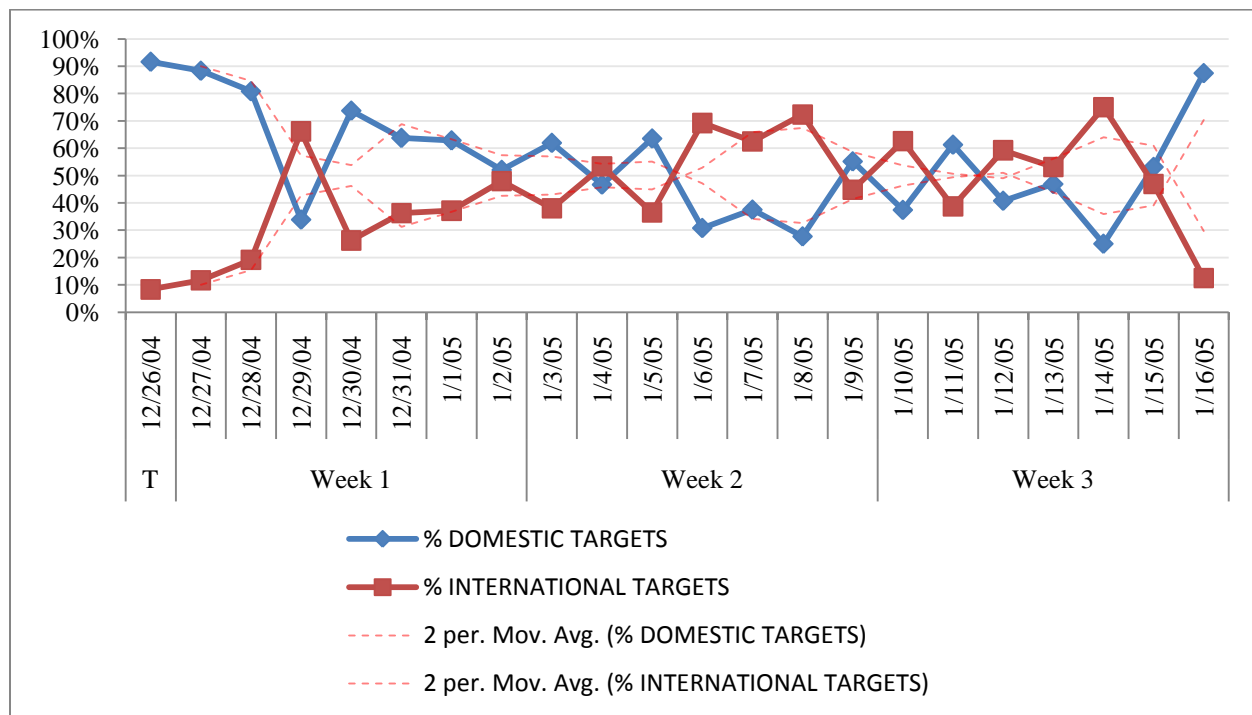


Figure 40: Shifts in Organizational Targets for All Organizations

The continual rise in the percentage of international targets indicates the extent to which the organizations in the core system became increasingly reliant upon the contributions of the international organizations. It was during this period of ever-increasing activity that international organizations became involved in activities related to the establishment of logistics, initiating the

mechanisms needed for information exchange, and establishing bases of operation. Many of these same organizations were also instrumental in reaching out to domestic organizations, creating working relationships for information collection, the repair of critical transportation facilities, and the delivery of relief supplies. This conclusion is also supported by the network findings discussed previously; that the interactions exchanged between the organizations in the domestic and international sub-systems improved the capacity of the core system.

The findings presented in chapter six indicate that the structure of the core system and its constituent sub-systems evolved in a various ways during the twenty-two days that followed the earthquake and tsunami of 26 December 2004. While these findings build upon those presented in chapter five, the empirical results presented by these two chapters do not identify the specific factors that drove this structural change. To understand why these systems experienced structural change, the subsequent chapter will review the operational opportunities and the operational constraints that were present in the administrative system after the earthquake and tsunami.

7.0 OPERATIONAL CONSTRAINTS AND OPPORTUNITIES IN THE ADMINISTRATIVE SYSTEM

The respondents indicated that the constraints present in the post-tsunami environment were unlike anything they had ever experienced. Yet some of them also indicated that there were opportunities that could be found in the confusion that followed the earthquake and tsunami. This diverse spectrum of constraints and opportunities helped to create a dynamic operational environment for both domestic and international response organizations. This chapter addresses the study's third research question: to what extent did constraints and opportunities influence the administrative system that responded to the earthquake and tsunami of 26 December 2004?

7.1 OVERVIEW OF INTERVIEW SUBJECTS

Portions of the data used by this study were collected from fifty-one respondents, each of which possessed knowledge of the events that transpired in Indonesia after the tsunami. These respondents worked in forty-one distinct organizations, participated in forty-eight semi-structured interviews and completed fifty-two surveys. Four respondents reported that they worked in multiple organizations during the period after the tsunami. These respondents completed two surveys, one from the perspective of each organization. Three respondents were not present in Indonesia at the time of data collection, and only completed the survey.

7.1.1 Organizational Data

The organizations included in the sample varied in size. On the small end were local non-profit organizations, which were staffed by five or fewer individuals. On the high end were international public and non-profit organizations, which had thousands of staff members and significant resources. Almost 50% of organizations had fewer than fifty disaster management personnel on staff at the time of the tsunami. Table 9 indicates the distribution of the organizations in the sample according to their level of jurisdiction and their source of funding.

Table 9: Number of Distinct Organizations Represented in Study

	Public		Non-Profit		Private		Total	
	N	%	N	%	N	%	N	%
International	8	19.5	7	17.1	1	2.0	16	39.0
Domestic	20	48.8	5	12.2	0	0.0	25	61.0
Total	28	68.3	12	29.3	1	2.0	41	100

7.1.2 Individual Data

The respondents who participated in this study were not homogeneous. First, in terms of their sex, the majority of the respondents, 41 or 80.40%, were male. Table 10 indicates that a similar distribution was present when the respondents were categorized according to their respective sub-systems. Out of a total of 22 subjects, males represented 72.73% of sample from the

international sub-system. A similar pattern was present in the domestic sub-system, where out of 29 respondents, 86.20% were male.

Table 10: Sex of Subjects

	Female		Male		Total	
	N	%	N	%	N	%
International	6	11.8	16	31.4	22	43.1
Domestic	4	7.8	25	49.0	29	56.9
Total	10	19.6	41	80.4	51	100

Table 11 indicates that the respondents also differed by age. Of the 45 respondents who reported their age, 38 or 84.44% indicated they were between 26 and 55 years old. The “26-35” and “46-55” categories were well represented, at 13 or 28.9% and 16 or 35.6% respectively. Only 9 or 20% of the respondents fell into the “35-45” category. When categorized by sub-system, the domestic respondents followed a similar age distribution; and the “26-35” and “46-55” categories were well represented, at 8 or 33.33% and 11 or 45.83% respectively. The ages of the international respondents were distributed more evenly. Other than the “21-25” category, which only had 1 or 4.76% of the international respondents, the other categories contained 5 or 23.81% of the respondents. The majority of the respondents who fell into the “56-65” category were from the international sub-system, at 5 or 23.81%, as opposed to the 1 or 4.76% who represented the domestic sub-system.

Table 11: Age of Subjects

	21-25		26-35		36-45		46-55		56-65		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
International	1	2.2	5	11.1	5	11.1	5	11.1	5	11.1	21	46.7
Domestic	0	0.0	8	17.8	4	8.9	11	24.4	1	2.2	24	53.3
Total	1	2.2	13	28.9	9	20.0	16	35.6	6	13.3	45	100

The respondents were also highly educated. indicates that 12 or 27.27% of the respondents who reported their level of education had a bachelor's degree, 18 or 40.91% had a master's degree, and 11 or 25% had a doctoral degree. The areas of expertise reported by these respondents also varied, having earned degrees in engineering, economics, soil science, biology, public administration and community development. In contrast, only 3 or 6.81% of the respondents had earned secondary or associate degrees. While it is likely that these findings reflect the recent professionalization of disaster management personnel, none of the respondents had received degrees in disaster management. The only major difference between sub-systems was found in the "doctorate" category, where 8 or 72.73% of the respondents who reported having earned a doctorate were found in the domestic sub-system.

Table 12: Subject's Highest Level of Education

	Secondary (High School)		University (Associate)		University (Bachelors)		University (Masters)		University (Doctorate)		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
International	1	2.3	0	0.0	7	15.9	10	22.7	3	6.8	21	47.7
Domestic	1	2.3	1	2.3	5	11.4	8	18.2	8	18.2	23	52.3
Total	2	4.5	1	2.3	12	27.3	18	40.9	11	25.0	44	100

Finally, Table 13 indicates that the respondents possessed different levels of disaster management experience. Interestingly, only 9 or 20% of the 45 respondents reported that they possessed eleven or more years of disaster management experience. What was the most surprising about the respondents was number of new disaster management practitioners. In fact, 24 or 53.33% of the respondents reported that they had less than five years of disaster management experience. This means that, at the time of the earthquake and tsunami, many of the participants who participated in the response had little, if any, disaster management experience. Similar distribution patterns were present in both the domestic and international sub-systems, where respectively, 21 or 87.50% and 15 or 71.43% of the respondents reported ten or fewer years of experience. The respondents became disaster managers for various reasons. Some intentionally entered the field after college, while others entered the field after careers in conflict resolution, education, tourism and public health.

Table 13: Subject's Years of Disaster Management Experience

	0-5		6-10		11-15		16-20		25+		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
International	10	22.2	5	11.1	3	6.7	2	4.4	1	2.2	21	46.7
Domestic	14	31.1	7	15.6	2	4.4	1	2.2	0	0.0	24	53.3
Total	24	53.3	12	26.7	5	11.1	3	6.7	1	2.2	45	100

7.2 OPERATIONAL CONSTRAINTS

The respondents indicated that the administrative system that operated in Indonesia after the earthquake and tsunami experienced a variety of constraints. Table 14 reveals that 43, or 91.49% of 47 respondents, indicated that operational constraints had, at the very least, some effect on the administrative system. Of the respondents that represented the minority, only 3 or 6.38% reported that the constraints had “no effect” on their activities, while 1 or 2.22% reported that the question was “not applicable.” The respondents who reported that constraints had “no effect” on their activities all represented the domestic sub-system. Given that 23 or 48.94% of the respondents reported that operational constraints permeated the system at a “great extent or higher,” it is important to consider how these constraints differed, in terms of their substance and effect, for the organizations that operated in the domestic and international sub-systems.

Table 14: Tsunami Response Affected by Operational Constraints

	No Extent		Small Extent		Moderate Extent		Great Extent		Significant Extent		Not Applicable		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
International	0	0.0	5	10.6	5	10.6	8	17.0	2	4.3	1	2.1	21	44.7
Domestic	3	6.4	2	4.3	8	17.0	10	21.3	3	6.4	0	0.0	26	55.3
Total	3	6.4	7	14.9	13	27.7	18	38.3	5	10.6	1	2.1	47	100

7.2.1 Domestic Administrative Sub-System

The domestic respondents reported that their activities were subject to two major operational constraints. First, prior to the tsunami, Indonesia's government and communities lacked adequate disaster awareness and disaster regulations, which meant their disaster management system was not prepared to manage the post-tsunami environment. Second, after the tsunami, the lack of information in the domestic sub-system prevented domestic organizations from developing a comprehensive understanding of scope of the disaster, the needs of the affected population, and the steps that should be taken to meet those needs.

7.2.1.1 Lack of Disaster Regulations and Disaster Awareness

The most significant constraint reported by domestic officials was the extent to which Indonesian governments and communities were unprepared for the consequences of large disasters. This lack of preparedness was discussed at length by the respondents, none of whom indicated that the disaster regulations that had been adopted by Indonesia prior to the tsunami were adequate to

meet the needs of the community. When asked to elaborate, they could not identify specifics about the legal regulations and mechanisms that were in effect prior to the tsunami, but rather, would make general references to the BAKORNAS PBP, SATLAK and SATKORLAK coordination mechanisms. They did report that the legal framework at the time of the tsunami was vague, fragmented, and did not address the full cycle of disaster management (Respondent 10 2009). The respondents also indicated that BAKORNAS PBP, the national disaster management institution, was nothing more than an ad hoc agency, which had neither the structure nor the capacity to manage large scale natural disasters.

In describing how BAKORNAS PBP operated at the national level prior to the tsunami, a respondent that worked for an international organization elaborated on the shortcomings of the board. The respondent indicated that the board was nothing more than “a bunch of people from big organizations who try to coordinate stuff. They don’t have their own budget line, they don’t have power, well, they have a budget line for their own personnel, but to do anything, it is nothing. And, secondly, the disaster law [implemented at the time] is too vague” (Respondent 10 2009). These shortcomings generated two problems for Indonesia’s disaster management system. First, BAKORNAS PBP did not have the capacity or authority to direct the Indonesian line ministries to adopt more effective policies. Second, while BAKORNAS PBP would attempt to coordinate response activities following a disaster, they did not have the power to ensure that the line ministries would comply with the decisions made during the coordinating meetings.

The problems generated by regulatory vagueness and the lack of a cohesive national policy also created problems for disaster management activities at the local level. A high ranking Indonesian government official indicated the nature and extent of the problems, “[During the period between 2000 and 2004] ...the Satlak, Satkorlak, even the BAKORNAS...were clearly

mandated in disaster management. But Satlak and Satkorlak in the provincial and local levels were not that good. People, they just come and go. People do not have the power or the clear responsibility in disaster management” (Respondent 13 2009). The respondent continued by noting that the officials that staffed disaster management positions at the local and provincial levels would often accept such positions as a “side job” (Respondent 13 2009). Other respondents indicated that local officials were not “committed” to disaster management, and simply used their position as a transition point for career development (Respondent 52 2009).

The administrative gaps in disaster management that existed in Indonesia prior to the tsunami were also influenced by factors other than shortcomings in legislation and policy. The respondents reported that Indonesia’s governments and communities were just not aware of the risks and hazards posed by disaster. Prior to the tsunami, disasters were considered to be nothing more than “acts of God,” meaning that there was not much that community or government officials could do to prevent events such as floods or fires from occurring. If a disaster event did occur, then officials would generate a response to that specific event.

In explaining the consequences of this perspective, one respondent stated, “the culture was, and this is by the government’s own admission, the culture was ‘we have disasters.’ They are a fact of life. When they happen, we will respond to them, and we have a structure to do that. And this was called BAKORNAS PBP. And BAKORNAS, as I understand it, was a bunch of government ministers with a small secretariat...that came together to coordinate the response. Very little happened apart from that” (Respondent 16 2009). This lack of awareness had consequences, particularly with the degree to which local governments and communities were prepared for disasters. Another respondent emphasized this point by stating “when the tsunami hit Aceh, we were like, oh my God, what the hell is this? They weren’t prepared, we could see

that from how they managed, you know ... the refugees, and how to check them, and what to do, and how to make their daily lives, their health. So, we were all helped by the national organizations and then other countries” (Respondent 43 2009).

7.2.1.2 Confusion Generated by the Lack of Information

The respondents also indicated that confusion permeated the domestic sub-system after the tsunami. During the initial response period, the Indonesian government experienced confusion, particularly about the scope and scale of the disaster. Although Jakarta had received reports that an earthquake had occurred off the island of Sumatra, the destruction of critical infrastructure prevented the government from receiving information about the tsunami. Even when information did arrive - the respondents estimated it took between 24 and 48 hours - the government underestimated the size of the affected population and the scope of the destruction.

The respondents also reported that Indonesian government officials were confused about their capacity in the tsunami affected regions. One respondent indicated that the national and local governments, which had lost a large amount of personnel and resources, spent a month “trying to map their capacity on the ground” (Respondent 15 2009). This governmental confusion also had an impact on the organizations that participated in the administrative response system, particularly the non-governmental organizations that sought direction from government officials. Another respondent referred to confusion that existed by stating, “[y]ou had no system; no mechanism. That was a constraint. It was like there was no particular organization, that was one month, it was chaos because there was no mechanism, no standard operating procedures, so NGOs [were] like a ping-pong [ball] ... they were confused (Respondent 14 2009).

Much of this “bouncing around” seems to have been caused by constraints in information collection. Almost all of the respondents discussed the need for information, which would have helped them to make effective decisions in a confusing situation. There were three areas of concern related to information collection, which influenced the extent to which organizations could determine the scope and scale of the disaster. The first related to the availability of baseline information. The respondents indicated that they needed a wide range of information, for example, the number of people living in the affected communities, and even more startling, information related to where some of the affected communities were even located (Respondent 20 2009). Without such information, it was almost impossible for organizations to conduct accurate impact and damage assessments. A second concern related to the lack of consensus on the types of indicators that should be used for information collection purposes. One respondent reported that, after the tsunami, he could not find statistics on the number of people who rented homes in Aceh, or accurate information on the number of people who lived under the poverty level (Respondent 10 2009). The third concern related to the methodologies employed to collect information. For instance, a high ranking government official reported problems with the Environmental Commission for Latin America and the Caribbean (ECLAC) methodology for conducting post-disaster damage assessments. In his own words:

“[w]e tried to adopt the ECLAC, but it is very complicated, it is very difficult for the...not only for the local [governments], but also the central government. You know, the data reliability is very poor here, and you know the collection that we are doing is very difficult. I don’t think that we had the full effect of the ECLAC, it won’t fit with the supply [of information]. That is why, for the personnel plan, we have been trying to do some modifications, what we call the Lite ECLAC. The reduced ECLAC methodology” (Respondent 48 2009).

This statement indicates that the organization involved in the disaster assessment activities had to modify their procedures in order to collect information in the post-tsunami environment. While

no two disasters are exactly alike, identifying and refining the information collection methodologies before the occurrence of a system disrupting event can speed up information processes after a disaster and reduce confusion in uncertain and rapidly changing conditions.

7.2.2 International Administrative Sub-System

The international respondents also reported various operational constraints. The first was the lack of governmental and social infrastructure in the tsunami affected regions. The second was that international organizations did not have the linguistic and cultural skills needed to work in Indonesia. Together, these constraints worked to undermine the capacity of the international organizations, which had to conduct response activities in an unfamiliar environment.

7.2.2.1 Lack of Governmental and Social Infrastructure

The collapse of governmental and social infrastructure had a significant impact on the organizations in the international sub-system. When called upon to provide disaster assistance, international organizations typically work within domestic institutions. This was difficult to do in Indonesia, as the tsunami struck governmental institutions particularly hard, many of which had already been weakened by thirty years of conflict. Emphasizing this constraint, an international official reported, “the area of coverage was so big. It was in the northern part. It was in the western part. The northwest part. The local government was not there, so you had to work with what was left. Um, limited personnel from the local government” (Respondent 16 2009). Along with the collapse of the government was the loss of office space, vehicles, staff, equipment, and data that would have normally been used to support disaster response activities.

The respondents also indicated that there was a period of anarchy in Aceh, meaning the lack of governmental authority, while the national government took the steps to assess the damage caused by the disaster. Officials from domestic and international organizations reported that, even a week after the tsunami, the governmental structures in Aceh remained inoperable, and there was confusion about who was in command (Respondent 12 2009; Respondent 17 2009). In response to this constraint, domestic and international organizations had to develop the administrative mechanisms to manage operations while the operations were being carried out.

The disaster also had an impact on the social fabric of Indonesian communities. One respondent estimated that because of the tsunami, “80% of the public sector, in the sense of institutions, were dysfunctional” (Respondent 21 2009). But the damage was not just limited to institutions. A separate respondent suggested that the event disproportionately eliminated the professional class, many of which lived along the coast (Respondent 24 2009). Those who did survive the tsunami were in a state of shock. For instance, an official from a University in the Aceh who had worked with international organizations reported, “everyone, almost everybody, lost his or her family members, lost their house, and all their stuff. And ok, you can imagine, there were some friends of mine, many friends of mine, who used to be very good, you know, economically, they have a good house, cars, and so on. Then, after the tsunami, they lost everything.... This is what they had to face” (Respondent 37 2009). As they attempted to process what had just happened, entire segments of the affected population were unable to contribute to the response. The organizations that responded to the tsunami not only found themselves collecting information and delivering relief supplies, they also found themselves contemplating how to rebuild the social fabric of communities that had all but evaporated.

7.2.2.2 Lack of Language and Cultural Understanding

Many respondents indicated that international organizations experienced difficulties bridging linguistic and cultural gaps. These gaps delayed the rapidity at which relief goods and services could be delivered, and created further confusion among response organizations. The linguistic gaps were particularly problematic during the period immediately after the tsunami. A domestic respondent, who recalled the arrival of the foreign doctors in Aceh, reported “it was good that they arrived, but they could not speak the local language. So, our people first worked as a translator for these doctors, who were checking on the people, and so on. So, it was very magnanimous, of them, [but] there was a big need for anyone who could speak English, and the local language, obviously” (Respondent 45 2009).

The same respondent stressed how language problems made it difficult to accomplish tasks immediately after the tsunami. For instance, the procurement procedures of some of the international organizations required that assistance request forms be filled out in English. Many of the local organizations were unable to comply with these requirements. Consequently, there was a substantial demand for translators, who were in short supply. Another respondent, a bilingual Indonesian medical doctor who worked for an international organization, reported on the pressure for her to act as a translator. There were “only limited translators. [There were] only three medical doctors, including me, who were national consultants. I don’t want to be a translator. I have my own tasks. I have my own job. Why do I have to be a translator for them? It’s a constraint” (Respondent 2 2009). The constraint of language meant that staff who worked for small organizations would often be “poached” by larger international organizations.

Equally problematic were the cultural gaps between the international responders and the tsunami affected populations, many of whom practice a conservative form of Islam. Westerners

arrived in Aceh wearing shorts and t-shirts, and would often interrupt populations at prayer with a convoy of loud trucks or talking during services. The cultural mistake that was the most often mentioned by the respondents was the direct importation of response plans that were not appropriate for Aceh. This resulted in problems such as the accidental delivery of pork products to Muslim populations by western relief organizations. Cultural constraints also affected the manner in which activities could be carried out. An academic who tracked the interaction between the domestic and international organizations indicated, “The culture of Aceh is very difficult. You have to respect the dead body. They do not allow you to just shovel the people... You can’t just use the bulldozer. In other country, maybe you can do. Other places, maybe, in Indonesia, but not in Aceh... So you have to respect one by one. So, they cover. Even you don’t have those bags; you have to cover with batik, or whatever. The culture is strong. This is the problem. The culture is strong and this is the difficulty that we found” (Respondent 52 2009).

A local Acehnese respondent who worked for an international organization reported that the culture gap ran both ways, and the Acehnese also had difficulties adapting to western standards. For instance, when smoking was prohibited in inside western facilities, many Acehnese just continued to smoke. This respondent argued that response organizations, particularly those that come from the west, need to do more to explain their cultural norms to the local populations, “If you say to me, you are not allowed to smoke, but don’t give me a reason, then there was no way that I am going to just stop smoking” (Respondent 35 2009).

7.2.3 Core Administrative System

The core administrative system experienced three primary operational constraints. The first was the amount of resources that were available to response organizations, which often encouraged organizational competition. Second, the effectiveness of the activities conducted by the organizations in the core system was constrained by a lack of collaboration and coordination. Finally, the organizations in the core system had to manage a variety of logistical constraints.

7.2.3.1 Resource Availability and Organizational Competition

Some of the respondents indicated that the organizations in the core system were overwhelmed with resources, particularly financial resources. The *Tsunami Evaluation Coalition Report* indicated that more than US\$13.5 billion dollars was pledged and donated for both response and recovery activities (Telford, Cosgrave, and Houghton 2006, p. 80). The financial generosity of donor communities created various constraints. For example, non-profits are directly accountable for the manner and rate at which they spend the contributions of their benefactors. The respondents indicated that this placed non-profits in the difficult position of having to spend and deliver their resources as quickly as possible. While explaining the pressure on such organizations, an official from an international organization reported, “suddenly you had organizations that had five times their normal operational budget, globally, thinking, ‘crap, how are we going to get rid of this money in one year?’ So, you had NGOs going in and claiming villages. ‘So, this is our village, we are going to rebuild it’” (Respondent 15 2009). This “excess supply of money over demand” worked to “constrain opportunities for collaboration and cooperation,” which in turn, led to situations where communities would receive too much (or not

enough) food, blankets or medical supplies. In other instances, respondents reported physical confrontations between response personnel who attempted to exclude other organizations from communities and regions that had already been targeted for relief (Respondent 15 2009).

Organizational competition could be directly observed through what some of the respondents referred to as “flag-raising,” or the promotion of political or organizational interests over the interests of the affected populations. A domestic respondent referred to *Disneyland* when she indicated that one of the major problems in the Indonesian response system were the volunteers from political parties. These organizations “[used] the conditions of the disaster to promote their political party... The problem is that when you go there during the first month, most of the relief or refugee camps are filled with all the banners. This is very disturbing to me” (Respondent 52 2009). A separate respondent, a westerner who worked for a local organization expressed frustration with organizational flag-raising amongst non-governmental organizations. Referring to coordination meetings that broke down due to differences in opinions as to where logos should be placed on t-shirts, he reported, “The organizations only care about their logo. I can see that. They couldn’t give a shit about the program, how many people it is helping, how much money, what results are being generated in the field. All they care about is their logo visibility. That is all they care about. That I guarantee you” (Respondent 34 2009).

7.2.3.2 Lack of Collaboration and Coordination

The gaps in Indonesia’s disaster management system also constrained the collaboration and coordination of response organizations. The lack of collaboration and coordination permeated all levels of the administrative response system, resulting in the duplication of efforts, delays in the distribution of relief supplies, and over the long term, the inability to complete projects and tasks

that required contributions from multiple organizations. There did not seem to be a single factor that caused the lack of organizational collaboration and coordination. Rather, it was the simultaneous interaction of multiple factors that reduced the ability, but not the desire, of organizations to work together in the post-tsunami environment. Perhaps the most important explanation for the lack of organizational coordination was the failure of the SATKORLAK system, particularly in Aceh. The result was a vacuum in government authority. As the national government contemplated how to respond to this vacuum, the affected regions became inundated with response organizations. The lack of coordination meant that there was no systematic oversight of these organizations, many of which lacked disaster management expertise and experience. According to an individual who was involved with coordination at the national level:

“Some of the local NGOs don’t help the emergency response plan. But it’s more on the spontaneous, whenever there is a disaster, people just go. This is part of the humanity culture. They just go and give the help. For example, I notice a lot of small NGOs, small political party, they just go there. Even though they didn’t know what to do, they just go there. If they don’t have money, they don’t have fund, they just give the skill helping them. They give the power, the human power. Something like that. But if they have money, they donate the money. Whatever their intention. People sometimes have their own intention. Something like that” (Respondent 52 2009).

This excerpt indicates that the response system lacked a formal administrative structure, which meant that there was little guidance behind its development and operation. So why didn’t organizations simply hold meetings to facilitate coordination? Interestingly, while the respondents indicated that such coordination meetings did occur, they also indicated that these meetings were not as effective as they could have been.

The organizations in the response system also appeared unable to reach a consensus on how to define coordination. One respondent questioned whether organizations even knew what coordination was, “So, I think to having a proper coordination, is a dream of everyone, but what

is coordination? What exactly is it? Is it the same activity in the different places, or is it various activities in one place? What happened in Aceh, they want to coordinate the same activity in different places. That is what happened ... the coordination is happening at the policy level, not at the ground level. What I don't see in Aceh, is that the coordination is happening at the ground level, where you coordinate ... different activities in one place" (Respondent 10 2009). Another respondent, when asked about the effectiveness of the coordination meetings indicated that the meetings lacked the focus needed to guide policy. Rather, "people just reported what they did today. I mean, this morning, and what not. But not from a needs focus. So, it is like, what is the gap? I don't know. I attended those meetings, but I don't know" (Respondent 8 2009).

The third explanation for the lack of organizational coordination stemmed from the fact that organizations distinguished between the organizations that they were willing to collaborate with, and those that they were not willing to collaborate with. This does not mean that organizations did not inquire about opportunities for collaboration, but rather, when an inquiry was made, it may not have been accepted. For instance, a respondent who worked on response activities in Aceh reported, "the big [organizations] have their own little, personal, internal arrangements, that sort of thing. The head of this one is friends with the head of that one, or this sort of thing. So we will sort of, work together. Whereas the smaller, slightly obscure [organizations] that you know, don't have the contacts in the top ranks... They just get shut out. Not interested" (Respondent 34 2009). Indeed, many of the respondents indicated that some of the organizations were large enough from the standpoint of their finances, resources and personnel, that they could conduct operations by themselves, without the collaborative assistance of other organizations. This reflects the findings presented in chapter six, which indicate that there were clusters of organizations that operated as isolated entities within the system.

7.2.3.3 Logistical Obstacles

When asked about the nature of the constraints that existed in the response system, all of the respondents mentioned the challenges posed by logistics. The respondents distinguished between three categories of logistical obstacles: those caused by the physical environment; those caused by the regulatory environment; and those caused by the lack of personnel and equipment.

The first category was caused by the physical environment. The damage caused by the earthquake was not just limited to the coastline. Unlike the tsunami, the effects of the earthquake were felt inland, many kilometers from the shore, and they disrupted transportation and communication infrastructures throughout parts of the island of Sumatra. These disruptions increased the time it took response organizations to deliver disaster goods and personnel to transportation hubs, and once there, distribute them to communities before they became spoiled or were no longer of any utility. A respondent who delivered assistance immediately after the tsunami reported how the damage constrained his capacity to operate:

“Logistics was a big mess. There was, you look at Aceh, people would receive in Banda Aceh. The destruction in the west coast, starting from Chalang, just totally gone. Mualabo, was totally gone. Eh? People transporting material to Banda Aceh, they have a problem, they have no road. Nothing. I was traveling to Chalang with [organization’s name removed] in our car. A very good Toyota. Usually, it took me two hours. It took me about 20 hours. Usually, only two. Transport was really bad” (Respondent 10 2009).

Another respondent used the word “paralysis” to describe the transportation system in the Aceh after the tsunami. These constraints were eventually overcome by organizations, for example, through the use of helicopters and amphibious landing craft.

The second category of logistical obstacles was that certain types of critical equipment and specialized personnel either did not exist, or were used inappropriately. One respondent indicated that “...for us, no problem for logistics from Jakarta to Aceh. The problem one in

Aceh, [was] getting it out” (Respondent 12 2009). He explained that there were often goods scheduled to be delivered to airports, but their delivery had to be delayed due to the lack of air traffic controllers or the lack of the forklifts needed to unload the cargo. In other instances, there were not enough vehicles to transport goods from Banda Aceh to other districts. Still others reported that equipment was used inappropriately. An official from an international organization reported, “I mean, you know, I would say that 70% of what was done was pretty much on target. It was the 30% that was the problem. For example, hiring helicopters to carry bottled water around, when you could have used a tanker truck a day later for half the price. I mean, there was a lot of that sort of knee jerk stuff. Helicopters were wrongly used” (Respondent 18 2009).

The third category of logistical obstacles was caused by Indonesia’s regulatory environment. Although these issues were reduced in the months after the tsunami, respondents expressed concern with how difficult it was to get goods through Indonesian customs. Some respondents reported that the port in Medan was particularly challenging. According to one official who worked in a non-profit organization, the problem was, “the bureaucracy. The [customs in Medan] needed to provide requests to Jakarta, a hundred kilometers away. There is no authority for them to release [the goods] in Medan’ (Respondent 27 2009). Some of the respondents even suggested that corruption may have played a role in delaying release of certain goods that had arrived in Medan, especially medical supplies. Whatever the source of the delay, the consequences soon became apparent, as goods piled up at port facilities, some of which expired before they could be utilized.

7.3 OPERATIONAL OPPORTUNITIES

Given the uncertain nature of post-disaster environments, administrative systems that respond to disruptive events will always experience constraints. Yet administrative systems often have the capacity to overcome these constraints. Even against almost insurmountable odds, response organizations managed to save lives, deliver supplies and initiate the process of reconstruction in post-tsunami Indonesia. This suggests that there were aspects of the administrative system that operated effectively, and in many instances, it managed to take advantage of the opportunities present in the post-tsunami environment. Table 15 indicates that 45 or 100% of the respondents reported that the opportunities had some effect on post-tsunami operations. Of these, 32 or 71.11% reported the effects of opportunities at a “great extent or higher.”

Table 15: Tsunami Response Affected by Operational Opportunities

	No Extent		Small Extent		Moderate Extent		Great Extent		Significant Extent		Not Applicable		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
International	0	0.0	3	6.4	5	10.6	9	19.1	3	6.4	1	2.1	21	44.7
Domestic	0	0.0	0	0.0	5	10.6	15	31.9	5	10.6	1	2.1	26	55.3
Total	0	0.0	3	6.4	10	21.3	24	51.1	8	17.0	2	4.3	47	100

7.3.1 Domestic Administrative Sub-System

The domestic respondents reported that their ability to conduct operations was affected by a variety of opportunities, two of which were extremely beneficial. First, domestic leadership played an important role after the tsunami, ensuring that critical organizations had access to the disaster scene. Second, the domestic respondents also indicated that the international attention generated by the tsunami motivated the international community to provide assistance.

7.3.1.1 Political Leadership

Political leadership played an important role in the domestic sub-system. Many of the respondents acknowledged the professionalism of the members of the national government, many of whom had only entered office three months prior to the tsunami. Especially valuable was President Susilo Bambang Yudhoyono's decision to open the Aceh to foreign assistance and to relax the regulatory restrictions on the importation of relief supplies and the granting of visas to international disaster personnel. Given the political pressures to keep the Aceh closed, these decisions represented a critical turning point for the development of the response system.

The respondents readily acknowledged the role of leadership as an opportunity. A respondent who worked with Indonesia's governmental institutions indicated that he experienced a feeling of relief when he realized that he would be dealing with a government that he could engage, and that he could have open and honest dialogue with senior government officials about operations (Respondent 17 2009). Other respondents singled out specific national organizations for their leadership efforts. For instance, a respondent who worked for an international non-profit organization acknowledged the Indonesian Ministry of Health for accepting a leadership role

when it realized that there was a gap in coordination and began to direct health related operations (Respondent 1 2009). Perhaps the most important aspect of political leadership was the fact that Indonesian government officials sought help from the international community, and let the response system unfold naturally, interjecting only when necessary.

7.3.1.2 International Attention and the Desire to Assist

The domestic respondents also noted that the tsunami directed a significant amount of international attention to towards their country, and that the images of the disaster created a huge desire on the part of individuals and organizations outside of Indonesia to provide assistance. An Indonesian university official noted how the “CNN effect” influenced the response. He continued, “CNN, Al Jazeera, and all televisions have a very great impact on international philanthropic activities in Aceh. Teams from famous countries had come to Aceh on the second or third day. A team from Japan was already there the second day of the disaster, as well as from Thailand. Germany came on the fourth or fifth day. After that the American Navy came. Yea, the Aceh disaster shows how the international cooperation develops because of mass information” (Respondent 5 2009). This attention encouraged international organizations to marshal large quantities of financial resources, technical expertise and personnel to the disaster area.

The tsunami was, in many measures, one of the world’s largest disasters, and everyone wanted to be seen involved in the response efforts. While this may have been the case for some organizations, one of the respondents suggested that the desire to provide assistance after the tsunami was fundamental to human nature, and reflected humanity’s desire to assist those in need (Respondent 52 2009). Illustrating this point was an example provided by an official from a national official, who reported amazement when, during the response period, his office received

a check in the mail from someone in the United States for thirty dollars. Even though some respondents questioned the extent to which the media focused on the death and destruction wrought by the tsunami was appropriate, the attention created by the stories and images encouraged individuals and organizations to donate their time, goods and money, which ensured that the organizations in the domestic system had sufficient resources to respond to the tsunami.

7.3.2 International Administrative Sub-System

The international respondents reported that their response capacity was affected by two primary operational opportunities. First, international organizations possessed the authority to act as they felt necessary, and did not necessarily have to wait for approval from the central government centralized before implementing response strategies. Second, international organizations possessed the mechanisms that they needed to convert information into actionable knowledge.

7.3.2.1 Authority to Act

Most of the respondents reported that they were surprised by the amount of authority that the international organizations enjoyed during the month after the tsunami, meaning they were able to make decisions and implement programs without having to request approval from governmental officials. A respondent from an international organization recognized the freedom that was available to the international community when he stressed that, “You could go anywhere; you could do whatever you want. Because the government is having problems coordinating, you see, you have freedom” (Respondent 16 2009). This freedom action was especially helpful to the initial wave of organizations, which needed the autonomy to conduct

search and rescue operations and deliver relief supplies to rural areas. The broad granting of authority seemed to be caused by two separate factors. The first was the collapse of the local government. There was simply no one in a position of authority to exert control over the international organizations when they initially arrived. Second, even when the national government began to reestablish control, it “very sensibly, and very rapidly, realized that [it couldn’t] try to keep all the rules and regulations” (Respondent 19 2009).

7.3.2.2 Information Collection and Knowledge Utilization

The second operational opportunity in the international sub-system was the extent to which organizations engaged in information collection activities and generated the knowledge needed to take effective action. A respondent indicated that international organizations were ready and willing to accept new information, “Well, I think if we did something well. We did this one well. We definitely have accepted new information. We had to find our role, in terms of where we [fit] in” (Respondent 7 2009). The availability and accuracy of information in the operational environment was critical to the decision making process. Another respondent stressed the need, not just for information exchange, but also for information accuracy, “I think that was really significant, as you know, the [operational] management [was] not always there. Right, I mean decision making can be made, based upon the [information contained in the] situation reports that we made. If it is false, then there will be a false decision” (Respondent 47 2009).

Organizations took various steps to ensure information accuracy. First, organizations deployed collaborative teams to collect information. In describing the information collection processes in his international non-governmental organization, one respondent indicated, “Well, I think roughly 150 people were involved, from government, local expertise and the international

community. In, I think, 12 different teams, that were looking at the classic sectors..., and so we had an environment team working with [organization name], working with local environmental experts, to assemble that information. But, there were teams [also] looking at health, and education, and housing, and infrastructure, and transportation, and so on” (Respondent 28 2009). Second, many organizations had trained their volunteers to use standardized information collection and assessment forms, which while sometimes difficult to employ, seemed to improve the quantity and quality of the information collected (Respondent 18 2009). Finally, organizations interacted to collect information about needs. One respondent indicated that the interaction was mutual; “they have troubles in customs. We make a phone call. So we were able to help with medicine and cleaning. We were able to provide Tupperware. So we [could] help direct organizations, what their needs were on the ground [were]” (Respondent 15 2009).

The information collected by organizations was converted into actionable knowledge and distributed throughout the system through a variety of means. Other than through interpersonal communication, the respondents indicated that international organizations used five mechanisms to share information. The first mechanism, the use of websites, represented the most indirect method of sharing information, especially for organizations interested in communicating directly with their benefactors (Respondent 47 2009). The second mechanism was the use of personal communication devices such as cell phone or satellite phones. According to one respondent, “We were able to communicate with our headquarters and potential donors as well. That’s what [was] happening. Even the cell phone, you were able to send text messages. It was very nice in a sense. Satellite phone, we have to use it because it was in a remote area from the network. So we have to use satellite phones. Expensive, but very valuable” (Respondent 15 2009).

The third mechanism was the use of organizational situation reports. Distributed through hard copies and the internet, situation reports represented a critical component of the decision making process. Respondent 15 (2009) also elaborated on the use of situation reports, “Our ... reports go to the President. We were able to get the government to put some pebbles on the street so that trucks could go to the tsunami area. It was bad, and you could not go there. [The information in these reports] were ... distributed to other organizations, even the government. We were able to provide a timely response.” The fourth mechanism was the use of coordination meetings, which brought together a large number of organizations, for example, every night at the offices of government officials, for the purpose of sharing information and designing effective response strategies (Respondent 15 2009). The final mechanism, primarily reserved for the largest of the response organizations, were rudimentary decision-support systems, which integrated various forms of technology for the collection and dissemination of information. In describing how such a system worked, an individual from a major international organization reported, “teams would get secondary information, historical data, they would analyze the satellite imagery, and then do an internal analysis, which was then vetted, at least during the damage loss assessment, with ... other governmental counterparts. [And] a website was set up to publicly disseminate the information that was being developed. I think that this was the most effective means of transmission” (Respondent 28 2009). These mechanisms represented a critical element of the international sub-system in that helped to ensure that the organizations that were connected shared a “common operational picture” of the post-tsunami environment.

7.3.3 Core Administrative System

The respondents identified three opportunities that helped the system operate in the post-tsunami environment. The first opportunity was social networks, which provided organizational decision makers with the means to navigate the complex post-tsunami environment and to find solutions to a variety of operational constraints. The second opportunity was that, while difficult and imperfect, many of the organizations in the core system were willing to engage in activities based on collaboration and coordination. The final opportunity was that the organizations were flexible, and could adapt in response to the development of unforeseen constraints.

7.3.3.1 Social Networks

Social networks played an important role for the organizations in the response system. The respondents indicated that organizations utilized social networks in three ways: 1) to acquire access to local communities, 2) to facilitate their access to information, resources and expertise; and 3) to navigate Indonesia's regulatory processes. In describing the post-tsunami environment, one respondent indicated that it was, "all about interacting and exchanging and collecting information. It was done personally, and face to face. You will always find that there is a professional willingness to share information" (Respondent 6 2009).

The first category of social networks was those that enabled response organizations to gain access to the local communities. The respondents stressed that the organizations with local connections, the result of having been embedded in the community prior to the tsunami, were often perceived to be the most effective. Examples of such organizations included the Indonesian Red Cross, CARE, religious organizations such as Muhammadiyah, and local organizations that

had worked in the communities before the tsunami. These organizations, while headquartered in Jakarta, were able to contact their local branches, and where necessary, have their local staff mobilize their local partners. When their relief personnel and supplies finally arrived, these organizations found that their local partners had already used their local contacts to organize volunteers, transportation, and locate accommodations for the management of relief operations. As a result, organizations that were connected to local communities, and had developed their social networks, were in a better position to initiate relief operations than the organizations that had little, if any, experience working in Aceh, let alone Indonesia.

The second category of social networks was those that enabled organizations to gain access to information, resources and expertise. Some of these social networks included formalized, pre-arranged ties between response organizations. Other social networks operated at the inter-personal level, and the respondents reported that it often only took a phone call or a text message to get access to critical information or get an important task completed. It was important to have access to such networks in the post-tsunami environment. An official from an international non-governmental organization recalled how an official with significant contacts used his social network to develop an effective disaster management team:

“I think that is one of the more interesting stories of all this. The way that, as far as I can recall, what happened with [name removed], we was not only the director of [Organization Name], but also the interim coordinator for [Organization Name]. His superior was out of the country, so he was in charge. I think that the first thing that he did was contact the government and pulled together very quickly an ad hoc disaster management team. In the [Organization Name] there is this whole protocol, and that involves a whole set of things, but he pulled together a disaster management team meeting, and he was very clever about it, not only with the government or [Organization Name], but also with [Organization Name], and critically, the donors. And, so then once he had all that, and once he had everybody lined up, you know, this is what we want to do, this is how we want to do it, um, he was able to get the authority more quickly. So, donor A wants to do this, send food there, access there, get planes, whatever, helicopters, so he was in

a much better place to get that authority. But, I think that really happened very quickly. And the next thing that he did, again with very high levels of government, the vice-president, he was down in Aceh was meeting with him, grabbing a plane, and checking things out” (Respondent 24 2009).

Interwoven throughout this story are indications of the third category, that social networks enabled organizations to navigate Indonesia’s complex regulatory processes. One area that was particularly problematic was customs, with Indonesian custom agents reportedly delaying the release of critical supplies such as food and medicine. A member of an international non-governmental organization reported that they “had stuff coming from the UK and the US. There are a lot of items that we brought in. I think maybe 40,000 pounds or so, [including] international assistance, medicine and food and a lot of stuff. Hygiene kits. We did not have problems. Some SATKORLAK, they try to give us problems. We faced them. We knew some people in the government who are able to get us through the customs” (Respondent 34 2009).

The lesson is that social networks help individuals to complete tasks. The strongest example came from a respondent who reported how his boss utilized his social network:

He had worked here for four years, and if you want an example of that, there was one day where one of my colleagues came in and said, ‘we need to get the Army to do this.’ [He] said, ‘hang on a second,’ and picked up the telephone and called the Indonesian Minister of Defense and said, ‘I need to see you now.’ He put the phone down, looked at us and said, ‘ok, we are going to the Ministry of Defense.’ We just sat there going, ‘how did you do that?’ I think it was on day two. And I think the next day, he needed to ask the Vice-President about something and he said, ‘just a second,’ and picked up the phone and called the guy’s cell phone and said, ‘I need to see you.’ He had positioned himself very well, so that we had access. It wasn’t difficult, you know, given that he was sms’ing the Vice-President. [He] had the authority and the access” (Respondent 17 2009).

While it may not be possible for all organizations to have direct cell phone access to the vice-president of the country in which they operate, these stories convey another valuable lesson. It is important for organizations to have contacts in the field, and to know what these contacts can

bring to the table in terms of access, expertise, resources, finances and personnel. Organizations must not only collect and organize information about social networks before a disaster occurs, they must also take the time to develop relationships with the contacts that populate social networks. As was the case in Indonesia after the tsunami, organizations that take steps to develop their social networks may find that the solutions to their problems may just be a phone call away.

7.3.3.2 Emphasis on Collaboration and Coordination

The respondents also identified collaboration and coordination as an important opportunity in the core system. While the respondents indicated that there is always a need for improvement, the coordination and cooperation that did occur enabled response organizations to improve their capacity to deliver goods and services in unfamiliar environment. Coordination and cooperation were particularly helpful in two areas. First, they helped to facilitate the collection and dissemination of critical information. Initially, the organizations in the response system had to determine the extent of the damage and the quantity of assistance that needed to be provided. Almost immediately, organizations such as the World Bank and the Indonesian National Planning Agency began to work together to collect the information needed to complete the official disaster damage and loss assessment. At the same time, other organizations were actively involved in the collection of information they needed to conduct their own operations, many of which attempted to distribute this information throughout the system. The most prevalent example of information sharing was the daily situation reports or bulletins, which provided organizations and donors with critical updates. According to one respondent, the creation of the daily progress reports played an extremely important role for the organizations in the response system. The respondent elaborated on this process by stating that that:

“We got news from the UN system, the UNOCHA. We update our reports on the website. Our progress reports went to the President. We were able to get the government to put some pebbles on the street so that trucks could go into the tsunami area.... Those information were able to be distributed to other organizations, even the government. We were able to provide a timely response” (Respondent 15 2009).

The sharing of information was a continual and iterative process. Another respondent reported that his organization established an office in a building in Medan, and that the organizations that shared this space would communicate with each other on a regular basis. The respondents indicated that the response system did not suffer from a shortage of coordination meetings.

Second, efforts at coordination and cooperation also helped to improve the decision making processes of the response organizations. For example, non-profits worked with their donors on a collaborative basis to develop policies that would reflect their desires and goals. According to another respondent, coordination and cooperation enabled his organization to share ideas through a process of “give-and-take” (Respondent 10 2009). Organizations would also communicate about the areas that needed assistance, which response strategies worked, and the avenues of potential collaboration. Examples of collaboration were particularly apparent among international organizations, which helped them to strengthen their decision making capacity. One international official reported success in working with other organizations, “we had pretty good collaboration with the UN family and with the non-governmental community. I think that the decision making processes were as informed as they could have been, and thus, the decisions were as objective as they could have been” (Respondent 17 2009).

7.3.3.3 Organizational Flexibility and Adaptation

The final opportunity reflected the capacity of the organizations in the core system to exhibit flexibility, which enabled them to adapt in the post-tsunami environment. Some respondents indicated that this flexibility was the result of the operational environment itself. In discussing the system's flexibility, an official from an international non-governmental organization noted, "I think the opportunity was that we all had an open environment. The government was open...and uh, the local people were open. I think that the people were stunned by the openness. And that I think was the opportunity" (Respondent 18 2009). Other respondents reported that organizations took action to improve their flexibility. For instance, a respondent from a separate international non-governmental organization reported, "[w]e try to develop local capacity. We do not have expatriates. Uh, and you know, I have the opportunity to hire expats, but we do not go to that direction because we want to develop local capacity" (Respondent 15 2009).

Whether due to the actions of the organizations, or their operational environment, the flexibility that existed in the core system enabled organizations to step outside of traditional operational patterns and develop unique solutions to unforeseen problems. There were two areas where organizational flexibility was particularly useful. First, organizations that demonstrated flexibility were able to adapt to the physical environment. The earthquake and tsunami destroyed infrastructure that inhibited organizations from using traditional forms of transportation. An international official who dealt with this problem indicated that the situation demanded that organizations be flexible. He stated, "[The organization's name] recognized that doing all that methodologically sound stuff was going to be very difficult. We got on U.S. helicopters. We flew down the west coast. We, actually, did lots of things that would be considered rather bad humanitarian practice. But in the absence of our capacity to do anything else, it was like, well,

this is the best we could do, so let's do it" (Respondent 17 2009). This ability to adjust was crucial for the organizations that participated in the initial response. A respondent from an Indonesian university gave an excellent example, "In our case, [our] rescue team, [our] medical response team, when they have to do operations, for example, you have to do it at the hospital in the sterilized operating room, right? But during the disaster, there is not sterilized operation room; they have to do it out of the tent. They adjust all those regulations (Respondent 5 2009).

Second, flexible organizations were able to adapt to the needs of the affected communities. Many of the respondents made comparisons between governmental organizations and non-governmental organizations, noting that the governmental organizations were the least likely to adapt. For example, when asked which category of organizations were more flexible, a respondent indicated, "I'd say that non-governmental organization [were] much more open to change compared to the government" (Respondent 5 2009). Although governmental organizations may have been less likely to change, they still demonstrated significant flexibility, especially considering that it was the government that allowed international organizations to access the disaster site (Respondent 5 2009; Respondent 19 2009). The need to adapt was particularly pressing for the non-governmental organizations, which quickly realized that they had to modify their procedures to fit the Indonesian context. An Acehese resident who served as a tsunami volunteer explained the need for flexibility in non-governmental organizations:

If [non-governmental organizations] want to do something, they may have a program and a procedure, but between they come to the community, the community says that no, you can't do that because it is against our local customs, and this is our way. So, they sit together and talk about what's the problem, and how to solve it, and then they make the deal, because otherwise, they can't work" (Respondent 43 2009).

The processes by which organizations adapted and adjusted in the post-tsunami environment were not scripted. In many instances, the response organizations lacked standard operational procedures that covered the circumstances they encountered on the ground. When reacting to such situations, many organizations would simply develop an ad hoc procedure and then adjust that procedure as necessary. One Indonesian respondent described this evolutionary process as one of “mutual adjustment and change” (Respondent 51 2009).

This chapter indicates that the administrative system which responded to the Great Sumatran Earthquake and Tsunami of 26 December 2004 managed to adjust to a variety of operational constraints and opportunities. These findings complement those presented in chapters five and six, which indicate that the administrative system possessed the capacity to adapt and self-organize in uncertain and rapidly changing conditions. The subsequent chapter takes this analysis one step further, by evaluating the extent to which the core system and its sub-systems possessed the components of administrative resilience.

8.0 THE RESILIENCE OF THE ADMINISTRATIVE SYSTEM

The data presented in the previous chapters indicate that the organizations that operated in the administrative system that emerged after the Great Sumatran Earthquake and Tsunami of 26 December 2004 experienced a variety of operational constraints and opportunities. The data also indicate that the structure of the interactions among organizations within this system evolved. Focusing on the factors that drove this structural change, this chapter addresses this study's fourth research question: to what extent did the administrative system that operated in Indonesia after the Great Sumatran Earthquake and Tsunami possess the capacity for resilience?

8.1 EVALUATING THE COMPONENTS OF RESILIENCE

The qualitative data used in this study were collected from the transcripts of the forty-eight semi-structured interviews conducted with experts that possessed knowledge of the events that transpired in Indonesia after the tsunami. These transcripts, coded using *MAXQDA*, indicate that the components and sub-components of the framework of administrative resilience were present in the system that operated in Indonesia following the Great Sumatran Earthquake and Tsunami. These components and sub-components, coded using an ordinal schema (1 = Low; 2 = Medium; and 3 = High), were evaluated using the data collected from the fifty-two surveys and the forty-eight transcripts. By way of example, if the majority of respondents reported the presence of a

system characteristic as “great extent” or “significant extent,” the related sub-component would then receive a “high” score. While I recognize that this study’s sample size is small, and that my analysis often resulted in the awarding of scores where small differences led to a shift in category, for example, from “low” to “medium,” this analysis is useful as a preliminary assessment of the framework of administrative resilience. Future research will strengthen this framework by refining its measures and increasing the sample size used for data collection.

8.1.1 Environmental Component

The framework of administrative resilience evaluates the level of pre-event preparedness through the environmental component, which represents the set initial conditions in the at-risk community. In the Indonesian context, this sub-component considers the effectiveness of the disaster management laws, regulations and policies in Indonesia at the time of the tsunami. The environmental component is comprised of the six sub-components presented in Table 16.

Table 16: Description of Environmental Sub-Components

Governmental Awareness	Indications that Indonesia’s governments were aware of the risks posed by disasters.
Social Awareness	Indications that Indonesian society was aware of the risks posed by disasters.
Preparedness	Indications that government and communities were prepared for risks posed by disasters.
Laws and Regulations	Indications of the quality of disaster management rules and regulations.
Disaster Plans	Indications of the quality of disaster management plans and procedures.
Institutions	Indications of the capacity of disaster management institutions.

The environmental sub-components for the core system and its sub-systems, received “low” scores. Prior to the tsunami, Indonesia’s governments and communities were not aware of the risks posed by disasters. This lack of awareness had a substantial effect on Indonesia’s overall level of pre-tsunami disaster preparedness, which impacted both the domestic sub-system and the international sub-system. As Table 17 indicates, the majority of the respondents reported that Indonesia was not prepared for a large-scale disaster event prior to December 2004. In fact, 48 or 97.96% of the respondents indicated that Indonesia’s pre-tsunami level of preparedness was at, or below, “moderate extent.” Of these respondents, 44 or 89.80% classified Indonesia’s level of preparedness at, or below, “small extent.” The lack of preparation also had a severe impact on the response organizations that came to Indonesia. For instance, one of the initial tasks for responding organizations, in addition to providing assistance, was to identify the resources and responsibilities of the organizations that were already operating in the response system. Under normal circumstances, even in large scales disasters, there is typically is some pre-existing domestic capacity, which can be use to guide the development of the administrative response system. In Indonesia, this capacity was almost non-existent and the disaster response structures that developed after the tsunami were initiated on an ad hoc basis.

Table 17: Level of Pre-Tsunami Preparedness

	No Extent		Small Extent		Moderate Extent		Great Extent		Significant Extent		Not Applicable		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
International	3	6.1	15	30.6	3	6.1	0	0.0	0	0.0	0	0.0	21	42.9
Domestic	6	12.2	20	40.8	1	2.0	0	0.0	1	2.0	0	0.0	28	57.1
Total	9	18.4	35	71.4	4	8.2	0	0.0	1	2.0	0	0.0	49	100

This lack of preparedness was also apparent in the extent to which Indonesia's regulatory system was designed to facilitate disaster management activities. Again, the majority of the respondents reported that there was little, if any, regulatory capacity for disaster management prior to the tsunami. As Table 18 indicates, of the 41 respondents who considered the question applicable, 100% ranked the adequacy of Indonesia's regulations at, or below, "moderate extent." Of these, 35 or 85.37% ranked the adequacy at "small extent" or less. Although identified as a primary constraint for the domestic sub-system, both domestic and international respondents agreed about the inadequacy of Indonesia's disaster management regulations.

Table 18: Adequacy of Pre-Tsunami Regulations

	No Extent		Small Extent		Moderate Extent		Great Extent		Significant Extent		Not Applicable		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
International	4	8.9	10	22.2	4	8.9	0	0.0	0	0.0	3	6.7	21	46.7
Domestic	8	17.8	13	28.9	2	4.4	0	0.0	0	0.0	1	2.2	24	53.3
Total	12	26.7	23	51.2	6	13.3	0	0.0	0	0.0	4	8.9	45	100

Similar patterns were also apparent in the extent to which organizations had response plans that emphasized collaboration. The respondents reported that, prior to the tsunami; organizations did not have disaster response plans that emphasized collaboration. Table 19 indicates that 32 or 71.11% of the respondents believed that the extent to which organization possessed such plans was at "small extent" or less. While it would not necessarily be surprising that the domestic respondents would provide such results, what was surprising was the extent to

which the international respondents reported similar concerns. This suggests that, even with their extensive disaster management experience, international organizations had not yet fully integrated inter-organizational collaboration into their operational plans prior to the tsunami.

Table 19: Existence of Pre-Tsunami Plans that Emphasized Collaboration

	No Extent		Small Extent		Moderate Extent		Great Extent		Significant Extent		Not Applicable		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
International	3	6.3	10	20.8	5	10.4	3	6.3	0	0.0	0	0.0	21	43.8
Domestic	8	16.7	11	22.9	3	6.3	1	2.1	1	2.1	3	6.3	27	56.3
Total	11	22.9	21	43.8	8	16.7	4	8.3	1	2.1	3	6.3	48	100

The final environmental sub-component, institutional capacity, also received a “low” score. The respondents indicated that the Indonesian government did not have the institutional capacity to manage disaster events prior to the tsunami. At the national level, the disaster management agency, BAKORNAS PBP, was organized as a coordinating body, which was designed to manage disaster operations. Even though BAKORNAS PBP possessed the responsibility to shape policy, it lacked the authority to direct the actions of the line ministries. Indonesian institutions also disagreed on what constituted a disaster, and more importantly, whose responsibility it would be to respond to the events that did qualify as a disaster. These disagreements created deficiencies at the provincial and local levels, and SATKORLAK and SATLAK were often underfunded and understaffed. Many of the respondents also indicated that local officials had not received sufficient training prior to the tsunami, nor were they dedicated to

improving disaster management capacity in local communities. In an almost ironic fashion, it was the disruption of Indonesia's disaster management system, in conjunction with the collapse of government institutions, which improved the decision making capacity of the response system that developed. The results for the environmental sub-components are presented in Table 20.

Table 20: Scores for the Environmental Sub-Components

		Domestic System	International System	Core System
Sub-Components	Governmental Awareness	Low	Low	Low
	Social Awareness	Low	Low	Low
	Preparedness	Low	Low	Low
	Laws and Regulations	Low	Low	Low
	Disaster Plans	Low	Low	Low
	Institutions	Low	Low	Low

8.1.2 Technological Component

Technology can help decision makers to manage uncertain operational environments. The technological component of the framework of administrative resilience considers the nature of the technology employed in an administrative system, and the extent to which this technology is used to facilitate effective operations. In the context of the administrative system that operated in Indonesia after the tsunami, this component considers whether technology effectively supported disaster management operations during the month after the disaster. The technological component is comprised of the six sub-components described in Table 21.

Table 21: Description of Technological Sub-Components

Availability	Indications that technology was available for use by response organizations.
Form	Indications of the form (low / medium / high) of technology used by organizations.
Adaptability	Indications that organizations possessed expertise to utilize technology to adapt their activities.
Collaboration	Indication that technology facilitated collaboration by organizations in the system.
Interoperability	Indications that the technology used was interoperable.
Integration	Indications that technology was integrated in to a single decision support system.

During the month after the tsunami, response organizations had a diverse range of technology at their disposal. The larger organizations deployed high technology, including satellite communications, GPS and GIS databases. Some of the smaller organizations used less sophisticated technology, including pens, paper and white boards. Tables 22 through 24 indicate that most organizations employed technology such as cell phones, radios, personal computers, and the internet. Other than the distinctions discussed below, there were few technological differences between the sub-systems. The impression among the respondents was that advanced technology was more readily available to, and brought to the response system by, international organizations. While the availability of technology was sufficient for the response, the respondents reported difficulties with technology after the response ended, especially when departing organizations donated equipment, but not the expertise, to operate and maintain the equipment. One respondent indicated that his sick infant son had died during the recovery period

because local medical staff could not operate the equipment that an international organization had left behind at a clinic in Banda Aceh, Indonesia (Respondent 36 2009).

Table 22: Technology Reported Used in the Domestic Sub-System

	Used		Not Used		Total	
	N	%	N	%	N	%
High Frequency Radio	8	38.1	13	61.9	21	100
Low Frequency Radio	8	38.1	13	61.9	21	100
Cell Phone	19	90.5	2	9.5	21	100
Satellite Phone	10	47.6	11	52.4	21	100
Satellite Observation	4	19	17	81	21	100
Fax	13	61.9	8	38.1	21	100
Email	14	66.7	7	33.3	21	100
Websites	9	42.9	12	57.1	21	100
GIS	4	19	17	81	21	100
GPS	5	23.8	16	76.2	21	100
Other	7	33.3	14	66.7	21	100

The technology used by domestic organizations is reported in Table 22. Of interest is the prevalence of the cell phone, which 19 or 90.48% of the domestic respondents reported using. Although the cell phone system in parts of the island of Sumatra was disrupted by the disaster, public and private organizations were able to reestablish cellular communications with mobile cell phone towers. The reliance on the cell phone as a communication tool is explained by two factors. First, the cell phone generally, and sms messaging specifically, is the predominant form of communication technology used by Indonesians. Second, with basic infrastructure requirements, the cell phone is an extremely effective tool for promoting the rapid exchange of information. As indicated in chapter seven, cell phones were used by decision makers to call

upon their social networks. Other technologies were also extremely valuable for the response, for example, email, fax machines and satellite phones, which were reported used at 66.67%, 61.90% and 47.62% respectively.

Table 23: Technology Reported Used in the International Sub-System

	Used		Not Used		Total	
	N	%	N	%	N	%
High Frequency Radio	8	36.4	14	63.6	22	100
Low Frequency Radio	6	27.3	16	72.7	22	100
Cell Phone	19	86.4	3	13.6	22	100
Satellite Phone	12	54.5	10	45.5	22	100
Satellite Observation	7	31.8	15	68.2	22	100
Fax	13	59.1	9	40.9	22	100
Email	14	63.6	8	36.4	22	100
Websites	8	36.4	14	63.6	22	100
GIS	8	36.4	14	63.6	22	100
GPS	7	31.8	15	68.2	22	100
Other	6	27.3	16	72.2	22	100

A similar pattern in technology usage is apparent with the organizations in the international sub-system. Table 23 indicates that international organizations also relied heavily on cell phones, at 19 or 86.36% of 22 respondents. Like the domestic respondents, the international respondents reported that their organizations also relied on email and fax technology, which were reported as used at 63.64% and 59.10% respectively. Slightly more international respondents reported the use of satellite phones, at 12 or 54.55% of 22 respondents, than their domestic counterparts, at 10 or 47.62% of 21 respondents. There were larger differences between sub-systems regarding the use of more advanced forms of technologies, for

example, Graphical Information Systems (GIS) or Global Positioning Systems (GPS). International respondents reported the use of these technologies at 36.36% and 31.82% respectively, while domestic respondents reported their use at 19.05% and 23.81% respectively.

Table 24: Technology Reported Used in the Core System

	Used		Not Used		Total	
	N	%	N	%	N	%
High Frequency Radio	16	72.7	27	62.8	43	100
Low Frequency Radio	14	32.6	29	67.4	43	100
Cell Phone	38	88.4	5	11.6	43	100
Satellite Phone	22	51.2	21	48.8	43	100
Satellite Observation	11	25.6	32	74.4	43	100
Fax	26	60.5	17	39.5	43	100
Email	28	65.1	15	34.9	43	100
Websites	17	39.5	26	60.5	43	100
GIS	12	27.9	31	72.1	43	100
GPS	12	27.9	31	72.1	43	100
Other	13	30.2	30	69.8	43	100

The descriptive statistics related to technology usage in the core administrative system are reported in Table 24. Again, the cell phone was the form of technology most reported used by response organizations, at 38 or 88.37% of 43 respondents. What was perhaps more interesting was the extent to which certain technologies were not used. In particular, organizations in the core system did not employ three important categories of technology to the extent they perhaps could have. First, 32 or 74.42% of 43 respondents indicated that they did not use satellite observation technology to help them collect information that would guide their operations. While it not logical to assume that every organization would have access to satellites,

at the very least, the images generated by satellite technology should be made available to all of the organizations that participate in a response system. Second, many of the respondents, 31 or 72.09% of 43, reported that their organizations did not utilize decision-support technologies such as GIS or GPS. Finally, 26 or 60.47% of the respondents indicated they did not use the internet to collect or disseminate information. These findings suggest that, while organizations had sufficient technology to conduct their operations, the use of alternative forms of technology might have improved the adaptive capacity of the core system.

Table 25: Organizations had Sufficient Technology to Adapt their Activities

	No Extent		Small Extent		Moderate Extent		Great Extent		Significant Extent		Not Applicable		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
International	0	0.0	7	15.9	5	11.4	5	11.4	3	6.8	1	2.3	21	47.7
Domestic	1	2.3	10	22.7	3	6.8	6	13.6	1	2.3	2	4.5	23	52.3
Total	1	2.3	17	38.6	8	18.2	11	25	4	9.1	3	6.8	44	100

Even though the respondents reported that the organizations in the response system relied on common forms of technology, they also believed that the organizations had sufficient technology to adapt their activities. The descriptive statistics reported in Table 25 support this conclusion. Indeed, 13 or 65.00% of 20 the international respondents who considered the question relevant rated the sufficiency of technology for adaptation at “moderate extent” or higher. In contrast, 10 or 46.62% of 21 domestic respondents reported similar results. Given this difference, and because the respondents reported that the organizations in the international sub-

system were slightly more adaptive than the domestic counterparts, the international sub-system received a “high” score for adaptability. The core system received a “high” score, in large part, because of the presence and contributions of the international organizations. The domestic sub-system received a “medium” for adaptability because 19 or 82.6% of 21 the respondents rated the sufficiency of technology for adaptation between “small extent” and “great extent.”

Table 26: Organizations had Sufficient Technology to Collaborate

	No Extent		Small Extent		Moderate Extent		Great Extent		Significant Extent		Not Applicable		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
International	3	6.8	4	9.1	6	23.6	6	23.6	4	9.2	1	2.3	24	54.5
Domestic	0	0.0	7	15.9	6	23.6	6	23.6	0	0.0	1	2.3	20	45.5
Total	3	6.8	11	25	12	37.3	12	37.3	4	9.2	2	4.5	44	100

The statistics reported in Table 26 suggest that technology also played a role in enabling collaboration amongst response organization. The domestic respondents indicated that technology facilitated collaboration in the post-tsunami environment somewhere between “small extent” and “moderate extent.” This may reflect the fact that organizations relied heavily on cell phone technology. In contrast, the responses provided by the international respondents were distributed across the available categories, indicating that there were differences in opinion as to how important technology was for collaboration. While most responses fell within the “moderate extent” and “great extent” categories, 4 or 17.39% of 23 relevant international respondents suggested that technology helped collaboration to a “significant extent.” At the other end of this

spectrum, 7 or 30.43% of 23 respondents indicated that technology only helped to a “small extent” or less. While the international organizations reported that they had sufficient technology to adapt their activities, this same technology did not seem to facilitate collaboration amongst organizations. This finding corresponds with the findings presented in chapters six and seven, where the data indicate that there were international organizations that operated in isolation. This means organizations had technology to support their own operations, but not necessarily the technology to support collaboration with other organizations. Given these results, the core system and its sub-systems received “medium” scores for the collaboration sub-component.

The respondents did not report significant problems with the interoperability of the technology used after the tsunami. This is also likely because the response organizations relied heavily on standard technology, for example, cell phones and the internet. Consequently, the domestic and international sub-systems received a “medium” score for the interoperability sub-component. The reason why this sub-component did not receive a “high” score was some of the respondents reported problems with the fusion of data that was stored in electronic databases, which created difficulties for organizations that sought to provide to such databases or retrieve information from such databases. Many of the respondents, especially those that worked for local non-governmental organizations in Aceh, reported that this problem continued to hamper operations, even years after the conclusion of the emergency response phase.

Table 27: Integration of Technology for Decision-Support

	No Extent		Small Extent		Moderate Extent		Great Extent		Significant Extent		Not Applicable		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
International	1	2.3	2	4.7	7	16.3	6	14	4	9.3	3	7	23	53.5
Domestic	2	4.7	5	11.6	7	16.3	5	11.6	1	2.3	0	0.0	20	46.5
Total	3	7	7	16.3	14	32.6	11	25.6	5	11.6	3	7	43	100

The final sub-component considers the extent to which the technology employed in the post-tsunami environment was integrated into single decision-support system. Such systems are important in uncertain environments because they enable the organizations in administrative systems to develop a “common operating picture” of events as they unfold. The results presented in Table 27 indicate that the technology used during the response was partially integrated, which helped response organizations to develop a common operating picture of the disaster response system. When the respondents explained how the technology was integrated, many of them mentioned that they communicated information back to the local office, which would use the information to make decisions. The respondents did not mention whether their technology was also used to provide this information to the larger response community.

While technological integration did occur in the administrative response system, it was typically rudimentary and used in specific organizations. Most of the integration occurred amongst the organizations in the international sub-system, which used technology to create standardized databases and communication mechanisms that enabled them to disseminate information to their partner organizations and financial donors. Some of the respondents

indicated that there were organizations that did not have access to such technical systems, or if they did, they had difficulties receiving information from these systems. The respondents also suggested that, while some steps were taken develop decision-support systems for specific organizations, or groups of organizations, these steps did not facilitate the development of a single decision-support system for the response system as a whole. Given that there were areas where the integration of technology could have been improved, the core system and the international sub-systems each received a “medium” score for the integration sub-component. In contrast, because of its reliance on international organizations, the domestic sub-system received a “low” score. The results for the organizational sub-components are presented in Table 28.

Table 28: Scores for the Technological Sub-Components

		Domestic System	International System	Core System
Sub-Components	Availability	Low	High	Medium
	Form	Medium	Medium	Medium
	Adaptability	Medium	High	High
	Collaboration	Medium	Medium	Medium
	Interoperability	Medium	Medium	Medium
	Integration	Low	Medium	Medium

8.1.3 Interaction Component

The interaction component considers the extent to which organizational interactions enabled the distribution of information, resources and personnel throughout the response system. This

component also considers whether the interactions among the organizations evolved after the disruptive event. This component is comprised of the six sub-components described in Table 29.

Table 29: Description of Interacting Sub-Components

Assistance	Indications that organizations provided to, or received assistance from, other organizations.
Information	Indications that organizations exchanged information.
Expertise	Indications that organizations exchanged scientific expertise.
Resources	Indications that organizations exchanged resources.
Personnel	Indications that organizations exchanged personnel.
Evolution	Indications that the response system evolved over time.

The respondents indicated that organizations in both sub-systems provided assistance to, and received assistance from, other organizations. For the core system, Table 30 reveals that 38 or 88.37% of 43 respondents indicated that the provision of assistance occurred at a “moderate extent” or higher. This assistance came in many forms, including the provision of information, resources, technology and supplies. Similar findings are reported in Table 31, which reveals that organizations were also extremely likely to receive assistance from other organizations, especially when it came to the transmission of information. As indicated in chapter seven, both domestic and international organizations were willing to receive information that would help them to improve their understanding of the operational environment. When pressed for examples other than information exchange, the respondents indicated that their organizations were

primarily focused on providing assistance to affected communities, as opposed to other response organizations. Indeed, Table 30 and Table 31 reveal that organizations were more concerned with providing assistance than receiving assistance. For these reasons, the core system and its sub-systems received “medium” scores for the assistance sub-component.

Table 30: Organizations Provided Assistance to other Organizations

	No Extent		Small Extent		Moderate Extent		Great Extent		Significant Extent		Not Applicable		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
International	1	2.3	2	4.5	7	15.9	9	20.5	5	11.4	0	0.0	24	54.5
Domestic	1	2.3	1	2.3	7	15.9	6	13.6	4	9.1	1	2.3	20	45.5
Total	2	4.5	3	6.8	14	31.8	15	34.1	9	20.5	1	2.3	44	100

Table 31: Organizations Received Assistance from other Organizations

	No Extent		Small Extent		Moderate Extent		Great Extent		Significant Extent		Not Applicable		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
International	0	0.0	5	11.4	9	20.5	9	20.5	1	2.3	0	0.0	24	54.5
Domestic	2	4.5	4	9.1	5	11.4	4	9.1	4	9.1	1	2.3	20	45.5
Total	2	4.5	9	20.5	14	31.8	13	29.5	5	11.4	1	2.3	44	100

Organizations in both sub-systems were heavily involved in information exchange. Indeed, all organizations worked to developed mechanisms for information exchange, whether through the use of daily situation reports, meetings or personal telephone calls. Organizations did this to identify needs, to navigate the Indonesian bureaucracy, and to coordinate activities. The importance placed on information exchange is revealed by Table 32, where 42 or 97.67% of 43 relevant respondents indicated that such exchanges actually occurred. More importantly, of the 43 relevant respondents, 33 or 76.74% reported that information exchange occurred at a “great extent” or “significant extent.” These findings indicate why the core system and its sub-systems a “high” score for the information sub-component.

Table 32: Organizations Exchanged Information in Response System

	No Extent		Small Extent		Moderate Extent		Great Extent		Significant Extent		Not Applicable		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
International	1	2.2	0	0.0	5	10.9	11	23.9	5	10.9	2	4.3	24	52.2
Domestic	0	0.0	1	2.2	3	6.5	13	28.3	4	8.7	1	2.2	22	47.8
Total	1	2.2	1	2.2	8	17.4	24	52.2	9	19.6	3	6.5	46	100

Table 33 indicates that organizations also exchanged scientific expertise. The respondents suggested, however, that organizations focused primarily on activities such as search and rescue, debris removal, and corpse disposal, which did not require much scientific expertise. Indeed, 6 or 13% of 46 respondents indicated that the exchange of scientific expertise was “not applicable” to

their operations. More specifically, 13 or 32.50% of 40 relevant respondents reported that the exchange of expertise occurred at a “small extent” or less. When such exchanges did occur, they related to the use of technology brought by international organizations. For these reasons, the core system and its sub-systems received a “low” score for the expertise sub-component.

Table 33: Organizations Exchanged Scientific Expertise in Response System

	No Extent		Small Extent		Moderate Extent		Great Extent		Significant Extent		Not Applicable		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
International	1	2.2	5	10.9	6	13	4	8.7	3	6.5	5	10.9	24	52.2
Domestic	2	4.3	5	10.9	3	6.5	6	13	5	10.9	1	2.2	22	47.8
Total	3	6.5	10	21.7	9	19.6	10	21.7	8	17.4	6	13	46	100

There was less of a difference in the extent to which organizations exchanged resources. Table 34 indicates that organizations actively exchanged resources. Of the 41 respondents who considered the questions relevant, 31 or 75.61% reported that resources were exchanged at a “moderate extent” or higher. The data retrieved from the semi-structured interviews, however, suggests that the respondents may have over reported the exchange of resources in the surveys. For example, the respondents indicated that the exchange of resources was not as high of a priority as the exchange of information. They also suggested that their mission was to provide resources to the affected populations, not to other response organizations. When resources were exchanged between organizations, the interactions were geared towards directing the resources to

the affected communities. Other examples of resource exchange reflected the need for transportation and major pieces of equipment. For these reasons, the core system and its constituent sub-systems received a “low” score for the resource exchange sub-component.

Table 34: Organizations Exchanged Resources in Response System

	No Extent		Small Extent		Moderate Extent		Great Extent		Significant Extent		Not Applicable		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
International	2	4.3	4	8.7	5	10.9	5	10.9	4	8.7	4	8.7	24	52.2
Domestic	0	0.0	4	8.7	8	17.4	6	13	3	6.5	1	2.2	22	47.8
Total	2	4.3	8	17.4	13	28.3	11	23.9	7	15.2	5	10.9	46	100

With respect to the exchange of personnel, 40 or 95.24% of the 42 respondents that considered the question applicable indicated that such exchanges occurred. There were differences between how the domestic and international respondents reported on such exchanges. As Table 35 reveals, of the 21 domestic respondents that fell into the applicable category, 17 or 80.95% classified the exchange of personnel at “moderate extent” or higher. In contrast, only 11 or 52.38% of the 21 international respondents who considered the question applicable felt the same way. This may have been because international organizations had to rely upon the domestic organizations for personnel who could speak local languages. The international results also indicate that 10 or 47.62% of the 31 respondents reported that personnel were exchanged at only a “small extent” or less. The respondents reported that most international organizations either

brought the personnel they needed to conduct operations with them, often from foreign offices, or they took steps to hire the personnel they needed as necessary. When pressed, the respondents could not provide many examples of where organizations exchanged personnel. Rather, the focus seemed to be on collaboration, where one organization might assign personnel to assist another organization for collaborative purposes, but the affiliation of the personnel would not change. For these reasons, the response systems received a “low” score for the personnel sub-component.

Table 35: Organizations Exchanged Personnel in Response System

	No Extent		Small Extent		Moderate Extent		Great Extent		Significant Extent		Not Applicable		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
International	2	4.3	8	17.4	4	8.7	6	13	1	2.2	3	6.5	24	52.2
Domestic	0	0.0	4	8.7	6	13	10	21.7	1	2.2	1	2.2	22	47.8
Total	2	4.3	12	26.1	10	21.7	16	34.8	2	4.3	4	4.3	46	100

According to chapters six, the core system and its sub-systems underwent significant structural evolution after the tsunami. Most evident was the extent to which the structures of these sub-systems differed, as indicated by the density, diameter and component results, which revealed that the international sub-system appeared to become more consolidated and stable in terms of organizational interactions. The data also indicated that the international organizations contributed to the development and structural evolution of Indonesia’s administrative response system. This was especially the case with respect to the manner in which organizations targeted

certain classifications of response organizations. Domestic organizations initially preferred to target other domestic organizations, but as the system developed, they began to increasingly target international organizations. In contrast, international organizations strictly preferred to target other international organizations. Given that the network data suggests that the domestic sub-system evolved away from a stable state, the domestic sub-system received a “low” score for the evolution sub-component. In contrast, the international sub-system and core system received “high” scores. The overall results for the network sub-components are presented in Table 36.

Table 36: Scores for the Interacting Sub-Components

		Domestic System	International System	Core System
Sub-Components	Assistance	Medium	Medium	Medium
	Information	High	High	High
	Expertise	Low	Low	Low
	Resources	Low	Low	Low
	Personnel	Low	Low	Low
	Evolution	Low	High	High

8.1.4 Information Component

Decision making processes must be supported by information. The more that information is available, the more likely that decision makers will make good decisions. The framework of administrative resilience employs the information component to evaluate extent to which

information is available to, and utilized by, the organizations in an administrative system. The information component is comprised of the six sub-components presented in Table 37.

Table 37: Description of Information Sub-Components

Needs	Indications that the information needs of the organizations in the response system were met.
Quality	Indications of the quality of the information in the response system.
Availability	Indications of the availability of information in the response system.
Importance	Indications of the importance placed on information by the organizations in the response system.
Search	Indications of information search and acquisition by organizations in the response system.
Acceptance	Indications that new information was accepted by the organizations in the response system.

For both sub-systems, the scores for the information sub-components ranged between “medium” and “high.” The three sub-components that received “medium” scores were needs, quality and availability. The respondents indicated that organizations had an extreme need for information during the month after the tsunami. In many situations, these needs were not initially met, and decision making was constrained due to the lack of information related to culture, language and the quantity and quality of resources available. Most problematic was the lack of demographic information, which undermined the ability of the response organizations to identify the most critically affected populations. With respect to quality and availability, many of the respondents indicated that some of the information they received was inaccurate. For example, there were problems with the number of reported deceased, as well as the number and location of

displaced persons. In some cases, organizations responded to problems in information quality by restricting information dissemination or spending time on information verification. There were also issues of information availability. Especially immediately after the tsunami, when organizations struggled to determine the nature and scope of the disaster. Although there were many difficulties with these three sub-components, they were scored as “medium” because the respondents indicated that organizations made it a priority to develop mechanisms to overcome the deficiencies in information quality and availability.

Table 38: Organizations Exchanged Information

	No Extent		Small Extent		Moderate Extent		Great Extent		Significant Extent		Not Applicable		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
International	1	2.2	0	0.0	5	10.9	11	23.9	5	10.9	2	4.3	24	52.2
Domestic	0	0.0	1	2.2	3	6.5	13	28.3	4	8.7	1	2.2	22	47.8
Total	1	2.2	1	2.2	8	17.4	24	52.2	9	19.6	3	6.5	46	100

The other three sub-components, importance, search, and acceptance received “high” scores. There were two reasons why organizations placed a “high” importance on information. First, many organizations had little experience conducting operations in Indonesia. Second, it was impossible to conduct effective operations without knowing the location and needs of the affected populations. An official from a local non-governmental organization with international funding indicated just how critical information was to their operations in Aceh, “We, yea, rely entirely on the information that other organizations provided to us” (Respondent 34 2009). The

statistics reported in Table 38 provide an indirect measure of the extent to which organizations in the response system searched for information. When asked about the exchange of information in the response system, 41 or 95.35% of the respondents who considered the question relevant rated information exchange at “moderate extent” or higher. Of these respondents, 31 or 75.61% rated information exchange at “great extent” or higher. The willingness to exchange information suggests that there was an extremely high demand for information in the administrative system.

Table 39: Willingness of Organizations to Accept New Information

	No Extent		Small Extent		Moderate Extent		Great Extent		Significant Extent		Not Applicable		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
International	0	0.0	3	7	3	7	11	25.6	5	11.6	2	4.7	24	55.8
Domestic	0	0.0	0	0.0	4	9.3	11	25.6	4	9.3	0	0.0	19	44.2
Total	0	0.0	3	7	7	16.3	22	51.2	9	20.9	2	4.7	43	100

Organizations were also willing to accept new information. As Table 39 indicates, of the 41 respondents who considered the question relevant, not one indicated that organizations refused to accept new information. Indeed, 38 or 92.68% of 41 respondents ranked willingness to accept information at “moderate extent” or higher. Of these, 22 or 57.89% ranked willingness to accept information at “great extent.” An official from an international organization indicated that “people were proactively seeking information assistance from anywhere they could find it, they were being creative in thinking about where I can get expertise, which I can get stuff. Both within the organization and externally” (Respondent 19 2009). The respondents who ranked

willingness to accept new information as “small extent” were from international organizations. The results for the information sub-components are presented in Table 40.

Table 40: Scores for the Information Sub-Components

		Domestic System	International System	Core System
Sub-Components	Needs	Medium	Medium	Medium
	Quality	Medium	Medium	Medium
	Availability	Medium	Medium	Medium
	Importance	High	High	High
	Search	High	High	High
	Acceptance	High	High	High

8.1.5 Organizational Component

To respond to uncertain environments, decision makers must be flexible in how they approach problems. Their goal should not be to identify the one perfect solution, but rather, identify good solutions that can be rapidly implemented. This process is included in the framework of administrative resilience through the organizational component, which represents rapidity and adjustment and considers the extent to which organizations had the operational plans, personnel, training, authority and resources that enabled them to engage in adaptive activities. The organizational component is comprised of the six sub-components described in Table 41.

Table 41: Description of Organizational Sub-Components

Operational Plans	Indications that organizations had plans necessary for adaptation and collaboration.
Authority	Indications that organizations had the authority to adapt their activities without approval.
Personnel	Indications that organizations had personnel necessary for adaptation and collaboration.
Training	Indications that organizations had training necessary for adaptation and collaboration.
Resources	Indications that organizations had personnel necessary for adaptation and collaboration.
Mistake Correction	Indications that organizations corrected their mistakes.

Regarding the effectiveness of their operational plans, the respondents reported that domestic organizations were limited in terms of their level of preparedness. This was related to the fact that, prior to the tsunami, the disaster management activities of domestic organizations were limited in scope and focus. This meant that domestic organizations did not typically engage in disaster management planning or collaboration activities. While there were larger domestic organizations, for example the Indonesian Red Cross, which had taken steps to prepare for collaboration, the international respondents reported that their organizations were slightly better prepared than their domestic counterparts. As Table 42 indicates, of those who considered the question applicable, 17 or 77.27% of the international respondents rated the effectiveness of their operational plans at “moderate extent” or higher. Likewise, 13 or 68.42% of the domestic respondents reported the effectiveness of their operational plans at “moderate extent” or higher. What is surprising is that 11 of 40, or 25% of the respondents who considered the question relevant rated the effectiveness of their operational plans at “small extent” or less. This is a clear

indication that many organizations were not prepared for response activities. This difference also explains why the core system received a “medium” rating for this sub-component.

Table 42: Effectiveness of Operational Plans

	No Extent		Small Extent		Moderate Extent		Great Extent		Significant Extent		Not Applicable		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
International	4	9.1	1	2.3	8	18.2	5	11.4	4	9.1	2	4.5	24	54.5
Domestic	3	6.8	3	6.8	2	4.5	10	22.7	1	2.3	1	2.3	20	45.5
Total	7	15.9	4	9.1	10	22.7	15	34.1	5	11.4	3	6.8	44	100

The respondents also indicated that there were differences in terms of the authority possessed by the organizations in the sub-systems. The respondents were asked about the extent to which that their organizations possessed the authority to adapt their activities without approval from governmental authorities such as BAKORNAS PBP or the Indonesian military. As indicated in chapter seven, the Indonesian government provided international organizations with a wide amount of latitude regarding the activities they undertook during the month after the tsunami. This latitude provided international organizations with an extensive amount of flexibility, enabling them to develop collaborative relationships with other organizations. In contrast, domestic respondents did not experience the same freedom. Table 43 confirms this difference. Of the international respondents that found the question relevant, 13 or 68.42% of them rated their authority at “great extent” or higher. In contrast, only 7 or 33.33% of the domestic respondents felt the same way. In fact, a larger portion of the domestic respondents, 10

or 47.61%, reported that their authority to adapt was only “small extent” or less. Contrasting the “high” authority in the international sub-system with the “low” authority in the domestic sub-system, the core system received a “medium” score for the authority sub-component.

Table 43: Organizations had the Authority to Adapt Activities

	No Extent		Small Extent		Moderate Extent		Great Extent		Significant Extent		Not Applicable		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
International	0	0.0	2	4.5	4	9.1	12	27.3	1	2.3	2	4.5	21	47.7
Domestic	3	6.8	7	15.9	4	9.1	5	11.4	2	4.5	2	4.5	23	52.3
Total	3	6.8	9	20.5	8	18.2	17	38.6	3	6.8	4	9.1	44	100

Response organizations experienced constraints in other areas, for example, within the personnel sub-component. Although most organizational needs were met in terms of personnel, the core system and its sub-systems were awarded a “medium” score for the personnel sub-component because, during the initial days of the response, organizations had difficulties getting personnel to the disaster scene. The problem was not so much related to constraints in transportation, which there were certainly many of, but rather, the fact that many of the most critical personnel were traveling for the holiday when the tsunami struck. This meant that these individuals had to return home and report to their offices before they could be deployed for disaster operations. The respondents indicated that, in some instances, it took a day or two before the critical personnel had returned from holiday. A separate problem reported by the respondents was the need for personnel who could speak local languages and had knowledge about the

geography and culture of the tsunami affected regions. Respondents indicated that, in some sectors, as many as fifty percent of the volunteers were of little utility due to constraints in language (Respondent 2 2009; Respondent 3 2009). There were also shortages of certain types of personnel, for example, the respondents mentioned the lack of air traffic controllers immediately after the tsunami. As the response system became increasingly organized, the organizations in the system were able to locate sufficient personnel to overcome these constraints.

Table 44: Effectiveness of Training

	No Extent		Small Extent		Moderate Extent		Great Extent		Significant Extent		Not Applicable		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
International	6	13.6	4	9.1	4	9.1	7	15.9	2	4.5	1	2.3	24	54.5
Domestic	2	4.5	6	13.6	3	6.8	8	18.2	0	0.0	1	2.3	20	45.5
Total	8	18.2	10	22.7	7	15.9	15	34.1	2	4.5	2	4.5	44	100

The training sub-component for the core system and its sub-systems also received a “medium score.” Although the respondents reported that training prior to the tsunami was inadequate, they indicated that those who worked for response organizations had sufficient training to complete their missions. In fact, many of the respondents from larger organizations indicated that their personnel had received disaster management training. The training results are presented in Table 44. When asked if the individuals in their organizations had sufficient training to enable collaboration, 24 or 57.14% of 42 respondents who considered the question relevant

rated the effectiveness of the training at “moderate extent” or higher. In contrast, 18 or 42.86% of these 42 respondents rated at the effectiveness of the training at “small extent” or less.

Table 45: Sufficiency of Resources

	No Extent		Small Extent		Moderate Extent		Great Extent		Significant Extent		Not Applicable		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
International	1	2.3	1	2.3	5	11.4	8	18.2	8	18.2	1	2.3	24	54.5
Domestic	0	0.0	6	13.6	4	9.1	6	13.6	2	4.5	2	4.5	20	45.5
Total	1	2.3	7	15.9	9	20.5	14	31.8	10	22.7	3	6.8	44	100

Also critical to the collaborative process was the level of resources. As indicted in Table 45, the majority of respondents indicated that resource availability enabled collaboration at a level of “moderate extent” or higher. While 6 or 13.6% of 18 domestic respondents who considered the question relevant rated the sufficiency of resources at only “small extent,” this seemed to be the exception to the rule. Typically, the respondents expressed astonishment at the availability of resources. One international respondent reported, “I [had] a forklift, we had our own cars, we had a really huge generator, and a portable tank, really good equipment, satellite phone, v-sat, everything. It was like heaven. We had everything” (Respondent 10 2009). In terms of the sufficiency of resources, the core system and its sub-systems received “high” score.

Table 46: Organizations Corrected Their Mistakes

	No Extent		Small Extent		Moderate Extent		Great Extent		Significant Extent		Not Applicable		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
International	0	0.0	7	16.3	6	14	6	14	3	7	2	4.7	24	55.8
Domestic	0	0.0	1	2.3	8	18.6	6	14	4	9.3	0	0.0	19	44.2
Total	0	0.0	8	18.6	14	32.6	12	27.9	7	16.3	2	4.7	43	100

The final organizational sub-component that received a “high” score was mistake correction. Table 46 shows that 80.48% of the 41 respondents who considered the question applicable reported that mistake correction occurred at a “moderate extent” or higher. Some respondents referred to the delivery of relief supplies that, due to religious practices, were inappropriate for the recipient populations. When such mistakes were identified, organizations took steps to remedy the situation and to prevent the mistakes from occurring again. The most compelling example of mistake correction was undertaken by the Indonesian government, which decided to prohibit the extraction of children from the disaster area. This decision was taken, not only to keep children with their surviving family members, but also to prevent them from being diverted to the sex trade. Table 47 presents the results for the organizational sub-components.

Table 47: Scores for the Organizational Sub-Components

		Domestic System	International System	Core System
Sub-Components	Operational Plans	Low	High	Medium
	Authority	Low	High	Medium
	Personnel	Medium	Medium	Medium
	Training	Medium	Medium	Medium
	Resources	High	High	High
	Mistake Correction	High	High	High

8.1.6 Cultural Component

To make effective decisions, decision makers must have the experience to identify similarities between the problems that they encounter and the problems they have previously encountered. The cultural component of framework of administrative resilience represents pattern-matching, and evaluates the extent to which organizations in an administrative system understand the risks they confront and have the experience and capacity to solve unique and unexpected problems. The cultural component is comprised of the six sub-components described in Table 48.

Table 48: Description of Cultural Sub-Components

Organizational Awareness	Indications that organizations were aware of the risk of disaster and its consequences.
Experience	Indications that organizations had experience necessary to respond to disaster.
Community	Indications that organizations worked in the interest of the affected community.
Review	Indications that organizations were willing to review their actions.
New Methods	Indications that organizations were willing to adopt new methods of problem solving.
Trust	Indications that organizations trusted the decisions of others.

The domestic organizations received “low” scores for the awareness and experience sub-components. When considering the awareness of Indonesian organizations prior to the tsunami, many domestic organizations were not attentive to the risks posed by disaster. The respondents provided a variety of explanations for this lack of awareness, two of which were emphasized the most. First, the lack of awareness by organizations was a reflection of the lack of awareness that permeated the Indonesian government and society. While organizations such as the Bandung Institute of Technology had implemented training programs prior to the tsunami, these programs were limited in scope and geared principally towards government officials. Second, there were few organizations working in Aceh prior to the tsunami. The organizations that were present addressed issues related to the conflict and disaster management did not fall within their operational parameters. The lack of disaster awareness also explains why domestic organizations lacked disaster management experience. In contrast, international organizations, while they did not have experience working in Indonesia, brought with them significant amounts of disaster

management experience. The international organizations used their experience to quickly assess the post-tsunami environment and initiate the development of the information collection and exchange mechanisms needed to conduct response operations.

Table 49: Willingness of Governmental Organizations to Review Actions

	No Extent		Small Extent		Moderate Extent		Great Extent		Significant Extent		Not Applicable		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
International	2	4.5	8	18.2	7	15.9	2	4.5	0	0.0	2	4.5	21	47.7
Domestic	4	9.1	6	13.6	4	9.1	4	9.1	4	9.1	1	2.3	23	52.3
Total	6	13.6	14	31.8	11	25	6	13.6	4	9.1	3	6.8	44	100

Table 50: Willingness of Non-Governmental Organizations to Review Actions

	No Extent		Small Extent		Moderate Extent		Great Extent		Significant Extent		Not Applicable		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
International	2	4.5	8	18.2	7	15.9	3	6.8	0	0.0	1	2.3	21	47.7
Domestic	1	2.3	3	6.8	4	9.1	5	11.4	6	13.6	4	9.1	23	53.2
Total	3	6.8	11	25	11	25	8	18.2	6	13.6	5	11.4	44	100

The domestic and international sub-systems began to converge in terms of the willingness of their constituent organizations to assist the community, as well as their willingness to review their actions. The sub-systems both received “medium” scores for these two sub-components. As

also indicated in chapter seven, the respondents believed that the majority of the organizations that participated in the tsunami response did so to provide assistance the communities affected by the disaster. Although most organizations had pure intentions, there was evidence that some organizations pursued religious or political interests. The respondents indicated that such pursuits created organizational tension and competition. Problems also existed with some of the individuals who responded to the disaster scene. Referred to as “disaster cowboys,” the respondents indicated that some individuals participated in the response simply to fulfill their personal desire to experience the chaos and excitement generated by a disaster event.

The other cultural sub-component that received a “medium” score was review, which represents the willingness of organizations to review their actions. The specific question used to evaluate the willingness of organizations to review delineated between non-governmental and governmental organizations. These results are presented in Table 49 and Table 50. Table 49 indicates that governmental organizations did not review their actions immediately after the tsunami. The overwhelming focus of these organizations was directed primarily towards the completion of response activities such as corpse and debris removal. In contrast, Table 50 indicates that the respondents believed that non-governmental organizations were more likely to review their actions. For example, of those who indicated that the willingness to review was “moderate extent” or higher, the results favored non-governmental organizations, at 25 or 64.10% of 39 respondents, over governmental organizations, at 21 or 51.22% of 41 respondents. Interestingly, the domestic respondents were more disposed than their international counterparts to rate the willingness of non-governmental organizations to review as “great extent” or higher.

Table 51: Organizations Adopted New Methods of Problem Solving

	No Extent		Small Extent		Moderate Extent		Great Extent		Significant Extent		Not Applicable		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
International	1	2.3	2	4.7	9	20.9	6	14	3	7	3	7	24	55.8
Domestic	1	2.3	1	2.3	3	7	10	23.3	4	9.3	0	0.0	19	44.2
Total	2	4.7	3	7	12	27.9	16	37.2	7	16.3	3	7	43	100

There were also similarities between the sub-systems in terms of the willingness of organizations to adopt new methods of problem solving and to trust the decisions of others. Both sub-systems received “high” scores for these sub-components. With respect to problem-solving, Table 51 indicates that when organizations encountered situations where their activities were not working, they were willing to step outside their traditional operational procedures. Of the 40 subjects who addressed the question on methods of problem-solving, 35 or 87.5% indicated that such procedural shifts occurred at a “moderate extent” or higher. The domestic respondents indicated that they were more willing to adopt new methods than their international counterparts. This may be because domestic organizations lacked experience, and unlike the international organizations, had to engage in a period of active learning after the tsunami.

Table 52: Organizations Trusted the Decisions of Others

	No Extent		Small Extent		Moderate Extent		Great Extent		Significant Extent		Not Applicable		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
International	2	4.7	1	2.3	10	23.3	8	18.6	0	0.0	3	7	24	55.8
Domestic	2	4.7	2	4.7	7	16.3	8	18.6	0	0.0	0	0.0	19	44.2
Total	4	9.3	3	7	17	39.5	16	37.2	0	0.0	3	7	43	100

Many of the constraints that existed in the post-tsunami environment could be managed because the organizations trusted the decisions of others. The sub-systems also received a “high” score for this sub-component and the respondents indicated that trust played a substantial role in response operations. As indicated by Table 52 of the international respondents who considered the question applicable, 18 or 85.71% indicated that reported that organizations trusted the decisions of others at “moderate extent” or higher. Likewise, 15 or 78.95% of the domestic respondents reported the levels of trust in the domestic response system at “moderate extent” or higher. It is important to recognize, however, that the trust that existed within the response system was not absolute. Indeed, that the respondents indicated that there was always the need to verify information that circulated throughout the administrative response system. The results for the cultural sub-components are presented in Table 53.

Table 53: Scores for the Cultural Sub-Component

		Domestic System	International System	Core System
Sub-Components	Organizational Awareness	Low	High	Medium
	Experience	Low	High	Medium
	Community	Medium	Medium	Medium
	Review	Medium	Medium	Medium
	New Methods	High	High	High
	Trust	High	High	High

8.2 EVALUATING THE CHARACTER AND STRUCTURE OF THE ADMINISTRATIVE SYSTEM

The remainder of this chapter employs the framework of administrative resilience to classify the character and structure of the tsunami response system. This analysis addresses two questions. First, should the system be classified as auto-adaptive, operative adaptive, emergent adaptive or non-adaptive? Second, should the system be classified as a highly stable system, a highly flexible system, or a balanced system? The answers to these questions will help to elucidate why, under extra-ordinary conditions, the organizations that participated in this administrative response system were able to adjust and self-organize in post-tsunami environment.

8.2.1 Character of Tsunami Response System

The indicators for the framework for administrative resilience, which are identified in Table 54, can be used to classify the extent to which resilience is present in an administrative system. Along the “x-axis” are the six components of resilience. Along the “y-axis” are the system typologies, which represent the continuum of resilient administrative systems. At the low end of the resilience continuum are non-adaptive systems, which possess low scores across all the resilience components, including environmental awareness, information exchange, organizational flexibility, cultural openness, technical capacity and network interaction. Emergent adaptive systems possess low scores for technical capacity and network interaction, but receive medium scores for environmental awareness, information exchange, organizational flexibility and cultural openness. Operational adaptive systems possess medium levels of environmental awareness, information exchange, organizational flexibility, cultural openness, technical capacity and network interaction. These three typologies represent systems that are highly reactive, meaning they emerge to respond to disruptive events. While emergent adaptive systems and operational adaptive systems may demonstrate self-organization, they do not exhibit the pro-active learning needed to facilitate system-wide policy change (Comfort 1999).

At the other end of the continuum are auto-adaptive systems, which are high on environmental awareness, information exchange, organizational flexibility, cultural openness, technical capacity and network interaction. Unlike the other three system typologies, auto-adaptive systems are proactive and exhibit high levels of creativity and pro-active learning processes in uncertain environments. The higher a system’s rank along this continuum, the better

able it is to “adapt to sudden change, reallocate its resources and energies in response to a major threat ... without losing its basic capacity for performance” (Comfort 1999).

Table 54: Cognitive Resilience Indicators

	Environmental Component	Information Component	Organization Component	Cultural Component	Technology Component	Interaction Component
Auto-Adaptive	High	High	High	High	High	High
Operative Adaptive	Medium	Medium	Medium	Medium	Medium	Medium
Emergent Adaptive	Medium	Medium	Medium	Medium	Low	Low
Non-Adaptive	Low	Low	Low	Low	Low	Low

To determine where the system under analysis ranked along this continuum, this section reviews the scores awarded in the previous section of this chapter. The final scores for the components of the framework of administrative resilience were derived from the average of the scores of its sub-components. After their averages were computed, the sub-components were classified according to the following schema: average scores that fell within [1 to 1.66] were classified as “low”; average scores that fell within [1.67 to 2.33] were classified as “medium”; and average scores that fell within [2.34 to 3.00] were classified as “high.”

These findings are presented in Table 55, which indicates that there were differences in the manner in which the components of the framework of administrative resilience were scored for the system and sub-systems under analysis. Some of the components received the same score for all three systems. For example, at the “low” end was the environmental component, which

received a score of 1. This score is reflective of a non-adaptive system, which has very little capacity to learn in uncertain operational environments. At the “high” end was the organizational component, which was awarded scores of 2.50. By way of further explanation, these scores are reflective of an auto-adaptive system, which represents a system that has the highest learning capacity of all, and the organizations that participate in such a system can automatically adapt in response to the constraints and opportunities present in uncertain environments.

Table 55: Average Component Scores for the Framework of Administrative Resilience

		Domestic System		International System		Core System	
		Score	Category	Score	Score	Category	Score
Components	Environmental	1.00	Low	1.00	Low	1.00	Low
	Information	2.50	High	2.50	High	2.50	High
	Cultural	2.00	Medium	2.67	High	2.33	Medium
	Organizational	2.00	Medium	2.67	High	2.50	High
	Technological	1.50	Low	2.33	High	2.17	Medium
	Interaction	1.50	Low	1.83	Medium	1.83	Medium

The scores awarded to the remainder of the components, which considered the cultural, organizational, technological and interaction aspects of the Indonesian tsunami response system, differed by sub-system. The domestic sub-system, for example, received lower scores than the international sub-system. The largest difference was reported in the technological component, where the domestic sub-system and international sub-systems were awarded scores of 1.50 or “low” and 2.33 or “high” respectively. This difference is explained by the forms and availability of technology used during the response, which was slightly more advanced for the international

organizations. The difference is also due to the fact that international organizations brought the technology and the experience they needed to operate in the post-tsunami environment.

The differences between the scores awarded for the other components were less considerable, but it was within the interaction component where the domestic sub-system was particularly constrained. While organizations in domestic sub-system exchanged information with, and provided assistance to, other organizations, the findings presented in chapters five and six indicated that the domestic actors had a difficult time structuring their interactions to promote the effective distribution of information, expertise, resources and personnel. Rather, when plotted longitudinally, the interactions detected among domestic organizations became increasingly erratic and diffused. Moreover, unlike the international sub-system, the diameter of the network in the domestic sub-system expanded rather than contracted. Consequently, the domestic sub-system received a score of 1.50 or “low” for the interaction component. In contrast, because the interactions in the international sub-system became more regular and consolidated, the sub-system was awarded a score of 1.83 or “medium” for the interaction component.

These findings indicate that the administrative system that operated in Indonesia following the Great Sumatran Earthquake and Tsunami was a system of sub-systems. These findings also indicate that the core system and its sub-systems possessed different degrees of administrative resilience. With respect to the domestic sub-system, there were three components that received “low” scores, environmental, technological, and interaction, two components that received “medium” scores, cultural and organizational, and only one component that received a “high” score, information. Even though its information component was “high,” at most, the domestic sub-system can only be categorized as an emergent adaptive system. This means that the sub-system did not possess the adaptive capacity needed to manage the uncertainty present in

the post-tsunami environment. In contrast, other than the environmental and information components, the international sub-system received higher scores than its domestic counterpart. The sub-system was particularly strong in the information, cultural, organizational and technological sub-components, each of which just managed to cross the “high” score threshold. Consequently, the international sub-system was categorized as an operational adaptive system, which may demonstrate the capacity to adapt in limited circumstances.

The preceding chapters indicate that the international sub-system influenced the resilience of the core administrative system. While the core system received “high” scores for the information and organizational components, the primary constraint for organizations was the “low” environmental score, which indicates the extent to which Indonesian governmental institutions and communities were inadequately prepared, in terms of disaster awareness, disaster preparedness and disaster regulations, prior to the tsunami. The remainder of the components scored for the core system, cultural, technological and interaction, received “medium” scores.

The most striking thing about these findings is how the inclusion of the international organizations into the core system worked to strengthen the capacity of the domestic sub-system. A comparison of the component scores awarded to the core system to against those awarded to the domestic sub-system reveals that the average scores of four components, cultural, organizational, technological and network, increased with the inclusion of the international organizations. Three of these components, organizational, technological and network, actually jumped from one category to another, for example, “medium” to “high.” The respondents alluded to such a finding during their interviews. While there were constraints created by allowing international organizations access to the disaster site, the consensus of the respondents was that the international organizations improved the operational capacity of the system. These

organizations brought to the system the expertise, technology, resources and experience that the domestic sub-system would not have otherwise possessed. The component scores awarded to the core system indicate that it was an operational adaptive system, and possessed the capacity to adapt in uncertain operational environments. Unlike an auto-adaptive system, however, Indonesia's core administrative system was characterized by its reactive nature.

8.2.2 Structure of the Tsunami Response System

When complex adaptive systems encounter disruptive stimuli, they have the capacity to maintain critical system functions through adaption and self-organization. To be effective, such systems must strike a balance between order and disorder. When this occurs, the system operates along “the edge of chaos,” which is the point where the actors in the system can exchange information and identify a successful course of action. In this study, the respondents were presented with a continuum and were asked rate and discuss the manner in which administrative authority was structured in the response system. One side of the continuum represented structure, or order in complex adaptive system theory, and the respondents were provided the options to rate the system as “somewhat structured” or “highly structured.” The other side of the continuum represented the lack of structure, or disorder in complex adaptive systems theory, and the respondents were provided the options to rate the system as “somewhat unstructured” or “highly unstructured.” In the middle of the continuum was a category classified as “balanced.” The results of this structural inquiry are presented in Table 56.

Table 56: Distribution of Authority in Response System

	Highly Unstructured		Somewhat Unstructured		Balanced		Somewhat Structured		Highly Structured		Not Applicable		Total	
	N	%	N	%	N	%	N	N	%	N	%	N	%	N
International	3	6.3	7	14.6	2	4.2	7	3	6.3	7	14.6	2	4.2	7
Domestic	8	16.7	10	20.8	3	10.4	5	8	16.7	10	20.8	3	10.4	5
Total	11	22.9	17	35.4	5	25	12	11	22.9	17	35.4	5	25	12

The responses provided by the international respondents were somewhat evenly distributed. Of 21 international respondents, 14 or 76.19% classified the system as falling between “somewhat unstructured” and “somewhat structured.” In contrast, 18 or 69.23% of the responses provided by the 26 domestic respondents who considered the question relevant fell within the “highly unstructured” or “somewhat unstructured” categories. This reflects the discussions contained in chapters four and seven, which report that disruption of Indonesia’s disaster management institutions, particularly at the provincial and local levels in Aceh, created a vacuum in structural authority that national and international organizations had to replace.

The lack in structural authority is also apparent when these data are considered from the perspective of the core system, where 28 or 59.57% of the 47 respondents who considered the question relevant categorized the response system as either “highly unstructured” or “somewhat unstructured;” 14 or 29.79% categorized the response system as either “highly structured” or “somewhat structured;” and only 5 or 10.64% categorized the response system as “balanced.” Almost two out of three respondents categorized the core system as unstructured. The categorization of the system as lacking in structural authority did not necessary represent a

conclusive judgment about its effectiveness. Indeed, some respondents thought that the lack of structural authority was positive, as it provided organizations with the independence they needed to meet the demands of the affected populations. Other respondents disagreed, and cautioned that this independence created chaos, at least with respect to the activities of the non-governmental organizations. The conclusion advanced by this section is that, in terms of how authority was structured in the Indonesian tsunami response system, the core system and its sub-systems displayed more flexibility than stability during twenty-two days that followed the tsunami.

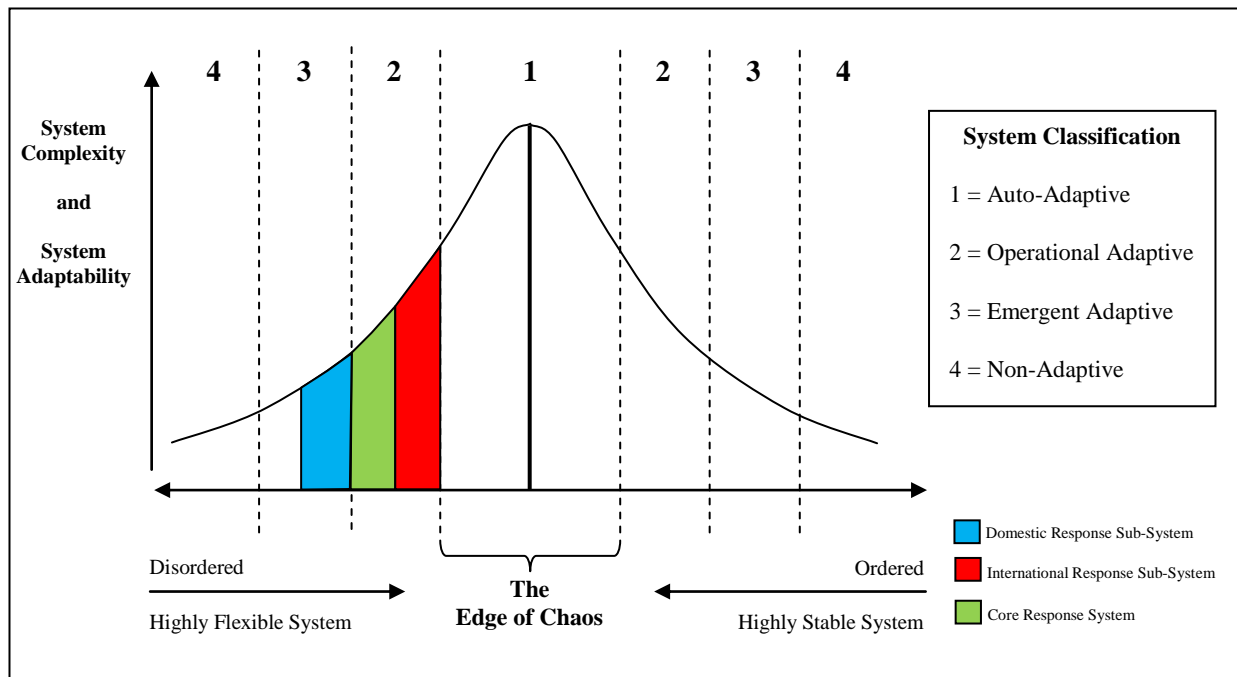


Figure 41: Classifications of the Administrative Response Systems under Analysis

It is now possible to situate the core system and its sub-systems within the framework of administrative resilience. As Figure 41 reveals, there were differences in terms of where the

systems were situated along the continuum. The domestic sub-system was the most disordered, and many of the organizational actors were confused by the chaos caused by the disruption of the governmental structures within the affected communities. In contrast, the international sub-system was more closely situated towards the ‘edge of chaos,’ and its organizations were able to take advantage of the operational flexibility granted to them by the Indonesian government.

The classification of the core system as an operational adaptive system means that its constituent organizations collected and disseminated information, possessed the authority to adapt, were willing to explore alternative methods of problem solving, utilized technology, and were willing to collaborate with other organizations in the response system. The core system’s classification reflected the relative strengths and weaknesses of its component sub-systems. For example, the inclusion of the organizations from the international sub-system improved the capacity of the domestic sub-system and helped the core system achieve a higher level of resilience. While Indonesia’s tsunami response system did not operate along the desired ‘edge of chaos,’ the support provided by the international organizations, in particular the use of information technology to collect and disseminate information, helped the core system to manage the uncertain and rapidly changing conditions present in the post-tsunami environment.

9.0 FINDINGS AND IMPLICATIONS

Policy-makers have long sought to manage the administrative challenges generated by disruptive and uncertain events. Contemporary approaches to this problem have emphasized the creation of increasingly detailed operational plans, the reformation of pre-determined organizational relationships, and increasing the frequency of organizational interactions across fixed channels of exchange. The implementation of such strategies can actually undermine an administrative system's capacity to operate in uncertain conditions. This chapter reviews the findings of this study, which indicate that it is possible to develop resilience in administrative systems, thereby ensuring an administrative system can adapt in response to disruptive and uncertain events.

9.1 MAJOR RESEARCH FINDINGS

This study investigated the resilience of the administrative system that operated in Indonesia after the Great Sumatran Earthquake and Tsunami, and was guided by four research questions:

1. To what extent did the organizations that conducted operations in Indonesia after the Great Sumatran Earthquake and Tsunami of 26 December 2004 facilitate the development of the administrative response system?
2. To what extent did the interactions exchanged among response organizations after the Great Sumatran Earthquake and Tsunami of 26 December 2004 drive the structural evolution of the administrative response system?

3. To what extent did constraints and opportunities influence the administrative system that responded to the Great Sumatran Earthquake and Tsunami of 26 December 2004?
4. To what extent did the administrative response system possess the capacity for resilience after the Great Sumatran Earthquake and Tsunami of 26 December 2004?

A summary of this study's major findings are presented in the following sub-sections.

9.1.1 Composition and Development of Administrative System

A total of 560 organizations were involved in the critical interactions that represented the foundation of the core administrative system. When these organizations were reviewed by their sources of funding and levels of jurisdiction, it was apparent that the response system was unprecedented in its size and complexity. In terms of the rate in which organizations accessed the system, the data indicate dynamic change, with multiple organizations entering the system during the days immediately after the tsunami. In terms of its rate of growth, the data indicate that the system grew rapidly, and that there were three significant dates related to the system growth. The first occurred on 31 December 2004, after which, the growth of the response system increased. The second occurred on 10 January 2005, when the growth rate began to plateau. Finally, the system reached 80% capacity on 6 January 2005, about two weeks after the tsunami.

9.1.2 Structural Evolution of Administrative System

The administrative system experienced periods of structural stability and structural change. The low overall density scores in the core system and its sub-systems indicate that response organizations did not engage in as many interactions as they perhaps could have. Even so, some

organizations became increasingly active as the response system developed. When other structural indicators were evaluated, it was revealed that the diameter of the domestic sub-system experienced brief period of contraction before expanding towards the end of week three. In contrast, the core system and the international sub-system displayed a different pattern, experiencing a brief period of expansion before beginning to contract during the third week. The Hamming distance statistics indicate that the structure of the core system likely changed on 6 January 2005, the day that the United Nations began to coordinate regional relief operations and the Indonesian Ministry of Health and the World Health Organization held their initial coordination meeting. After 6 January 2005, the organizations adopted what appeared to be regular patterns of interaction. The most significant finding is that, in terms of its structure, the international sub-system seemed to possess a higher capacity to manage the conditions of the post-tsunami environment. The fact that domestic organizations increasingly elected to target international organizations after the tsunami supports this conclusion.

9.1.3 Constraints and Opportunities in the Administrative System

The respondents indicated that the core administrative system experienced various constraints. Some of the most significant constraints included: the confusion generated by the lack of information; the lack of language and cultural understanding; and resource availability and organizational competition. The respondents reported that the core system benefited from opportunities that included: the international attention and the desire of the international community to provide assistance; the fact that organizations had the capacity to collect information and transform it into usable knowledge; and the emphasis that organizations placed

on collaboration and coordination. The respondents also revealed that organizations in both the domestic and international sub-systems had difficulties collecting the information they needed to understand their operational environment. The organizations in the international sub-system, which had significant disaster management experience, overcame this problem by establishing mechanisms that facilitated information exchange throughout the administrative system.

9.1.4 Resilience of Administrative System

The framework of administrative resilience indicated that the domestic sub-system was an emergent adaptive system and the international sub-system was an operational adaptive system. While both the sub-systems received “low” scores for the environmental component, the domestic sub-system was also constrained by “low” scores for the technological and interaction components. Due to the inclusion of the international organizations, the core system was also classified as an operational adaptive system. Although it received slightly lower component scores than the international sub-system, the core system possessed the resilience needed to adapt in the post-tsunami environment. The capacity of the core system was influenced by the inclusion of the international organizations, which helped to improve the capacity of the domestic sub-system. In terms of the system structure, the core system and its constituent sub-systems displayed more flexibility than stability. While this analysis indicated that this administrative system did not reach the desired ‘edge of chaos,’ it did possess sufficient resilience to react to the constraints and opportunities that existed in uncertain post-tsunami environment through adaptation and self-organization.

9.2 POLICY RECOMMENDATIONS: PROMOTING ADMINISTRATIVE RESILIENCE

These findings indicate that the administrative system that responded to the Great Sumatran Earthquake and Tsunami possessed sufficient resilience to manage the uncertainties present in the post-tsunami environment. Given these results, it is important for policy-makers to consider how to strengthen the adaptive capacity of administrative systems. The data reported in this study indicate that there are four primary ways that policy makers can strengthen administrative capacity: 1) develop a database of baseline information to support administrative action: 2) strengthen administrative policies and institutions; 3) strengthen community infrastructure and warning capacity; and 4) promote the development of international administrative resilience.

9.2.1 Develop a Baseline Database to Support Administrative Action

This study indicates that many of the constraints that were present in the post-tsunami environment were generated by the lack of basic information about the communities that were affected by the disaster. Many of these communities were located in rural areas, and were so small that there were not even identified on official government maps. Some of the respondents reported that the only way they could determine if a community had been located at a particular site was to see if there were pylons standing in the coastal waters. Even assuming that a community could be located, there was insufficient information about those who lived there. In many instances, the initial wave of response organization could not even determine how many people lived in an affected community. As a result, response organizations could often do nothing more than make educated guesses about the needs of those in affected communities.

Operations were also constrained by a lack of information about the organizations that responded to the disaster event. The respondents reported that they often struggled to acquire information about which organizations had actually begun to access the disaster area. More importantly, there was a lack of information about which organizations were doing what activities, in which communities, and with what resources. These information deficiencies created various problems. For example, in some communities, there was an over-distribution of relief supplies such as water, clothing and food. Other communities suffered from an under-distribution of even the most basic supplies. The development of a comprehensive database for the storage and distribution of baseline information about at-risk communities and the organizations that respond to disaster events would help to overcome these problems.

A real-time information database that stores baseline information is an important first step in the development of administrative resilience. In the context of disaster management, the database must contain two general categories of information. The first category would focus on the at-risk communities, and would contain information about the at-risk populations, community infrastructure and the natural environment. This information should be stored using a Geographic Information System platform to ensure that it can be rapidly analyzed and disseminated after a disaster. The most significant type of information that can be collected is the number of people who live in at-risk communities. Such information can be collected through a regularly scheduled census, which could also gather data related to age, sex, education level, socio-economic status, cultural affiliation, language usage and religious affiliation. With respect to information related to the infrastructure and the natural environment, at the very least, the location of the community must be identified by longitude and latitude. This would ensure that the community can be located after a disaster. Information about a communities' transportation

system, critical lifelines, and public facilities, including government offices, schools, hospitals, and public spaces should also be identified. The final items that should be stored in the database would be the nature and location of hazards, evacuation routes and safe zones.

The second category of information would focus on the organizations that assist communities affected by disasters. Even though the United Nations made attempts to gather information about the organizations that operated in Indonesia, many of the respondents indicated that these efforts were not sufficient. These respondents suggested that the following information should be collected from response organizations and distributed, perhaps through the internet or email, to all of the organizations involved in the response system. First, the name of the organizations must be recorded so that a detailed record is available of which organizations have responded to the disaster. Second, the location of the organizations' base of operations should be identified, as well as the names and telephone numbers of the individuals responsible for acting as liaisons with the community or other response organizations. Third, the organizations should report their primary areas of operational expertise, whether it is health care, child protection, education, logistics or community development. Equally critical is the need for response organizations to identify the language they use to conduct day-to-day operations (e.g., English, French or Mandarin), as well as the language spoken by its volunteers in the disaster area. Fifth, the organizations must report their capacity and needs in relation to their resources, technologies, personnel, areas of expertise and levels funding. Finally, the organizations should provide descriptions of the response activities in which they are engaged, paying particular attention to identifying the location where these activities are located.

9.2.2 Strengthen Administrative Policies and Institutions

Another way to promote the resilience in administrative systems is to strengthen administrative policies and institutions. Such developments should be proactive, meaning they should be implemented before the occurrence of a system disrupting event. As with the creation of the Department of Homeland Security in the United States, most attempts to strengthen administrative policies and institutions are reactionary, and are implemented after the occurrence of a system disrupting event. Equally important, any changes in administrative policies and institutions should facilitate flexibility, moving away from hierarchical command and control structures employed in contemporary administrative systems.

The Indonesian government has made significant progress in the development of its disaster management policies and institutions. The first major change occurred in 2006, when the national government adopted the *National Action Plan for Disaster Reduction: 2006-2009*. This plan was the Indonesian government's written commitment to shift the policy focus of disaster management activities from that of reaction to prevention, thereby bringing Indonesian disaster management closer to that envisioned by the international communities' *Hyogo Framework for Action*. According to the *National Plan*, this paradigm shift would have three components: 1) "instead of focusing on emergency response, disaster management now represents all aspects of risk management;" 2) "protection against disaster threats must be provided for by the government, not out of obligation, but for the fulfillment of the basic rights of the people;" and 3) "responsibility for disaster management lies no longer with the government alone, but with a shared responsibility of all elements of the society" (Republic of Indonesia 2006, pp. I2-I3).

The second major change in Indonesian policy occurred after the government began to support the *National Plan* with legislation that was intended to transform the ad hoc and reactionary disaster management system that existed prior to the tsunami into a flexible administrative system, which not only embraced the full disaster management cycle as a matter of public policy, but would be able to respond to a wide range of natural and man-made threats. Described briefly in Appendix L, some of the most important pieces of legislation include: Disaster Management Law No. 24/2007; Presidential Regulation No. 8/2008; Government Regulation No. 21/2008; and Government Regulation No: 22/2008.

Notwithstanding the significance of these developments, the Indonesian disaster management system has not yet reached its full potential. While the paradigm shift will take time to develop, the emerging legal framework for disaster management has created the potential for tension between the national and local governments. To overcome this problem, compromise must be reached as to where final political authority lies with respect to disaster management. The data presented in this study suggest that the question should not be whether final disaster management authority resides with the central government or local governments, but rather, whether authority can be distributed in such way that the administrative system responsible for disaster management activities has both the structure to promote sustained policy change and the flexibility to promote organizational adaptation and self-organization.

The need for such compromise, or at least clarification, was made clear by the respondents, who reported that even with the new legal framework, many of Indonesia's communities will continue to function as they did prior to the tsunami. One of the respondents elaborated on this point by suggesting that, while new laws have been passed, the individuals that work in local disaster management offices remain inexperienced and will not be able to

advance disaster management as a policy priority (Respondent 51 2009). Given the gaps that continue to exist in Indonesian disaster management policy, it is also recommended that disaster practitioners, particularly those from Indonesia's academic and non-profit sectors, continue to educate local communities about the threats posed by natural and man-made disasters. By educating those who live in at-risk communities on topics such as the signs of an impending natural disaster, evacuation routes, and the location of pre-established safe zones, disaster management practitioners can empower the citizens of such communities to take self-directed action in response to the disruptive events that will inevitably occur.

9.2.3 Strengthen Community Infrastructure and Warning Capacity

The resilience of administrative systems can also be developed by strengthening infrastructure. While this recommendation includes the infrastructure needed to conduct operations after a disrupting event, for example telecommunication and transportation systems, it also means infrastructure that can provide policy makers with a warning that a disruptive event might actually occur. The Indonesian government has made process in the development of disaster detection and early warning systems that can provide its administrative systems and at-risk communities with information about pending natural disasters. Given that Indonesia is located in a region of high seismic activity, one of the primary areas of focus has been on the development of a tsunami early warning system. Initiated while the government was still responding to the Great Sumatran Earthquake and Tsunami, the Indonesian Tsunami Early Warning System (INA-TEWS) sought to revolutionize the detection of tsunami events within the Pacific and Indian Oceans. Subsequent seismic events, such as the Nias earthquake of March 28, 2005, the Java

earthquake of May 27, 2006, the Java tsunami of July 17, 2006, and the devastating earthquake that struck the coastal community of Padang in September 30, 2009, reminded the Indonesian government that early warning systems could reduce the consequences of disasters.

Obstacles have prevented INA-TEWS from reaching its potential. In terms of technical hurdles, the respondents indicated that the data collection system is not fully operational. For example, many of the sensor devices used by the system are unable to transmit real-time data to the national center. Of the sensors that can transmit data to the national center, much of data cannot be utilized because of problems with data standardization (Respondent 48 2009). Furthermore, some of the ocean buoys, which have been deployed at great expense, are non-operational due to technical failures or vandalism (Respondent 48 2009). Equally problematic has been what is referred to as the “the last mile” of the warning system. The Indonesians have learned that it is difficult to get at-risk populations to evacuate, even when a tsunami warning is issued from the national center. These problems were reviewed in a presentation delivered by an official from BMKG after earthquakes near Padang, Indonesia on 12 and 13 September 2007. The government’s “lessons learned” report indicated that it was not clear how many people received the tsunami warning through official channels, the community of Padang lacked standard-operating-procedures to guide activities after the warning, and the community’s reaction to the warning was ad hoc in nature rather than coordinated (Fauzi and Vidiarina 2007).

9.2.4 Promote International Administrative Resilience

There is an emerging consensus on the need to improve the administrative capacity of nations that are threatened by disasters. Indeed, significant progress has been made in this policy area,

especially in the years since the United Nations designated the 1990s as the *International Decade for Natural Disaster Reduction*. At the local level, citizens have become aware of threats in their communities, and have started to take action, often on their own, to mitigate the potential consequences of disaster. At the national level, governments have started to adopt legislation that calls for the creation of national and sub-national policies and institutions to address disaster management issues. The international community has also made progress, not only by agreeing to come together to discuss disaster management issues, but by also recognizing the transnational character of disaster. More importantly, nations have recognized that the reduction of disaster risk will require cooperation and collaboration across jurisdictional boundaries. Even with this progress, the lack of a cohesive administrative and technical framework has impeded the development of administrative resilience at the international level. Stressing this point, the Secretary General of the United Nations indicated in 2007 that the international community will be unable to meet its goal of reducing disaster losses by 2015 (United Nations 2007).

The need for resilient administrative structures at the international level was evident in the response to the Great Sumatran Earthquake and Tsunami. After the disruption of the formal disaster management system in Aceh, hundreds of organizations rushed to the disaster scene, many of which had little experience with either disaster response activities or the affected regions. Although these organizations came together to form a scalable and heterogeneous administrative system, the operational constraints that were present in the post-tsunami environment prevented decision makers from leveraging the full capacity of the response system. The fact that response organizations broke off into separate components indicates that decision makers not only struggled to identify the needs of the affected population, they also struggled to match the needs of these populations with the available resources.

The international community can begin to manage these constraints by developing the foundations for a resilient administrative system that can support national administrative systems if they become constrained or disrupted. The development of international administrative resilience requires a socio-technical approach that not only recognizes “the relationships and interrelationships between the social and technical parts of [a] system,” but also that these relationships can enhance organizational knowledge and administrative effectiveness (Coakes, Willis, and Clark 2002, p. 5). For this approach to work in the disaster management context, policy makers must integrate the system’s social components, represented by the organizational actors, the availability of resources, and the needs of the citizens living in communities exposed to the risk of disaster, with the system’s technical component, represented by technical systems that will help policy makers to translate knowledge into effective action after a disruptive event.

With respect to the social component, the international community should continue to support national governments in their efforts to implement disaster management legislation. A significant contribution to this effort could come from the development of a single disaster management treaty that would not only strengthen the *Hyogo Framework for Action*, but also replace the current patchwork of bi-lateral, regional and multilateral agreements that do little for the emergence of a cohesive and comprehensive legal framework for international disaster management. This comprehensive legal framework needs to specify when the international community can intervene in the domestic affairs of a nation whose administrative systems have been disrupted. The framework must also ensure that, when assistance is requested by a national government, the international community has the authority to conduct response and relief operations without excessive interference from the national authorities. This does not mean that the international community will have carte blanche authority, but rather, the flexibility they need

to adapt and self-organize their response activities according to the nature of the disaster event. Finally, the international community needs to develop standardized disaster management policies and procedures, perhaps through by a series of international certification requirements, which would help policy makers to identify and manage the non-governmental organizations that populate the international disaster management arena.

With respect to the technical component, national governments must support the design and implementation of technical systems that can facilitate the transfer of information and resources, not only during the response period that follows a disaster, but also during the mitigation, prevention and recovery phases of the disaster cycle. This will require a database of baseline information on population size, demographics, building locations, and the distribution of resources for communities around the world. Moreover, a properly designed technical system would ensure that information flows and feedback loops function among the organizations that participate in such administrative systems (Comfort 2005; Comfort et al. 2001).

The sociotechnical system that is used to promote administrative resilience must possess a number of basic characteristics. First, in the disaster management context, the system would benefit from a “plug-and-play” capacity, meaning its design is standardized and available to all disaster management personnel and organizations. The standardized design would enable organizations to integrate the system into their operational schemas. The idea would be that, once a disruptive event occurs, domestic and international response organizations would arrive on scene, plug into the national level system, and utilize the data available in the system to initiate and coordinate their response activities. Second, regardless of the location of the disaster event, the data stored in the system should be scalable, meaning that decision makers can change the resolution of the data they receive by level of jurisdiction (e.g. city, county, provincial, national

and international). Third, the information available must be presented using a graphical interface, which makes it easy to understand and analyze. The key is to provide decision makers with information that will enable them to make “good” decisions, rather than having them wait for the arrival of information, which may never come, that is sufficient to make the “best decision.”

The fourth requirement is that the data that are available in the system should be stored in a format that provides response organizations with the capacity to query the database for the information they need to conduct their operations. This would ensure that organizations only receive “relevant” information, and would not be overwhelmed by information of little, if any, utility. Fifth, the system must also enable participating organization to input information back into the system in real-time. By providing organizations with the means to provide the administrative system with updates related to the information they collect from the field, or the activities that they initiate, the organizations themselves would serve as feedback loops and promote the flow of information that is needed to facilitate the adaptation and self-organization of the administrative system. Finally, the system should be sufficiently comprehensive to cover all of the various phases of a disaster event. The earlier that a disaster event can be detected, the earlier that response activities can begin, for example, with the evacuation of vulnerable populations, the pre-positioning of personnel and resources, and the organization of search and rescue teams. An administrative system with these characteristics would promote international resilience, by enabling information to be transformed into the knowledge that policy makers need to take effective action in uncertain conditions. While the development of a resilient administrative system would provide a significant improvement over the capacity of contemporary systems of public administration, the challenge is for policy makers to identify the appropriate mix of incentives that would convince organizations, especially non-profit and

governmental organizations, that their participation in such a system would not only improve their operational capacity, but it would also help them to fulfill their organizational missions.

9.3 THEORETICAL QUESTIONS AND FUTURE RESEARCH

This inquiry into administrative resilience has revealed an assortment of theoretical questions. These questions, considered from the perspective of administrative systems that respond to disaster events, can be situated within the broader field of public administration. This inquiry has also revealed a variety of research questions, which if addressed, can expand our empirical and theoretical understanding of administrative resilience. Some of the most important theoretical questions and research questions identified by this study are discussed below.

9.3.1 Theoretical Questions

The findings generated by this study provide policy makers with the knowledge they need to improve the capacity of the administrative systems that operate in uncertain conditions. The organizations that responded to the tsunami demonstrated the capacity to enter an unfamiliar operational environment, to scale up response operations, and to quickly identify the means to provide assistance to those affected by the disaster. In the weeks after the tsunami, this heterogeneous and scalable system of organizations completed these tasks by exhibiting some of the characteristics of administrative resilience. Yet the focus of this study calls into question the extent to which the findings are applicable to administrative systems outside of Indonesia. There are four categories of theoretical questions upon which future research might proceed.

The first category considers the organizational composition of resilient administrative systems. For example, to what extent do specific types of organizations influence the adaptive capacity of administrative systems? In other words, to what extent do resilient administrative systems possess a common organizational typology? In the Indonesian context, the findings indicate that, in terms of their sources of funding, the response organizations were overwhelmingly public in character. But is this true of all resilient administrative systems? Indeed, when affected by a disruptive event, many communities may not have the public capacity to manage response operations. When a disaster strikes such a community, what would be the character of the organizations that seek to fill this administrative void? Would the responding organizations tend to be public organizations from outside the affected community, for example the United Nations, or would domestic non-profit organizations play the overwhelming role in response and recovery activities? Similar theoretical questions exist about the jurisdictional level of the organizations that respond to such events. For example, will all resilient administrative systems be bolstered by the presence of international organizations?

The second category considers the emergence and development of resilient administrative systems. For example, to what extent does the emergence and development of resilient administrative systems follow common patterns or trends? In the Indonesian context, two growth related findings were of particular interest. First, there was an extremely rapid period of growth in the days immediately after the disaster. This period of growth was followed by a momentary pause before the system once again started to increase in size. Second, the growth of the system reached a plateau after two weeks. Are these examples of system growth unique only to the Indonesian context, or do they represent patterns common to resilient administrative systems in

general? If so, what factors would explain their occurrence, and can they be manipulated by policy makers to accelerate the growth of resilient administrative systems?

The third category considers the structural characteristics of resilient administrative systems. For example, to what extent do different resilient systems, which may have emerged in response to different types of disruptive events, share common structural characteristics? While administrative systems may operate in different countries and in different operational environments, it may be the case that the density of interactions detected in resilient administrative systems, regardless of their size and location, will remain relatively low. Further analysis might also reveal that the most central actor in any resilient administrative system will always be a national organization, which could serve as an intermediary between the international and domestic organizations. Moreover, shifting to temporal issues, to what extent do resilient systems exhibit commonalities in terms of their structural evolution? It may be that, from a structural perspective, the organizational interactions present during the first week after a disruptive event differs substantially from the organizational interactions present during the third week. If such structural similarities or differences are found, the important question is why.

The final category considers whether there are linkages between the nature of the organizational interactions that occur in an administrative system and that administrative system's capacity for resilience. The research conducted in this study is based upon the proposition that such linkages exist. Yet to what extent does the nature of the organizational interactions that occur in resilient administrative systems provide empirical support for this proposition? It may be that certain types of interactions have the most influence on an administrative system's capacity to respond to disruptive events. Likewise, the method of interaction might also be influential in ways not considered by this study. In the Indonesian

context, many of the respondents reported that the communication tool which was the most effective for facilitating action was the cell phone, especially after the rehabilitation of the communication infrastructure. This seems to compliment the idea that the resilience of an administrative system can be improved through a unified information support system.

As future research address these theoretical questions, it may become possible to identify the fundamental premises by which resilient administrative systems operate. For policy makers concerned with improving the resilience of administrative systems, the identification of such premises would have two implications. First, they would enable policy makers to design administrative systems that take better advantage of organizational diversity, which can improve the ability of these systems to adapt in response to conditions of uncertainty. Second, they may indicate that there are limits to the government's capacity to design administrative systems that can respond to disruptive events. For instance, the findings generated by future research might indicate that there will always be a delay between the occurrence of a disruptive event and the point at which a resilient administrative system becomes fully operational. Such findings would help policy makers to determine how to best allocate scarce resources.

9.3.2 Future Research: Expanding the Indonesian Analysis

To advance knowledge of the adaptive capacity of resilient administrative systems, future research must extend the analysis of the Indonesian response system. The first avenue of research would explore the extent to which the resilience of the system differed by jurisdictional level. For example, did the organizations categorized as local possess a better adaptive capacity than organizations at the national or provincial levels? Moreover, to what extent were certain

categories of response transactions initiated or received by organizations that operated within certain jurisdictional levels? These lines of inquiry might help policy makers to better distribute scarce resources or to improve the resilience of specific jurisdictions.

The second avenue would examine how the cumulative network structure of the Indonesian response system changed after January 6, 2005, the date the Hamming distance statistic indicated that a major structural change occurred within the system. As chapter six revealed, it was on 6 January 2005 that the World Health Organization and the Indonesian Ministry of Health initiated tri-weekly coordination meetings. To explore the extent to which these meetings had an impact on the cumulative structure of the response system, the daily network data would be aggregated into two separate matrices, which would be comparatively evaluated using the measures evaluated by chapter six. This would allow for a comprehensive “before and after” analysis of the structure of Indonesia’s tsunami response system.

The third avenue of research would take an in-depth look at the network structures identified in the Indonesian response system. For example, which resources were needed to complete which response activities, and more importantly, did the organizations that engaged in certain activities actually possess, or have access to, the resources they needed to complete these activities? Exploring such questions would require that distinctions be made among the types of interactions reported in the response system. In the present study, the interactions used to complete the network analysis were not organized into distinct categories. Future research can organize the interactions into categories that relate to: 1) the type of task completed by the interaction; 2) the knowledge required to complete the interaction; and 3) the resources required to complete the interaction. As Table 57 indicates, such categories would enable researchers to analyze the emergence and development of organizational capacity and institutional support

networks (Carley 2003). In contrast, this study was limited to the inter-organizational network that developed in Indonesia after the tsunami.

Table 57: Categories of Meta-Matrices for Dynamic Network Analysis⁷

	People	Knowledge/ Resources	Events/ Tasks	Organizations
People	Social Network	Knowledge Network	Attendance Network	Membership Network
Knowledge/ Resources		Information Network	Needs Network	Organizational Capacity
Events/ Tasks			Temporal Ordering	Institutional Support Network
Organizations				Inter-Organizational Network

9.3.3 Future Research: Moving Beyond Indonesia

Cultural and contextual differences suggest that countries such as Thailand and India experienced the tsunami differently than Indonesia. It is also likely that there were differences in the manner in which the administrative systems in these countries operated. To explore whether

⁷ A full discussion of these categories and the forms of analyses that can be conducted utilizing dynamic network analysis methods can be found in Carley, Kathleen M. 2003. Dynamic Network Analysis. In *Dynamic Social Network Modeling and Analysis: Workshop Summary and Papers*, ed. Ron Breiger, Kathleen M. Carley and Philippa Pattison: 133-145. Washington, D.C.: National Research Council.

such differences existed, and whether these differences promoted or undermined administrative resilience, future research must move beyond the context of Indonesia.

The success of this research agenda, however, depends upon whether the measures for determining the presence and degrees of resilience within systems of public administration can be refined. Four improvements would strengthen the empirical results generated by the framework of administrative resilience. First, the structural analysis of administrative systems can be strengthened by expanding the coding schema used to classify the organizations that participate in such systems. This study revealed that the community of organizations that responded to the Indonesian tsunami was heterogeneous. The organizational coding schema employed by this study, however, was highly generalized, which restricted the type of data that was included in the analysis. That is, this study assumed that all non-profit organizations shared the same structural and operational characteristics. Yet not all non-profit organizations were alike. Some were small, and completely dependent upon volunteers and the financial contributions of the public. Others were self-sufficient, and had a permanent staff and budget. As research moves forward, the coding schema must better capture such organizational differences.

Second, the components and sub-components employed by the framework must be expanded to include the structural and social categories of resilience. For example, the revised framework would not only incorporate data that reflect the extent to which the life-lines and buildings in a community are protected against disaster, structural resilience, but also data related to the demographic, educational and socio-economic characteristics of the community, social resilience. Third, the coding schema must be refined beyond the simple “low,” “medium,” and “high” options employed in this study. Expanding the range of scoring options would improve the precision and reliability of the conclusions generated by the framework, as well as the policy

recommendations that could be provided to policy makers. Finally, it is necessary to consider how the construct of administrative resilience can be framed as a dependent variable through which adaptive capacity can be measured and evaluated. For instance, the development of a “resilience variable” would enable the use of statistical methods to evaluate the validity of the constructs that underlie the framework of administrative resilience.

Once these refinements are made to the framework of administrative resilience, the next phase of the research will begin with a series of analyses on the other countries that were affected by the Great Sumatran Earthquake and Tsunami, three of which would be of particular interest: Sri Lanka, Thailand and India. An in-depth analysis of the response networks that developed in these countries would be conducted, on a day-by-day basis, for a period of three weeks. The data would be collected through a careful review of primary source materials that include newspaper articles and daily situation reports. Once the coding is complete, network matrices would be created, which would enable structural and evolutionary comparisons to be made between the countries. One important area of focus might be whether the administrative systems of the other countries developed at a faster rate than the Indonesian system. If such a finding were observed, it may indicate that the systems possessed a higher degree of resilience. This conclusion could only be reached after a series of in-depth semi-structured interviews with experts in each of the affected countries. Equally interesting would be whether differences could be detected between the administrative systems that formed in each of these countries at specific levels of jurisdiction. For example, were the interactions exchanged between organizations detected at a higher rate at the local level of jurisdiction in Thailand than in Indonesia?

It would also be possible to create a unified network matrix that combines all of the interaction data coded for the response period under analysis. This would include the data that

has been collected from all four systems under analysis: Indonesia; Sri Lanka; Thailand and India. Separate matrices would also be created for each of the sub-categories of interaction data, including resources, information and knowledge. The data contained in these unified matrices could then be used for two purposes. These data could be used to identify the system components that are isolated and unable to acquire the information, personnel or resources needed to complete their response activities. Assuming that the policy modifications are implemented, these data could be used as a baseline to determine whether, after a future disaster, the resilience of the administrative system actually improved following policy modifications.

The challenges of the twenty-first century, many of which are created by the uncertain and rapidly changing conditions that permeate the increasingly interconnected international system, will require new administrative solutions. To overcome these challenges, policy makers will need to implement sociotechnical infrastructures that will enable their administrative systems to take advantage of the dynamic and non-linear interactions exchanged among heterogeneous communities of organizational actors. Only then will it be possible for policy makers to harness the complexity of such systems, and to take advantage of the adaptive capacity of resilient administrative systems. While the Great Sumatran Earthquake and Tsunami was an event of horrific consequences, it did contain a silver lining (Clarke 2006). As the data in this study indicate, the event demonstrated that administrative systems can operate effectively in uncertain conditions without relying upon hierarchy and rigid operational procedures. In referring to why the administrative response system that formed in Indonesia after the tsunami managed to overcome unimaginable constraints, an official from a Indonesian university stated, “I think [that] what we can say that we had, [was] the willingness to work together without any formal structure, [it was] networks of people with good intentions” (Respondent 50 2009).

APPENDIX A Semi-Structured Interview and Survey Instruments

Demographic **1 What is your age?**

_____	21-25	_____	26-35	_____	36-45
_____	46-55	_____	56-65	_____	65+

Demographic **2 What is the highest level of formal education that you attained?**

_____	No Formal Education	_____	University (Associate)
_____	Primary (Elementary)	_____	University (Bachelors)
_____	Secondary (High School)	_____	University (Masters)
_____	Vocational (Trade School)	_____	University (Doctorate)

If you attained a University degree, in what discipline did you concentrate?

Demographic **3 How many years of experience do you have in disaster management?**

_____	0-5	_____	6-10	_____	11-15
_____	16-20	_____	21-25	_____	Over 25

Demographic **4 In terms of number of disaster management personnel, how would you rate the size of your organization?**

_____	1-10	_____	11-50	_____	51-100
_____	101-500	_____	501-1000	_____	Over 1000

Background 5 **What were the primary missions and responsibilities of your organization before and after the 26 December 2004 tsunami?**

Before?

After?

Background 6 **What was your role in your organization’s operations during its response to the 2004 Earthquake and Tsunami?**

Environmental 7 **To what extent were Indonesia's governments and communities prepared to respond to the risks presented by disasters such as the tsunami before and after 26 December 2004?**
and
Cultural

Before December 2004

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
----------------------------	----------------------	-------------------------	----------------------	-------------------	----------

Currently

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
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In what ways? Please explain.

- Environmental 8 **To what extent did the rules, regulations and procedures enacted by the Indonesian government before and after the 26 December 2004 guide the operation of the tsunami response system?**

Before 2004

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
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Currently

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
----------------------------	----------------------	-------------------------	----------------------	-------------------	----------

In what ways? Please explain.

- Organizational 9 **To what extent did response organizations have emergency response plans that emphasized collaboration with other organizations, particularly those that operated in other jurisdictions?**

Before December 2004

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
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Currently

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
----------------------------	----------------------	-------------------------	----------------------	-------------------	----------

In what ways? Please explain.

- Organizational 10 To what extent did response organizations have the training, scientific expertise, resources, technology and authority to adapt their emergency response activities to the demands of the tsunami event?

Training

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
----------------------------	----------------------	-------------------------	----------------------	-------------------	----------

Scientific Expertise

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
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Resources

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
----------------------------	----------------------	-------------------------	----------------------	-------------------	----------

Technology

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
----------------------------	----------------------	-------------------------	----------------------	-------------------	----------

Authority

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
----------------------------	----------------------	-------------------------	----------------------	-------------------	----------

How did changes, if any, occur in practice? Please explain.

Decision
making

11 What steps did the Indonesian government institutions and organizations take in response to the 26 December 2004 Earthquake and Tsunami?

Immediately after the tsunami.

One week after the tsunami.

One month after the tsunami.

Decision
making

12 Did these steps differ from those taken by International, National and Local non-governmental organizations? If so, in what ways?

Immediately after the tsunami

One week after the tsunami

One month after the tsunami

Decision
making

13 To what extent were these steps affected by constraints and opportunities that existed in the post-tsunami disaster environment?

Constraints

Significant Extent	Great Extent	Moderate Extent	Small Extent	No Extent	N/A
5	4	3	2	1	9

Opportunities

Significant Extent	Great Extent	Moderate Extent	Small Extent	No Extent	N/A
5	4	3	2	1	9

In what ways? Please explain.

Cultural

- 14 To what extent were governmental and non-governmental organizations willing to review their actions, and if necessary correct mistakes, during the month that followed the tsunami?

Governmental Organizations

Significant Extent	Great Extent	Moderate Extent	Small Extent	No Extent	N/A
5	4	3	2	1	9

Non-Governmental Organizations

Significant Extent	Great Extent	Moderate Extent	Small Extent	No Extent	N/A
5	4	3	2	1	9

In what ways? Please explain.

Technology

- 15 What types of technologies did your organization use to collect and disseminate information after the tsunami?

Please number from 1 to 10 in order of frequency of use, with 1 the most frequently used.

_____ High Frequency Radio	_____ Fax Machine
_____ Low Frequency Radio	_____ E-mail
_____ Cellular Phone	_____ Satellite Phone
_____ GIS	_____ GPS
_____ Satellite Observations	_____ Website
_____ Other - please specify: _____	

Please explain who used these technologies for what purposes.

Technology **16 To what extent were these technologies integrated and used to create a common operating picture for the management of response operations?**

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
----------------------------	----------------------	-------------------------	----------------------	-------------------	----------

Please explain the impact, if any, that these technologies had upon the management of response operations.

Interaction **17 To what extent did your organization collaborate and exchange information, scientific expertise, resources and personnel after the tsunami?**

Information

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
----------------------------	----------------------	-------------------------	----------------------	-------------------	----------

Scientific Expertise

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
----------------------------	----------------------	-------------------------	----------------------	-------------------	----------

Resources

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
----------------------------	----------------------	-------------------------	----------------------	-------------------	----------

Personnel

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
----------------------------	----------------------	-------------------------	----------------------	-------------------	----------

In what ways? Please explain.

Interaction
and
Decision
making

- 18 To what extent did collaboration, or lack of collaboration, affect decision making in and among response organizations during the month that followed the tsunami?**

Collaboration

Significant Extent	Great Extent	Moderate Extent	Small Extent	No Extent	N/A
5	4	3	2	1	9

Lack of Collaboration

Significant Extent	Great Extent	Moderate Extent	Small Extent	No Extent	N/A
5	4	3	2	1	9

In what ways? Please explain.

Authority

- 19 Which best describes the distribution of command and control authority throughout Indonesia's tsunami response system, before December 2004 and currently?**

Before December 2004

Highly Unstructured	Somewhat Unstructured	Balanced	Somewhat Structured	Highly Structured	N/A
1	2	3	4	5	9

Currently

Highly Unstructured	Somewhat Unstructured	Balanced	Somewhat Structured	Highly Structured	N/A
1	2	3	4	5	9

In what ways? Please explain.

Interaction 20 **Which three organizations were the most helpful to your organization's operations during the month that followed the tsunami?**

1. _____
2. _____
3. _____

In what ways? Please explain.

Interaction 21 **Which three organizations could have helped to improve your organization's operations during the month that followed the tsunami?**

1. _____
2. _____
3. _____

In what ways? Please explain.

Organizational and Interaction 22 **To what extent did your organization provide assistance to, or receive assistance from, other response organizations, particularly those in other jurisdictions, during the month that followed the tsunami?**

Provide Assistance To:

Significant Extent	Great Extent	Moderate Extent	Small Extent	No Extent	N/A
5	4	3	2	1	9

Receive Assistance From:

Significant Extent	Great Extent	Moderate Extent	Small Extent	No Extent	N/A
5	4	3	2	1	9

In what ways? Please explain.

- Organizational 23 To what extent did the following initial conditions enable your organization to collaborate with other organizations during the month after the tsunami, especially those in other jurisdictions?

Operational Plans

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
----------------------------	----------------------	-------------------------	----------------------	-------------------	----------

Training

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
----------------------------	----------------------	-------------------------	----------------------	-------------------	----------

Resources

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
----------------------------	----------------------	-------------------------	----------------------	-------------------	----------

Expertise

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
----------------------------	----------------------	-------------------------	----------------------	-------------------	----------

Technology

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
----------------------------	----------------------	-------------------------	----------------------	-------------------	----------

In what ways? Please explain.

- 24 To what extent did your organization update its disaster response plans, training activities, resources, scientific expertise and technology as a result of the lessons that it learned during the tsunami disaster?

Operational Plans

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
----------------------------	----------------------	-------------------------	----------------------	-------------------	----------

Training

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
----------------------------	----------------------	-------------------------	----------------------	-------------------	----------

Resources

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
----------------------------	----------------------	-------------------------	----------------------	-------------------	----------

Expertise

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
----------------------------	----------------------	-------------------------	----------------------	-------------------	----------

Technology

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
----------------------------	----------------------	-------------------------	----------------------	-------------------	----------

In what ways? Please explain.

- 25 To what extent did your organization accept new information, adopt new methods of problem solving, trust the decisions of others, and correct mistakes made in conducting response activities?

Accept New Information

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
----------------------------	----------------------	-------------------------	----------------------	-------------------	----------

Adopt New Methods of Problem Solving

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
----------------------------	----------------------	-------------------------	----------------------	-------------------	----------

Trust Decisions of Others

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
----------------------------	----------------------	-------------------------	----------------------	-------------------	----------

Correct Mistakes

Significant Extent 5	Great Extent 4	Moderate Extent 3	Small Extent 2	No Extent 1	N/A 9
----------------------------	----------------------	-------------------------	----------------------	-------------------	----------

In what ways? Please explain.

APPENDIX B Coding Rules for Organizations

Variable	Value	Definition
Name	Name	Official name for the organization.
Acronym	Acronym	Acronym for the organization.
Date of Entry	System Number	Each organization receives a distinct system number, which records the date the organization was initially detected as an actor within the system, as well as the order it entered the system.
Order of Entry		
Level of Jurisdiction	International	Organization not based within Indonesia.
	National	Organization based within Indonesia that primarily operates or governs at the national level.
	Provincial	Organization based within Indonesia that primarily operates or governs at the provincial level.
	Local	Organization based within that operates or governs at the municipal level or lower.
Source of Funding	Public	Organization has an executive, legislative, judicial or administrative governmental function.
	Non-Profit	Organization has a non-commercial function.
	Private	Organization is privately owned and has a commercial function.
	Special Interest	Organization has a political purpose.

APPENDIX C Coding Rules for Interactions and Transactions

Variable	Value	Definition
Date	Date	The date that the interaction occurred.
Initiator	Initiator	The organization that initiated the interaction.
Recipient	Recipient	The organization(s) that received the interaction.
Transaction	Transaction	A description of the interaction that took place between the Initiator and the Recipient.
Function	Assessment	Involved activities related to the assessment of damage or response tasks.
	Health	Involved activities related to the health of the survivors (i.e. medicine, or disease control).
	Transportation	Involved activities related to the actual movement of goods and supplies.
	Coordination and Collaboration	Involved the coordination and collaboration of organizations.
	Personnel	Involved personnel related to the response (i.e., movement of staff or doctors).
	Financial	Involved contributions, donations, or financial assistance (i.e. donations or debt relief).
	Supplies / Equipment	Involved equipment and supplies (generators, tents, cots, etc.).
	Logistics	Involved activities related to the arrangements needed to move goods and supplies.
	Nutrition	Involved the delivery of food and nutrition items to the survivors.
	Shelters / Displaced Persons	Involved shelters or displaced persons (e.g. tents, missing family members, etc.).
	Water, Sanitation and Hygiene	Involved water, sanitation and hygiene (e.g. water treatment or hygiene kits).
	Political Affairs	Transaction was political in nature (e.g. government letters of condolences, etc.).
	Recovery and Reconstruction	Involved recovery and reconstruction (e.g. planning or actual).
	Security	Involved security (e.g. protection of relief personnel or conflict between GAM and TNI).
	Communication	Involved communication technology (e.g. assessment, repairs or infrastructure).
	Search, Rescue and Evacuation	Involved search, rescue and evacuation activities.
	Protection	Involved the protection of vulnerable populations (e.g. child services).
	Education	Involved education (e.g. the repair of schools, or the movement of teachers).
	Utilities	Involved the repair of community lifelines such as electricity, communication and water).
	Other	Involved some other form of activity.

APPENDIX D Coding Schema for Interview Transcripts

Code I	Missions and Responsibilities	Represents the missions, responsibilities and activities reported by organizations involved in the post disaster environment. Each opportunity will be identified individually, and will have four sub-codes.
Sub-Codes	Organizational Typology	Indication of types of organizations involved in the semi-structured interviews and surveys.
	Governmental Activities	Indication of activities (steps) conducted by government actors (immediately, week and month) after tsunami.
	Non-Governmental Activities	Indication of activities (steps) conducted by non-government actors (immediately, week and month) after tsunami.
	Preparedness	Indication of whether organizations were prepared for disasters such the tsunami.
Code II	Opportunities	Represents the extent to which opportunities affected decision making in the post disaster environment. Each opportunity will be identified individually, and will have four sub-codes.
Sub-Codes	Opportunity Typology	Indication of the type of opportunity.
	Affected Decision making	Indication of how the opportunity affected decision making.
	Consequences	Indication of the consequences (social or organizational) of the opportunity.
	Management	Indication of how the opportunity was managed.
Code III	Constraints	Represents the extent to which constraints affected decision making in the post disaster environment. Each constraint will be identified individually, and will have four sub-codes.
Sub-Codes	Constraint Typology	Indication of the type of constraint.
	Affected Decision making	Indication of how the constraint affected decision making.
	Consequences	Indication of the consequences (social or organizational) of the constraint.
	Management	Indication of how the constraint was managed.

Code IV	Decision making Process	Represents the decision making processes used by organizations within the post-tsunami environment. As necessary, there will be multiple distinct elements coded under each of the respective sub-codes.
Sub-Codes	Process	Indication of the processes used by organizations for decision making.
	Collaboration	Indication of organizational collaboration with respect to decision making.
	Evolution	Indication of specific events that caused the system to evolve.
	Lessons Learned	Indication of the lessons learned by organizations that participated in the tsunami response system.

APPENDIX E Components of Administrative Resilience

Code I	Environmental Component	Represents the <u>initial environmental conditions</u> , and considers the extent to which effective disaster management laws, regulations and policy existed in Indonesia at the time of the tsunami.
Sub-Codes	Governmental Awareness	Indications that Indonesia's governments were aware of risks posed by disasters.
	Social Awareness	Indications that Indonesian society was aware of the risks posed by disasters.
	Preparedness	Indications that government and communities were prepared for risks posed by disasters.
	Laws and Regulations	Indications of the quality of disaster management rules and regulations.
	Disaster Plans	Indications of the quality of disaster management plans and procedures.
	Institutions	Indications of the quality of disaster management institutions.
Code II	Information Component	Represents <u>information</u> , and considers the extent to which information directed the action of the organizations within the system.
Sub-Codes	Needs	Indications of information needs of organizations in the system were met.
	Quality	Indications of the quality of information in the system.
	Availability	Indications of the availability of information in the system.
	Importance	Indications of the importance placed on information by organizations in the system.
	Search	Indications of information search and acquisition by organizations in the system.
	Acceptance	Indications that new information was accepted by organizations in the system.

Code III	Cultural Component	Represents <u>pattern matching</u>, and considers the extent to which organizations understood the risks they confronted as well as the ability solve problems using previous disaster management experiences.
Sub-Codes	Organizational Awareness	Indications that organizations were aware of the risk of disaster and its consequences.
	Experience	Indications that organizations had experience necessary to respond to disaster.
	Community	Indications that organizations worked in the interest of the affected community.
	Review	Indications that organizations were willing to review their actions.
	New Methods	Indications that organizations were willing to adopt new methods of problem solving.
	Trust	Indications that organizations trusted the decisions of others.
Code IV	Organizational Component	Represents <u>rapidity</u> and <u>adjustment</u> and considers the extent to which organizations had the operational plans, personnel, training, and resources to engage in adaptive and collaborative activities.
Sub-Codes	Operational Plans	Indications that organizations had plans necessary for adaptation and collaboration.
	Authority	Indications that organizations had the authority to adapt activities without approval.
	Personnel	Indications that organizations had personnel necessary for adaptation and collaboration.
	Training	Indications that organizations had training necessary for adaptation and collaboration.
	Resources	Indications that organizations had resources necessary for adaptation and collaboration.
	Mistake Correction	Indications that organizations corrected their mistakes.

Code V	Technological Component	Represents <u>technology</u>, and considers the nature of the technology used to conduct disaster operations, and whether the technology effectively supported the disaster management system.
Sub-Codes	Availability	Indications that technology was available for use by response organizations.
	Form	Indications of the form (high / medium / low tech) of technology used by organizations.
	Adaptability	Indications that organizations possessed technology that enabled them to adapt.
	Collaboration	Indication that technology facilitated collaboration by organizations in the system.
	Interoperability	Indications that the technology used was interoperable.
	Integration	Indications that technology was integrated in to a single decision support system.
Code VI	Interaction Component	Represents <u>interaction</u>, and considers the extent to which organizational interactions enabled the distribution of information, resources and personnel throughout the system.
Sub-Codes	Assistance	Indications that organizations provided to, or received assistance from, other organizations.
	Information	Indications that organizations exchanged information.
	Expertise	Indications that organizations exchanged scientific expertise.
	Resources	Indications that organizations exchanged resources.
	Personnel	Indications that organizations exchanged personnel.
	Evolution	Indications that the response system evolved over time.

APPENDIX F Indonesian Disasters: 1983 - 2003⁸

State Date	Location	Type	Total. Affected
00/03/1983	Lampung Province	Epidemic	-
3/4/1983	Banda Aceh (North Sumatra ...	Earthquake (seismic activity)	100
28/06/1983	Halmahera Island	Volcano	2500
00/07/1983	Banggai	Flood	2000
14/07/1983	Unauna Isl. (central Sula ...	Volcano	7101
9/9/1983	-	Volcano	6334
00/10/1983	Aceh, Sumatra	Flood	5000
00/12/1983	Java, Yogyakarta	Flood	410497
00/00/1983	-	Mass movement wet	-
10/1/1984	Mamuju (Central Sulawesi) ...	Earthquake (seismic activity)	89
27/04/1984	West Java	Flood	2700
25/05/1984	North Surawasi province	Volcano	6000
27/08/1984	Pahae Jae sub-district (N ...	Earthquake (seismic activity)	1858
5/9/1984	Siau Isl (North Sulawesi) ...	Volcano	17000
00/12/1984	Cilicap district (Central ...	Epidemic	4000
3/12/1984	Bandung Region (West Java ...	Flood	37500
3/2/1984	Central, East, West Java, ...	Flood	320000
15/06/1984	Dukuh, Srumbung, Sawangan ...	Volcano	5000
00/00/1984	Kyrim, Irian Jaya	Drought	2000
4/2/1985	Northern Sulawesi	Flood	300
00/02/1985	Bandung region	Storm	10000
19/02/1985	Central and East Java, Ea ...	Flood	2000
30/06/1985	West coast of Sumatra	Flood	2000
30/07/1985	Ntb Prov.	Volcano	1078
15/09/1985	Paniai District (Eastern ...	Earthquake (seismic activity)	7
1/1/1986	Sulawesi	Epidemic	500000
15/04/1986	West Java	Flood	38000
00/08/1986	West Sumatra	Epidemic	700
24/10/1986	Bengkulu, Lampung provinc ...	Flood	20000
16/01/1986	Timor province (Java)	Flood	19000
6/3/1986		Flood	50000
00/00/1986	Kurima (Irian Jaya)	Drought	1000
23/02/1987	Esatern Java	Flood	26000
26/04/1987	Tarutung (North Sumatra)	Earthquake (seismic activity)	15001
00/05/1987	Bengkulu (South Sumatra)	Flood	-
4/5/1987	Padang Panjang (West Suma ...	Mass movement dry	701
26/11/1987	South Pantar Isl.(Timor)	Earthquake (seismic activity)	17100
14/12/1987	West Sumatra	Flood	884

⁸ Source: "EM-DAT: The OFDA/CRED International Disaster Database www.emdat.be - Université Catholique de Louvain - Brussels - Belgium"

State Date	Location	Type	Total. Affected
25/12/1987	Esp. Polmas, Pinrang (Sul ...	Flood	-
28/12/1987	Flores Isl.	Volcano	13000
00/11/1987	Aceh province (North Suma ...	Flood	2000
00/00/1987	Java, Bali, Nusa Tenggara ...	Drought	-
6/2/1988	Java	Mass movement wet	-
9/5/1988	Moluccas	Volcano	10000
17/07/1988	Makian Isl.	Volcano	1570
20/12/1988	Central & West Java, Suma ...	Flood	100000
6/11/1988	Flores Isl.	Flood	-
16/01/1989	Solok, Sawahlunto Sijunju ...	Mass movement wet	11601
8/3/1989	Molucca passage	Earthquake (seismic activity)	5500
1/8/1989	Irian Jaya, Jayawijaya di ...	Earthquake (seismic activity)	17196
23/04/1989	Noongan	Volcano	3000
3/6/1989	Madiun Regency (East Java ...	Flood	29000
14/07/1989	Alor (Timor)	Earthquake (seismic activity)	197
20/06/1989	Ambon (Malucu Isl.)	Flood	32500
26/01/1990	Semarang, Temanggung, Bat ...	Flood	21000
10/2/1990	East Java	Volcano	10265
18/04/1990	Minahassa Peninsula (Sula ...	Earthquake (seismic activity)	7036
00/12/1990	Moluccan Isl.	Epidemic	-
15/11/1990	Bangkejeren, Kutacane, Me ...	Earthquake (seismic activity)	2172
6/7/1990	Kuningan, Majalenga, Sume ...	Earthquake (seismic activity)	103
4/4/1990	Bogor (Jakarta)	Flood	-
16/01/1991	Java	Mass movement wet	-
00/03/1991	Aceh province (North Suma ...	Epidemic	6000
20/06/1991	Gorontalo area (Minahassa ...	Earthquake (seismic activity)	1000
00/04/1991	Aceh province (North Suma ...	Epidemic	9000
4/7/1991	Kalabahi (Alors district, ...	Earthquake (seismic activity)	16191
1/8/1991	Borneo, Sumatra Isl., Kal ...	Wildfire	8
24/10/1991	Minahasa (Tomohon distric ...	Volcano	7679
6/6/1991	Kalimatan province	Flood	-
00/01/1991	-	Epidemic	-
15/01/1991	Java	Epidemic	-
00/08/1991	Sumatra Centrale	Epidemic	-
16/12/1991	Riau, Jambi, Lampung prov ...	Flood	240000
8/10/1992	Tasikmalaya, Ciamis, Garu ...	Mass movement wet	37000
12/12/1992	Sikka, East Flores, Ende, ...	Earthquake (seismic activity)	92103
4/2/1992	Brebes area (Java, Sulawe ...	Earthquake (seismic activity)	7501
00/08/1992	Trenggalek (East Java)	Flood	265553
2/2/1993	Northern coast from Indra ...	Flood	259553
21/01/1993	Maluku Province	Volcano	3012
25/01/1993	Sangir Talaud Island	Volcano	452
26/12/1993	Tangerang, Serang and Le ...	Flood	8000
21/01/1994	(1) Irian Jaya region(2) ...	Earthquake (seismic activity)	200040
16/02/1994	Liwa, Lampung Province (S ...	Earthquake (seismic activity)	49399
12/1/1994	City of Bandung (West Jav ...	Flood	30000
3/2/1994	Eastern Java	Volcano	2000
2/6/1994	Purwoharjo, Sarongan, Teg ...	Earthquake (seismic activity)	8720
23/04/1994	Simalungun District	Flood	1000
12/10/1994	Riau Province	Flood	60000
00/10/1994	-	Wildfire	3000000
9/10/1994	North Maluku (Obi Isl.)	Earthquake (seismic activity)	2437
3/11/1994	Lombok (West Nusa Tenggar ...	Volcano	-
22/11/1994	Java Isl.	Volcano	2722
23/03/1994	Ngawi, Tuban, Bojonegoro, ...	Flood	187131

State Date	Location	Type	Total. Affected
20/11/1994	Maluki, Irian Jaya, North ...	Earthquake (seismic activity)	67
2/12/1994	Pesisir Selatan (West Sum ...	Flood	640
12/7/1994	West Nusa Tenggara provin ...	Flood	50000
11/1/1995	Riau	Flood	3000
3/2/1995	Java, Sumatra	Flood	36000
1/5/1995	Tapanuli, Labuhan distric ...	Flood	17500
7/5/1995	Bengkulu (Northern Sumatr ...	Flood	2200
14/05/1995	Dili, Maliana, Mauraba (E ...	Earthquake (seismic activity)	176
19/05/1995	Parigi, Palu, Poso (Sulaw ...	Earthquake (seismic activity)	1538
7/10/1995	Airhangat, Danaukerinci, ...	Earthquake (seismic activity)	90218
28/12/1995	North Aceh Provinces	Flood	201472
1/1/1996	North of Palu (Sulawesi I ...	Earthquake (seismic activity)	13000
17/02/1996	Biak (Iran Jaya)	Earthquake (seismic activity)	25638
9/2/1996	Jakarta	Flood	556000
27/03/1996	SULu Musi district, Lahat ...	Flood	527
00/01/1996	Java Isl.	Epidemic	5373
3/10/1996	Batam Isl.	Mass movement wet	4
20/10/1996	Banyumas, Cilacap, Kebume ...	Flood	5007
13/12/1996	Piddie, Utara & Blora Dis ...	Flood	10000
00/01/1996	Jakarta	Flood	252965
17/01/1997	Boyolali, Klaten, Magelan ...	Volcano	3000
00/09/1997	Sumatra & Kalimantan	Wildfire	32070
28/09/1997	Parepare (city) Level 1 = ...	Earthquake (seismic activity)	3105
4/6/1997	Kalimatan	Epidemic	-
5/11/1997	Irian Jaya	Epidemic	-
00/09/1997	Irian Jaya Province	Drought	1065000
00/01/1998	Irian Java, Maluku	Epidemic	-
00/03/1998	Kalimatan Province (Borne ...	Wildfire	2000
13/05/1998	N.A. on the source	Epidemic	32665
11/7/1998	Jawa Tengah and Yogyakarta ...	Volcano	6000
2/8/1998	East Kalamatan = Kaliman ...	Flood	100000
29/11/1998	Halmahera Tengah (Sula Is ...	Earthquake (seismic activity)	6448
28/09/1998	Malang area (Jawa)	Earthquake (seismic activity)	500
5/1/1999	Sulawesi, Java	Flood	16000
7/1/1999	Bali Isl.	Mass movement wet	2
00/06/1999	Sumatra, Kalimantan	Wildfire	
2/3/1999	Flores Island, Level 1 = ...	Epidemic	267
00/03/1999	South central Timor, Tala ...	Epidemic	627
21/12/1999	Karyasari, Pandelang Dist ...	Earthquake (seismic activity)	16920
9/12/1999	Dberang Pallinggam (Sumat ...	Mass movement wet	-
00/00/1999	-	Epidemic	3751
22/02/2000	Brebes District (Java Isl ...	Mass movement wet	-
00/01/2000	Jakarta	Epidemic	1516
00/02/2000	Riau Province (East coast ...	Wildfire	
4/5/2000	Bangga, Totikum, Tinangk ...	Earthquake (seismic activity)	52770
16/05/2000	Malaka Tengah, Malaka Bar ...	Flood	50000
4/6/2000	Bengkulu province (Sumatr ...	Earthquake (seismic activity)	204714
00/05/2000	Ngada district (Flores Is ...	Epidemic	203
12/7/2000	Ciranggon (West Java Isl. ...	Earthquake (seismic activity)	4124
24/06/2000	Banngai	Mass movement wet	520
29/10/2000	Cilacap, Banyumas (Centra ...	Mass movement wet	56210
5/11/2000	Purworejo, Purbalingga, K ...	Mass movement wet	19
25/10/2000	Pandelang, Lebak, Serang	Earthquake (seismic activity)	5500
7/6/2000	Southern Sumatra	Earthquake (seismic activity)	3000
28/11/2000	Aceh, Riau, Jambi (Tanah ...	Flood	386021

State Date	Location	Type	Total. Affected
00/09/2000	Phetchabun	Flood	12500
3/12/2000	Bitung, Bolang Mongondow, ...	Flood	39852
8/2/2001	Cipinas, Lebak district (...	Mass movement wet	23000
22/01/2001	North Sulawesi province	Mass movement wet	
4/2/2001	Jember (East Java provinc ...	Flood	80000
31/07/2001	Nias Isl. (North Sumatra ...	Flood	3694
28/06/2001	Jawa Barat province	Earthquake (seismic activity)	12512
30/10/2001	Seling village (Sadang di ...	Mass movement wet	310
23/10/2001	Ayah district	Mass movement wet	600
14/02/2001	Bengkulu (Sumatra)	Earthquake (seismic activity)	
17/12/2001	Sentani (Papua province)	Flood	
28/12/2001	Sumatra Isl., Sulawesi pr ...	Flood	2000
8/1/2002	Dempo Utara (Southern Sum ...	Flood	40
10/1/2002	Alor, Manggarai, Sikka, B ...	Epidemic	757
13/01/2002	Medan city (Sumatra Isl.) ...	Flood	2000
27/01/2002	Bondowoso, Sampang, Surab ...	Flood	500750
27/03/2002	Gomo and Amandraya sub-di ...	Flood	780
17/04/2002	Sumba Isl. (East Nusa Ten ...	Flood	
00/05/2002	Kolaka district (Sulawesi ...	Flood	1000
15/08/2002	Poso region (Sulawesi)	Earthquake (seismic activity)	2548
00/08/2002	West, Central Kalimantan ...	Wildfire	200
10/10/2002	Manokwari, Ransiki, Orans ...	Earthquake (seismic activity)	9082
11/11/2002	Garut (near Bandoung, Jav ...	Volcano	5000
19/11/2002	South Aceh, Southwest Ace ...	Flood	87000
11/12/2002	Pacet (Java Isl.)	Mass movement wet	5
20/09/2002	Ransiki (Irian Jaya regio ...	Earthquake (seismic activity)	155
2/11/2002	Simeulue Isl.	Earthquake (seismic activity)	60
6/4/2003		Epidemic	2
00/01/2003	Java, Sulawesi islands	Flood	10000
8/1/2003	Batulayar village (West ...	Flood	230
29/01/2003	Garut, Nenggeng, Budi Ate ...	Mass movement wet	1760
31/01/2003	Cantilan village, Kuninga ...	Mass movement wet	20
10/1/2003	Solok, Kapai Tabu Karambi ...	Flood	3700
23/01/2003	Dompu area	Earthquake (seismic activity)	2502
28/01/2003	Cilacap district (Central ...	Flood	15000
13/02/2003	Jakarta area	Flood	33000
18/03/2003	Makale, Sa'dan Balusu are ...	Mass movement wet	
31/03/2003	Ende, Sikka, East Flores ...	Mass movement wet	229548
27/05/2003	Morotai Isl.	Earthquake (seismic activity)	247
11/8/2003	Wasile area (Halmahera Is ...	Earthquake (seismic activity)	500
2/11/2003	Hahorok sub-district (Lan ...	Flood	1498
30/11/2003	Muraro, Jambi, Tanjab Tim ...	Flood	25000
10/12/2003	Jambi, Riau, South and No ...	Flood	350000
00/08/2003	West Timor	Drought	15000

APPENDIX G Indonesian Pre-Tsunami Disaster Legislation

Act No. 6 / 1974 on the Basic Arrangement of Social Welfare: indicates the provision of assistance to Indonesians by the government when their social lives are affected by social and natural disasters (Siahaan 2006). The regulation also called for the Indonesian government to develop social assistance and social insurance programs that would help to rehabilitate disaster affected populations.

Act No. 4 / 1984 on Epidemics: indicates that social disease can overwhelm communities and create the potential for disasters. The Act identified the Ministry of Health as a lead institution, which has the authorization to issue and cancel declarations of epidemics. The Act also identified a variety of responsibilities for the organizations involved in epidemic activities, including but not limited to: 1) investigation; 2) examination and quarantine; 3) prevention and immunization, 4) management of corpses and 5) disease training and education (Siahaan 2006).

Act No. 5 / 1990 on the Conservation of Biological Natural Resources and Ecosystems: indicates that it is the government's responsibility to protect Indonesia's natural resources and ecosystems from the potential of disaster. The Act also indicates that the government shall take steps to rehabilitate areas that are damaged as a result of natural events such as landslides, erosion, forest fires and earthquakes, or man-made events caused by misuse (Siahaan 2006).

Act No. 23 / 1992 on Health: indicates that Indonesians are entitled by right to their health, which ensures economic and social prosperity. The Act states that both the Indonesian government and its various communities have the general responsibility to maintain and improve health conditions. The act also indicates that it the responsibility of the Government to “regulate, promote and supervise the implementation” of health related activities (Siahaan 2006).

Act No. 24 / 1992 on Spatial Planning: indicates that Indonesia acknowledges that is national security and prosperity depends upon the effective and efficient use of its resources and social resources. In terms of disaster management, the act identifies a range of areas worthy of spatial protection, including “protected forests, turf areas, water conservation area, costal area, river area, areas around a lake/dam, spring, conservation areas on nature, natural park, national park, national forest and nature park for tourist attraction, cultural and science park, and area prone to natural disaster” (Siahaan 2006).

Act No. 23 / 1997 on Environmental Management: indicates that it is the Indonesian government's responsibility to protect and preserve the environment through regulations that include, but are not limited to, the issuance of licenses. In the event that a disaster occurs, the Act indicates that individuals and organizations that possess a license are entitled to financial compensation, or immunity from legal damages, if the environmental destruction in their area of responsibility was caused by the disaster (Siahaan 2006).

Act No. 22 / 2001 on Oil and Gas: does not directly affect issues of disaster management, however, it does indicate that businesses are obligated to prevent pollution and restore any environmental damages they cause (Siahaan 2006).

Act No. 2 / 2002 on Police Institution: indicates that the Indonesian Police have the responsibility to maintain public security, enforce the law, and protect the safety of the community. In terms of disaster management, the Indonesian Police are responsible for protecting the public from disaster, and their specific responsibilities includes search and rescue activities and the delivery of assistance until other institutions can recommence their normal functions (Siahaan 2006).

Act No. 3 / 2002 on State Defense: this Act does not directly affect issues of disaster management, however, it identifies that state defense is a primary function of the Indonesian government. As such, it is the responsibility of both the government and the citizens to defend the nation from internal and external threats, which includes natural and man-made disasters (Siahaan 2006).

APPENDIX H Organizations in Core Administrative System

<u>Number</u>	<u>Organization Name</u>	<u>Acronym</u>	<u>Jurisdiction</u>	<u>Source of Funding</u>
122604_002	Badan Meteorologi Dan Geofisika	bmng	National	Public
122604_003	Presiden Republik Indonesia	pri	National	Public
122604_004	Kabinet Indonesia Bersatu	kib	National	Public
122604_005	Situs Resmi Kementerian Koordinator Bidang Kesejahteraan Rakyat	mekokesra	National	Public
122604_006	Tentara Nasional Indonesia	tni	National	Public
122604_007	Kepolisian Negara Republik Indonesia	polri	National	Public
122604_009	Government of Malaysia	govmy	International	Public
122604_011	Ministry of Trade, Id	mtradid	National	Public
122604_012	Ministry of Health, Id	mhealid	National	Public
122604_013	Government of Aceh Province	govaceh	Provincial	Public
122604_014	Government of North Sumatra Province	govnsum	Provincial	Public
122604_015	Provincial Police of Aceh	achppol	Provincial	Public
122604_016	Cut Meutia Hospital (Lhokseumawe Aceh)	cmghosp	Local	Public
122604_020	PT Angkasa Pura II	persero	National	Public
122604_021	Sultan Iskandar Muda / Blang Bintang (Banda Aceh) Airport	simapt	Local	Public
122604_022	Office of the Governor of Aceh Province	ogap	Provincial	Public
122604_023	Suara Muhammadiyah Radio	muhamrad	Local	Non-Profit
122604_024	Prima FM	primfm	Local	Private
122604_025	Dalka Radio	dalrad	Local	Private
122604_026	Megaphone Radio	megrad	Local	Private
122604_027	Banda Aceh Hospital for the Mentally Ill	bahospmi	Local	Public
122604_029	International Organization for Migration	iom	International	Non-Profit
122604_030	Gorilla 3 Military Post	gor3mp	Local	Public
122604_031	Afrika 6 Marine Post	af6mp	Local	Public
122604_032	Afrika 1 Marine Post	af1mp	Local	Public
122604_033	United Nations Office for the Coordination of Humanitarian Affairs for Indonesia	unochaid	International	Public
122604_034	Palang Merah Indonesia	pmi	National	Non-Profit
122604_035	World Health Organization, Id	whoid	International	Public
122604_036	United Nations Children's Fund	unicef	International	Public
122704_001	Vice-Presiden Republik Indonesia	ovpid	National	Public
122704_002	National Disaster Management Coordination Board, Id	bakornas	National	Public
122704_003	City of Lhokseumawe	ctylho	Local	Public
122704_004	Ministry of Finance, Id	mfinid	National	Public
122704_005	Free Aceh Movement (GAM)	gam	Provincial	Special Interest
122704_006	Ministry of Public Works, Id	mpwid	National	Public
122704_007	City of Banda Aceh	ctybanda	Local	Public

<u>Number</u>	<u>Organization Name</u>	<u>Acronym</u>	<u>Jurisdiction</u>	<u>Source of Funding</u>
122704_008	United Nations	un	International	Public
122704_009	Government of Japan	govjap	International	Public
122704_010	Government of Taiwan	govtai	International	Public
122704_011	Government of the United States	govus	International	Public
122704_012	Government of Australia	govaul	International	Public
122704_013	Government of Indonesia	govid	National	Public
122704_014	Australian Red Cross	ausrcros	International	Non-Profit
122704_015	Halim Perdanakusumh Military Air Base (Jakarta)	hpmair	National	Public
122704_016	Ministry of Social Affairs, Id	msaid	National	Public
122704_019	Government of Spain	govsp	International	Public
122704_020	Government of India	govin	International	Public
122704_023	United Nations Mission to Indonesia	unind	International	Public
122704_024	Ministry of Defense, Australia	middifaust	International	Public
122704_025	Air Force, Australia	afaus	International	Public
122704_026	Free Aceh Movement (Central Command)	gamcc	International	Special Interest
122704_027	Iskandar Muda Military Command	immc	National	Public
122704_031	Dompot Dhuaga Republika Foundation	ddrf	National	Non-Profit
122704_032	Medical Emergency Rescue Committee	merc	International	Non-Profit
122704_033	Red Cross - West Aceh Branch	rcwab	Local	Non-Profit
122704_034	Doctors without Borders - Indonesia Mission	msfid	International	Non-Profit
122704_035	Bali Hotel Association	bha	Provincial	Non-Profit
122704_036	PT Toh Jiwa Cargo	tjc	National	Private
122704_037	Bintang Supermarket	bintsup	International	Private
122704_038	Sourcing Bali	sbali	National	Private
122704_039	Dijon Food Specialties	dfs	Local	Private
122704_040	Ombak Putih	ombak	National	Private
122704_041	Air Force, Indonesia	afind	National	Public
122704_042	Indonesian Red Cross - Jakarta Chapter	idrcrosjc	Provincial	Non-Profit
122704_043	Lippo Bank Slipi Branch	lbsb	Local	Private
122704_044	Office of the Prime Minister of Japan	opmjap	International	Public
122704_045	PT Pasifik Satelit Nusantara	ptpsn	National	Private
122704_047	United Nations Office of the Resident Coordinator for Indonesia	unorci	International	Public
122704_048	United Nations Development Program	undp	International	Public
122704_049	United Nations Country Team - Indonesia	uncti	International	Public
122704_050	Health Office of the Province of North Sumatra	hopns	Provincial	Public
122704_051	United Nations Disaster Assessment and Coordination Team	undac	International	Public
122704_052	Office of the Coordination of Humanitarian Affairs, United Nations	ochaun	International	Public
122704_053	European Union	eu	International	Public
122704_054	Government of the United Kingdom	govuk	International	Public
122704_055	Government of Denmark	govden	International	Public
122704_058	Government of Saudia Arabia	govsa	International	Public
122704_059	Government of Norway	govnor	International	Public
122704_060	Government of Canada	govcan	International	Public
122704_061	Government of New Zealand	govnz	International	Public
122704_063	Government of Germany	govger	International	Public
122704_064	Government of the Netherlands	dutch	International	Public
122704_065	Government of China	govchin	International	Public
122704_066	Government of the United Arab Emirates	govuae	International	Public
122704_069	Government of Singapore	govsing	International	Public

Number	Organization Name	Acronym	Jurisdiction	Source of Funding
122704_075	Government of Greece	govgre	International	Public
122704_076	Government of France	govfra	International	Public
122704_077	Government of Egypt	govegypt	International	Public
122704_079	Regency of East Aceh	regea	Local	Public
122704_080	City of Bireun	ctybir	Local	Public
122704_081	District of Pidie	distpid	Local	Public
122704_082	District of North Aceh	distna	Local	Public
122704_083	Regency of Nagan Raya	regnr	Local	Public
122704_084	Regency of Krueng Mane	regkm	Local	Public
122704_085	District of Nias	distni	Local	Public
122704_086	District of Serdang Bedagai	distsb	Local	Public
122704_087	District of Tapanuli Tengah	disttt	Local	Public
122704_088	Adam Malik Hospital	amhosp	Local	Public
122704_089	International Federation of the Red Cross and Red Crescent	ifrc	International	Non-Profit
122704_090	Indonesian Red Cross Hospital (Lhoksemawe)	irdcshosp	Local	Non-Profit
122704_091	Dr. Fauziah General Hospital	dfghosp	Local	Public
122704_092	Melati Perbaungan Hospital	mphosp	Local	Public
122704_093	Langsa Hospital	lanhosp	Local	Public
122704_094	Bireun Hospital	birhosp	Local	Public
122704_095	Aceh Timur Hospital	athosp	Local	Public
122704_096	Simuelue Hospital	simhosp	Local	Public
122704_097	Village of Kuala	kuvil	Local	Public
122704_098	District of Aceh Utara	distau	Local	Public
122704_099	Medan Polonia Airport	mpapt	Local	Public
122704_100	Center for Health Emergency Preparedness and Response	chepr	National	Public
122704_101	Jakarta Health Agency	jakha	Provincial	Public
122704_102	Government of South Sumatra Province	govssp	Provincial	Public
122704_103	Hasan Sadikin Hospital (West Java)	hshosp	Local	Public
122704_104	Dr. Soetomo Hospital (East Java)	soehosp	Local	Public
122704_105	Sardjito General Hospital	sarhosp	Local	Public
122704_106	South Sulawesi Hospital	sshosp	Local	Public
122704_107	City of Medan	ctymed	Local	Public
122704_108	World Health Organization	who	International	Public
122704_109	World Health Organization, Id - Banda Aceh Field Office	whoidba	International	Public
122704_110	Department of Health, Aceh Province	dohap	Provincial	Public
122704_111	World Health Organization - South East Asian Regional Office	whosearo	International	Public
122704_112	Office of the United Nations Security Coordinator	unsecoord	International	Public
122704_113	Ministry of Health POSKO	posko	National	Public
122804_001	Cut Mutia Hospital Victim Camp	cmhospc	Local	Public
122804_002	Cut Mutia Emergency Command Post	cmecp	Local	Public
122804_003	Regency of North Aceh	regna	Local	Public
122804_004	Office of the Governor of North Sumatra	ogns	Provincial	Public
122804_005	Navy of Indonesia	navid	National	Public
122804_009	City of Meulaboh	ctymeu	Local	Public
122804_011	Ministry of Fisheries and Maritime, Id	mfmid	National	Public
122804_012	Bank Indonesia	bkid	National	Public
122804_013	Office of the Coordinating Minister for the Economy, Id	ocmpeid	National	Public
122804_021	Gadjah Mada University	gmu	Provincial	Public

Number	Organization Name	Acronym	Jurisdiction	Source of Funding
122804_022	Ministry of Justice and Human Rights, Id	mjhrid	National	Public
122804_027	Garuda Indonesia	gar	National	Private
122804_028	Jatayu	jatayu	National	Private
122804_031	European Union Monitoring and Information Center	eumic	International	Public
122804_032	Embassy of the United States, Jakarta	embus	International	Public
122804_033	Department of International Development, UK	diduk	International	Public
122804_034	Ministry of Foreign Affairs, Id	mfaid	National	Public
122804_037	Embassy of the People's Republic of China, Jakarta	emchina	International	Public
122804_039	Office of the Prime Minister of the People's Republic of China	opmchina	International	Public
122804_042	Asian Development Bank	adb	International	Public
122804_043	World Bank	wb	International	Public
122804_044	Ministry of Energy and Mineral Resources, Id	memrid	National	Public
122804_045	PT Pertamina	ptper	National	Public
122804_046	PT Perusahaan Listrik Negara	ptpln	National	Public
122804_047	PT Telekom	pttel	National	Private
122804_049	Aceh-North Sumatra Natural Disaster Relief Agency	asndra	Provincial	Public
122804_050	Polonia Air Force Base (Medan)	paftb	Local	Public
122804_051	Office of Social Welfare Government of North Sumatra	ohgns	Provincial	Public
122804_052	Pirngadi General Hospital	pirhosp	Local	Public
122804_053	Brimob Hospital	brihosp	Local	Public
122804_054	Poldasu Hospital	polhosp	Local	Public
122804_055	Soekarno-Hatta Jakarta International Airport	shiapt	Local	Public
122804_056	Harapan Bunda Hospital	habunhosp	Local	Private
122804_057	Tjoet Njak Dien Public Kitchen	tndpk	Local	Non-Profit
122804_058	Ministry of Defense, Singapore	mdsing	International	Public
122804_059	Ministry of Defense, Id	mdid	National	Public
122804_060	Armed Forces of Singapore	milsing	International	Public
122804_063	Army of Indonesia	armyind	National	Public
122804_064	United Nations World Food Program	unwfp	International	Public
122804_065	Medan Command Post	medcp	Local	Public
122804_066	Association of Medical Doctors of Asia	amda	International	Non-Profit
122804_067	Association of Medical Doctors of Asia - Indonesia Chapter	amdaid	National	Non-Profit
122804_069	Kesdam Hospital	keshosp	Local	Public
122904_001	Indonesian House of Representatives	idhr	National	Public
122904_012	Lion Air	lion	National	Private
122904_016	University of Indonesia	uniid	National	Public
122904_018	Rumah Sakit (Aceh) Zainoel Abidin General Hospital	zbgh	Local	Public
122904_022	Office of the Governor of Jakarta	ogj	Provincial	Public
122904_027	Government of Jakarta Province	govjak	Provincial	Public
122904_028	Indonesian Association of Provincial Administrations	iapa	Provincial	Non-Profit
122904_029	Bank DKI	bankdki	Provincial	Public
122904_031	International Monetary Fund	imf	International	Public
122904_032	Office of the President of the United States	podus	International	Public
122904_036	Serambi Indonesia Lhokseumawe Office	serlo	Local	Private
122904_037	United Nations Population Fund	unpf	International	Public
122904_038	United Nations World Food Program, Banda Aceh Field Office	unwfpba	International	Public
122904_039	United Nations World Food Program, Loeksemawe Field Office	unwfppl	International	Public
122904_040	United Nations World Food Program, Sigli Field Office	unwfps	International	Public

Number	Organization Name	Acronym	Jurisdiction	Source of Funding
122904_041	United Nations World Food Program, Medan Field Office	unwfp	International	Public
122904_042	International Organization for Migration, Aceh Office	ioma	International	Non-Profit
122904_043	United Nations Food and Agriculture Organization	unfao	International	Public
122904_046	Navy of the United States	navus	International	Public
122904_047	CARE	care	International	Non-Profit
122904_048	Navy of Japan	navjap	International	Public
122904_049	Navy of Australia	navaus	International	Public
122904_050	Doctors without Borders	msf	International	Non-Profit
122904_051	International Medical Corps	imc	International	Non-Profit
122904_053	United States Agency for International Development	usaid	International	Public
122904_054	Canadian International Development Agency	cida	International	Public
122904_057	United Nations Information Center	unic	International	Public
122904_058	Yayasan OBOR	obor	National	Non-Profit
122904_059	Indonesian Tionghoa Association	inti	National	Non-Profit
122904_062	Japan International Cooperation Agency	jica	International	Public
122904_063	Peace Winds Japan	pwj	International	Non-Profit
122904_065	International Committee of the Red Cross	ircro	International	Non-Profit
122904_066	Ministry of Transportation, Id	mtranid	National	Public
123004_005	Muhammadiyah	muham	National	Non-Profit
123004_009	Office of the Governor of West Nusa Tenggara	ogwnt	Provincial	Public
123004_010	Indonesian Red Crescent	bsmi	National	Non-Profit
123004_012	Partai Keadilan Sejahtera (Justice and Prosperous Party)	pks	National	Special Interest
123004_016	Disaster Mitigation Command Center of North Aceh Regency	nadmcc	Local	Public
123004_018	Ministry of Culture and Tourism, Id	mctid	National	Public
123004_025	Indonesia Science Institute	idsi	National	Public
123004_027	Office of the Secretary General of the United Nations	osgun	International	Public
123004_029	Red Cross - South Aceh Branch	rcsab	Local	Non-Profit
123004_030	Aceh Kita	akita	National	Non-Profit
123004_031	United Nations Joint Logistics Center - National	unjlc	International	Public
123004_032	United Nations Joint Logistics Center - Banda Aceh	unjlcba	International	Public
123004_033	United Nations Food and Agriculture Organization - Indonesia Office	unfaoid	International	Public
123004_034	Utapao (Thailand) Air Base	utapao	International	Public
123004_036	Military of Australia	milau	International	Public
123004_038	Military of the United States	milus	International	Public
123004_039	Military of Malaysia	milma	International	Public
123004_040	United States Air Force	usaf	International	Public
123004_041	New Zealand Air Force	nzaf	International	Public
123004_042	Navy of Singapore	navsing	International	Public
123004_044	Navy of India	navind	International	Public
123004_045	United Nations Joint Logistics Center - Regional	unjlr	International	Public
123004_046	Government of Chile	govchile	International	Public
123004_051	Government of Mexico	govmex	International	Public
123004_052	Government of Tunisia	govtun	International	Public
123004_053	Government of Jordan	govjor	International	Public
123004_054	Office of United States Foreign Disaster Assistance	usfda	International	Public
123004_056	District of Aceh Jaya	distaj	Local	Public
123004_060	Calang Hospital	calhosp	Local	Public
123004_061	Pringadi Hospital	prihosp	Local	Public

<u>Number</u>	<u>Organization Name</u>	<u>Acronym</u>	<u>Jurisdiction</u>	<u>Source of Funding</u>
123004_062	Sari Mutiara Hospital	samhosp	Local	Public
123004_063	Elisabeth Hospital	elishosp	Local	Public
123004_066	Office of the Directorate General of Communicable Disease Control and Environmental Health	odgedch	National	Public
123004_067	Cipto Magunkusumo General Hospital	cimghosp	Local	Public
123004_068	Health Office of the Province of Bangka Belitung	hopbb	Provincial	Public
123004_069	Singapore and Australia Field Hospital	safhosp	Local	Public
123004_070	Blang Bintang Airport Field Hospital	bbaafhosp	Local	Public
123004_071	District Military Health Team Field Hospital	dmtfhosp	Local	Public
123004_072	City of Makassar	ctymak	Local	Public
123004_073	University of North Sumatra	unins	Local	Public
123004_074	Sigli Military Field Hospital	smfhosp	Local	Public
123004_075	Meulaboh Military Field Hospital	mmfhosp	Local	Public
123004_076	Health Department South Sumatra Province	hdssp	Provincial	Public
123004_077	Aceh Timur Field Hospital	atfhosp	Local	Public
123004_079	Islam Siti Fakinah Hospital	sfhosp	Local	Private
123004_080	Kontras Aceh	kont	National	Non-Profit
123004_081	Walubi	walubi	National	Non-Profit
123004_083	Japanese Red Cross	jrc	International	Non-Profit
123004_084	Singapore Red Cross	singrc	International	Public
123004_085	Malaysian Red Cross	malrc	International	Non-Profit
123004_086	Taiwanese Red Cross	tairc	International	Non-Profit
123104_002	Office of the Prosecutor, Aceh Province	nadpo	Provincial	Public
123104_003	Office of the Prosecutor, Nias Regency	opnr	Local	Public
123104_004	Office of the Attorney General, Id	oagid	National	Public
123104_005	Danish Red Cross	drc	International	Non-Profit
123104_006	Continental Airlines	conair	International	Private
123104_007	Aerowisata Catering Services	acs	National	Private
123104_009	United Nations Office of the Special Coordinator for the Tsunami Relief Effort	unsctre	International	Public
123104_010	International Humanitarian Partnership	ihp	International	Non-Profit
123104_011	United Nations Education, Scientific and Cultural Organization	unesco	International	Public
123104_012	Ministry of Education, Id	meid	National	Public
123104_013	On-Site Operation Coordination Center - Jakarta	osoccj	International	Public
123104_014	On-Site Operation Coordination Center - Banda Aceh	osocbba	International	Public
123104_015	Wahli	wahli	National	Non-Profit
123104_016	United Nations High Commissioner for Refugees	unhcr	International	Public
123104_017	Jesuit Relief Services	jrs	International	Non-Profit
123104_018	Mercy Corps International	mercy	International	Non-Profit
123104_019	World Vision of Indonesia	wvid	International	Non-Profit
123104_020	Meulaboh Airport	meulapt	Local	Public
123104_021	United Nations Disaster Assessment and Coordination Team - Banda Aceh	undacba	International	Public
123104_022	United Nations Disaster Assessment and Coordination Team - Jakarta	undacj	International	Public
123104_025	Haji Hospital (Medan)	hajhosp	Local	Public
123104_026	Rumkit Hospital	rumhosp	Local	Public
123104_027	Pertamina Hospital (Jakarta)	perthosp	Local	Private
123104_028	Health Office of the Province of Dinas Kesehatan	hopdk	Provincial	Public
010105_003	Office of the Prime Minister of Australia	opmaus	International	Public
010105_004	Department of State, United States	dosus	International	Public

Number	Organization Name	Acronym	Jurisdiction	Source of Funding
010105_007	Ministry of National Development and Planning, Id	bappenas	National	Public
010105_008	Embassy of Japan, Jakarta	embjapan	International	Public
010105_009	Embassy of the United Kingdom, Jakarta	embuk	International	Public
010105_010	United Nations Field Office in Banda Aceh	unfoba	International	Public
010105_011	Iskandar Muda Air Force Base	imaftp	Local	Public
010105_012	Aceh Sepakat Foundation	asf	National	Non-Profit
010105_013	Jl. Binjai Evacuation Center, Medan	jlbec	Local	Public
010105_014	Australian Agency for International Development	ausaid	International	Public
010105_015	Malaysian Air Force	malaf	International	Public
010105_019	Air Force of the United Kingdom	afuk	International	Public
010105_020	Navy of France	navfra	International	Public
010105_021	Air Force of Switzerland	afswitz	International	Public
010105_022	Apple Air	apair	International	Private
010105_023	Tanjung Priok Port (Jakarta)	tpp	Local	Public
010105_024	Indonesian Society of Paediatricians	isp	National	Non-Profit
010105_025	Puskesmas Health Center	phc	Local	Public
010105_026	Yogyakarta Harbor	yoghar	Local	Public
010105_027	Nya Dien Airport (Meulaboh)	ndapt	Local	Public
010105_028	Government of Morocco	govmor	International	Public
010105_029	TNT Express World Wide	tnt	International	Private
010105_030	Lapangan Bola Hospital	lbhosp	Local	Public
010205_001	PT Aceh Media Grafika	ptamg	National	Private
010205_002	Kompas Gramedia Group	kkg	National	Private
010205_003	Indonesian Democratic Party of Struggle	pdi-p	National	Special Interest
010205_004	Tjut Nyak Dhien Airport	tndapt	Local	Public
010205_005	Sub-District of Johan Pahlawan Command Center	jpec	Local	Public
010205_006	Embassy of Canada, Jakarta	emcan	International	Public
010205_008	Embassy of India, Jakarta	empind	International	Public
010205_009	Embassy of Pakistan, Jakarta	empak	International	Public
010205_010	Government of Pakistan	govpak	International	Public
010205_011	Navy of Pakistan	navpak	International	Public
010205_014	Embassy of Singapore, Jakarta	embsing	International	Public
010205_015	Embassy of Morocco, Jakarta	embmor	International	Public
010205_016	Embassy of Chile, Jakarta	embchil	International	Public
010205_017	Embassy of Egypt, Jakarta	embegy	International	Public
010205_020	Alcatel Indonesia	alcatel	National	Private
010205_024	Baiturrahman Grand Mosque	baitmos	Local	Non-Profit
010205_025	Government of Papua Province	gpp	Provincial	Public
010205_026	Mission Aviation Fellowship	maf	International	Non-Profit
010205_027	Sentani Airport (Jayapura)	senapt	Local	Public
010205_028	Oxford Committee for Famine Relief	oxfam	International	Non-Profit
010205_030	Ericsson	erics	International	Private
010205_031	Indonesian Red Cross National Special Disaster Response Team	idrcnsdrt	National	Non-Profit
010205_032	Subang Airport (Malaysia)	subapt	International	Public
010205_033	Kangkawi International Airport (Malaysia)	kangapt	International	Public
010205_034	Army of Australia	armyaus	International	Public
010205_035	United Kingdom Red Cross	ukrc	International	Public
010205_036	Spanish Red Cross	sprc	International	Public

Number	Organization Name	Acronym	Jurisdiction	Source of Funding
010205_037	Iceland Red Cross	icerc	International	Public
010205_039	Military of India	milind	International	Public
010205_040	Military of Germany	milger	International	Public
010205_041	Military (Self-Defense Forces) of Japanese	miljapan	International	Public
010205_042	Office of the Prime Minister of Malaysia	opmmal	International	Public
010205_043	Organization of the Islamic Conference	oic	International	Non-Profit
010205_045	Medical Emergency Relief, International	merlin	International	Non-Profit
010205_047	Meulaboh General Hospital	mghosp	Local	Public
010205_048	Sigli Hospital	sighosp	Local	Public
010205_049	Air Force of Singapore	afsing	International	Public
010205_050	Save the Children - United Kingdom	stc	International	Non-Profit
010205_051	Star Air	star	National	Private
010205_052	United Nations Disaster Management Team - Indonesia	undmpt	International	Public
010305_004	Office of the Prime Minister of Singapore	opmsing	International	Public
010305_008	Office of the Prime Minister of South Korea	opmsk	International	Public
010305_009	Jakarta Provincial Police	jakpol	Provincial	Public
010305_010	Balai Sidang Jakarta Convention Center	jcc	Provincial	Public
010305_013	Paris Club	paris	International	Public
010305_014	World Bank Consultative Group on Indonesia	wbcgid	International	Public
010305_015	Jakarta Public Works Agency	jpwa	Provincial	Public
010305_016	Jakarta Office for Development Affairs	joda	Provincial	Public
010305_017	Office of the Governor of Gorontalo Province	govgp	Provincial	Public
010305_018	Office of the Governor of Southeast Sulawesi Province	ogssp	Provincial	Public
010305_019	Office of the Governor of West Kalimantan Province	govwkp	Provincial	Public
010305_021	Agency for the Assessment and Application of Technology	bppt	National	Public
010305_022	Embassy of Sweden, Jakarta	embswe	International	Public
010305_023	Embassy of France, Jakarta	embfra	International	Public
010305_025	Embassy of Tunisia, Jakarta	embtun	International	Public
010305_026	Embassy of Jordan, Jakarta	embjor	International	Public
010305_029	Greenpeace	gp	International	Non-Profit
010305_035	Office of the Former President of the United States George H. W. Bush	fpodus1	International	Non-Profit
010305_036	Office of the Former President of the United States William Jefferson Clinton	fpodus2	International	Non-Profit
010305_037	Embassy of the Republic of Indonesia, Washington D.C.	embreindo	International	Public
010305_039	Erricson Relief	ericsrel	International	Non-Profit
010305_045	Iskandar Muda Military (Aceh) Hospital	imhosp	Local	Public
010305_046	Martha Friska Hospital	mfhosp	Local	Private
010305_047	Herna Hospital	herhosp	Local	Private
010305_048	Gleneagles Hospital	gehosp	Local	Private
010305_049	Lantamal TNI Hospital	ltnihosp	Local	Public
010305_050	Malahayati Islamic Hospital	malhosp	Local	Private
010305_052	Field Hospital in Aceh Besar (China)	fhabhosp	Local	Public
010305_053	Indonesian Humanitarian Emergency Commission	hec	National	Public
010305_055	World Vision International	wvi	International	Non-Profit
010305_056	Medical Assistance Programs	map	International	Non-Profit
010305_057	Terre des Hommes Netherlands	tdh	International	Non-Profit
010305_058	Port of Belawan (Medan)	ptbel	Local	Public
010405_001	Pt Excelcomindo Pratama	excel	National	Private

Number	Organization Name	Acronym	Jurisdiction	Source of Funding
010405_010	Coalition of Non-Governmental Organizations for Tsunami Victims	cngotv	International	Non-Profit
010405_011	Association of Private Jakarta Hospitals	apjhosp	Provincial	Non-Profit
010405_014	AIG Lippo Indonesia	aiglip	National	Private
010405_015	Office of the Insurance Directorate of the Ministry of Finance, Id	oidmif	National	Public
010405_017	House of Representative Team for the Supervision of the Distribution of Humanitarian Aid	tsdha	National	Public
010405_018	Syah Kuala State University (unsyah)	sksu	Local	Public
010405_019	Bogor Institute of Agriculture	ipb	Local	Public
010405_025	Office of the Prime Minister of Myanmar	opmmaya	International	Public
010405_035	National Sports Council	koni	National	Non-Profit
010405_036	National Sports Council Aceh Chapter	nscac	Provincial	Non-Profit
010405_038	Embassy of Switzerland, Jakarta	embswi	International	Public
010405_039	Government of Switzerland	govswi	International	Public
010405_040	Embassy of Spain, Jakarta	embSpain	International	Public
010405_041	Embassy of Portugal, Jakarta	embpor	International	Public
010405_042	Government of Portugal	govpor	International	Public
010405_045	Social Welfare Agency of North Aceh Province	naswa	Provincial	Public
010405_046	Santa Fe Relocations	sfr	International	Private
010405_047	Indonesia Peduli	idped	National	Non-Profit
010405_048	Exxon Mobile	exxon	International	Private
010405_049	Unilever	unil	International	Private
010405_050	Asia Pulp and Paper / Sinar Mas Group	appsmg	International	Private
010405_051	General Electric	ge	International	Private
010405_052	British American Tobacco	bat	International	Private
010405_053	World Wide Movers	wwm	International	Private
010405_054	Ache Humanitarian Committee	hca	Provincial	Non-Profit
010405_059	Ministry of the Environment, Id	minenvid	National	Public
010405_061	National Disaster Management Center, Id	ndmc	National	Public
010405_063	Government of Estonia	govest	International	Public
010405_064	Air Force of Norway	afnor	International	Public
010405_065	Norway Red Cross	norrc	International	Public
010405_066	United Nations World Food Program Bangkok Logistics Center	unwfpblc	International	Public
010405_067	United Nations Environment Program	unep	International	Public
010405_069	Tzu Chi Foundation	tzu	International	Non-Profit
010505_004	Ministry of Public Housing, Id	mphid	National	Public
010505_005	Office of State Minister of Cooperatives and Small and Medium Enterprises, Id	osmcsmc	National	Public
010505_006	United Nations Operations Coordination Center in Banda Aceh	unocbca	International	Public
010505_007	Indonesian Supreme Court	idsc	National	Public
010505_009	Indonesian Office of the Attorney General	idoag	National	Public
010505_010	Navy of South Korea	navsk	International	Public
010505_012	Merpati Nusantara Airlines	mnair	National	Private
010505_019	Ujong Batee Refugee Camp	ubrc	Local	Public
010505_021	National Commission for Child Protection, Id	nccp	National	Public
010505_023	Port of Banda Aceh	ptba	Local	Public
010505_024	Port of Meulaboh	ptmeul	Local	Public
010505_025	Port of Sabang (Weh Island)	ptsab	Local	Public
010505_026	Port of Lhoknga	ptlho	Local	Public
010505_027	Port of Lhokseumawa (East Aceh Province)	ptlhok	Local	Public
010505_028	Disaster Resource Network	drn	International	Non-Profit

<u>Number</u>	<u>Organization Name</u>	<u>Acronym</u>	<u>Jurisdiction</u>	<u>Source of Funding</u>
010505_029	Singapore Airport	singapt	International	Public
010505_030	Hilfe zur Selbsthilfe e. V.	help	International	Non-Profit
010505_031	Indonesian Forum for the Environment	walhi	National	Non-Profit
010505_033	Association of Medical Doctors of Asia - Japan	amdajap	International	Non-Profit
010505_034	Association of Medical Doctors - Cambodia	amdac	International	Non-Profit
010505_035	Association of Medical Doctors - Formosa	amaf	International	Non-Profit
010505_036	Sibolga Airport	sibapt	Local	Public
010505_039	Cut Nyak Dhien Hospital (Meulaboh)	cndhosp	Local	Public
010505_040	Meuraksa Hospital	meuhosp	Local	Public
010505_041	Lhok Nga Health Education Center	lhhec	Local	Public
010505_042	Boehringer Ingelheim	boeh	International	Private
010505_043	PT Bio Farma	bio	National	Public
010505_044	Indonesian Doctor's Association	ida	National	Non-Profit
010505_045	City of Dit Kesad	ctydk	Local	Public
010505_046	Batam Hospital	bathosp	Local	Private
010505_047	Merpati Airlines	merpati	National	Public
010605_003	City of Batam	ctybat	Local	Public
010605_004	Sekupang Transit House	sth	Local	Public
010605_007	Malasian Military	milmalis	International	Public
010605_025	Ministry of Home Affaris, Id	mhaid	National	Public
010605_026	Kantor Berita Radio 68H	kbr68	Local	Private
010605_027	Media Development Loan Fund	mdlf	International	Non-Profit
010605_029	Butterworth Military Airport (Malaysia)	bmapt	International	Public
010605_030	British Airways	briair	International	Private
010605_032	Civil Military Aid Committee	cmac	National	Public
010605_035	Médecins du Monde	mdm	International	Non-Profit
010605_036	International Catholic Migration Commission	icmc	International	Non-Profit
010605_037	International Relief and Development	ird	International	Non-Profit
010605_038	Cap Anamur	capana	International	Non-Profit
010605_039	Lhokseumawe Airport	lhokapt	Local	Public
010605_040	Port of Singkel	portsing	Local	Public
010605_043	National Institute of Science	lipi	National	Public
010605_044	Indonesian National Federation of Peasants Organization	fspi	National	Non-Profit
010605_045	Sri Lankan National Organization of Fisher Folk	nasfo	International	Non-Profit
010605_047	Mentor Initiative	menin	International	Non-Profit
010705_011	Kampus Humanity Fund	khf	National	Non-Profit
010705_012	Melia Purosani Hotel	mph	Local	Private
010705_013	Yogyakarta Tourism Center	ytic	Provincial	Public
010705_019	Muhammadiyah University Malang	muhuni	Provincial	Private
010705_020	Asia Foundation	asiafd	International	Non-Profit
010705_021	Office of the Deputy Coordinating Minister for People's Welfare, Id	odcmpwid	National	Public
010705_022	Office of the Deputy Governor of Aceh Province	odgap	Provincial	Public
010705_023	Group of Seven	G7	International	Public
010705_024	Oxfam - United Kingdom	oxfamuk	International	Non-Profit
010705_025	United Nations Humanitarian Air Service	unhas	International	Public
010705_026	Catholic Relief Services	crs	International	Non-Profit
010705_027	Food for the Hungry International	fhi	International	Non-Profit

<u>Number</u>	<u>Organization Name</u>	<u>Acronym</u>	<u>Jurisdiction</u>	<u>Source of Funding</u>
010705_028	Genelabs Diagnostics	gendia	International	Private
010705_029	Government of Hungary	govhun	International	Public
010705_030	Portuguese Medical Contingency Hospital (Banda Aceh)	pmchosp	Local	Public
010705_031	Indonesia Medical Association	ima	National	Non-Profit
010705_032	Korean Medical Association	kma	International	Non-Profit
010805_002	State Ministry for Women's Empowerment, Id	smwe	National	Public
010805_003	United Nations Development Fund for Women	undfw	International	Public
010805_004	United Nations Millennium Project	unmp	International	Public
010805_005	Federal Agency for Technical Relief, Germany	thw	International	Public
010805_006	United Nations Joint Logistics Center - Columbo, Sri Lanka	unjlccl	International	Public
010805_010	Centers of Disease Control and Prevention, United States	edcus	International	Public
010805_013	Indonesian Civil Aviation Authority	icaa	National	Non-Profit
010805_014	Civil Aviation Authority of Singapore	caas	International	Non-Profit
010805_015	Church World Service	cws	International	Non-Profit
010905_001	Hang Nadim Airport (Batam)	hnapt	Local	Public
010905_002	Dji Sam Soe	dss	National	Private
010905_003	Indonesian Buddhist Association	iba	National	Non-Profit
010905_004	Bandung Institute of Technology	bit	National	Public
010905_005	City of Medan Disaster Mitigation Center	ctymdmc	Local	Public
010905_013	Liberal Democratic Party, Japan	ldp	International	Special Interest
010905_017	Action Against Hunger	aah	International	Non-Profit
010905_018	Sabang Military Air Base	sabapt	Local	Public
010905_020	Military of New Zealand	milnz	International	Public
011005_003	General Motors	gm	International	Private
011005_004	American Red Cross	amrc	International	Non-Profit
011005_005	United Parcel Service	ups	International	Private
011005_006	PT Korea Exchange Bank Danamon	ptkebd	International	Private
011005_007	Korea Support Center for Tsunami Disaster	ksctd	International	Non-Profit
011005_009	Amazon.com	amazon	International	Private
011005_010	Agency for Education, Aceh Province	aeap	Provincial	Public
011005_013	Embassy of Libya, Jakarta	govlib	International	Public
011005_015	People's School Foundation	psf	Provincial	Non-Profit
011005_016	Keutapang Camp	kcamp	Local	Public
011005_017	Gue Gajah Camp	ggcamp	Local	Public
011005_018	Lampeunrut Camp	lamcamp	Local	Public
011005_019	Simeuleu Isle Camp	sicamp	Local	Public
011005_021	Habitat International Coalition	hic	International	Non-Profit
011005_022	United States Army	usarmy	International	Public
011005_023	Helen Keller International	hkint	International	Non-Profit
011005_024	Department of Public Works, Banda Aceh	dpwba	Local	Public
011005_025	Civil Military Operations Center - Banda Aceh	cmocba	National	Public
011005_029	YAPPIKA	yappika	National	Non-Profit
011005_030	PT Tempo Inti Media Terbuka	timt	National	Private
011005_031	SurfAid International	surf	International	Non-Profit
011005_032	World Vision - Canada	wvc	International	Non-Profit
011005_033	Mama Mia	mmia	Local	Non-Profit

Number	Organization Name	Acronym	Jurisdiction	Source of Funding
011105_004	PT Jamsostek	ptjam	National	Public
011105_005	PT Jamsostek - Banda Aceh Branch Office	ptjamba	National	Public
011105_006	PT Jamsostek - Lhokseumawe Branch Office	ptjaml	National	Public
011105_007	PT Jamsostek - Meulaboh Branch Office	ptjamm	National	Public
011105_008	PT Semen Andalas Indonesia	ptsai	International	Private
011105_009	Binawan Institute of Health Sciences	bihs	National	Public
011105_010	Golkar Party	golkar	National	Special Interest
011105_013	Media Group	media	National	Private
011105_014	Banda Aceh Museum	bamus	Local	Public
011105_016	PT Pelni	pelni	National	Private
011105_018	Save the Children - United States	saveus	International	Non-Profit
011205_007	Ministry of Foreign Affairs, Spain	mfasp	International	Public
011205_009	Military of Spain	milsp	International	Public
011205_011	Navy of Spain	navyspain	International	Public
011205_012	Rajawali Group	rajgr	National	Private
011205_013	Panglima Laot	paloat	Local	Non-Profit
011205_015	Danish Military	danmil	International	Public
011205_018	International Business Machines	ibm	International	Private
011305_002	Government of Southeast Sulawesi Province	govsesp	Provincial	Public
011305_003	Managment Coordination Board of Southeast Sulawesi Province	mcbssp	Provincial	Public
011305_006	Pekanbaru Airport (Riau Province)	pekapt	Local	Public
011305_007	Ernest & Young	eandy	International	Private
011305_009	Touch Community Services	tcs	International	Non-Profit
011305_010	Mercy Relief	merrel	International	Non-Profit
011305_011	National Volunteer Philanthropy Center	nvpc	International	Non-Profit
011305_012	Young Men's Christian Association - Singapore	ymcasing	International	Non-Profit
011405_003	United Cities of Local Government	uclg	International	Non-Profit
011405_005	Embassy of Romania, Jakarta	embrom	International	Public
011405_006	Government of Romania	govrom	International	Public
011405_007	Office of the Deputy Governor of North Sumatra	odgns	Provincial	Public
011405_008	Embassy of Cuba, Jakarta	embcub	International	Public
011405_011	SATKORLAK	satkorlak	National	Public
011505_001	Department of Defense, United States	dodus	International	Public
011505_003	Port of Kreung Raya (Banda Aceh)	ptkreray	Local	Public
011505_004	Mainum Saleh Airfield	msaif	Local	Public
011505_005	Islamic Relief	islrel	National	Non-Profit
011505_006	Palyja	paly	National	Private
011505_007	Aceh Regional Police	acehrpol	Local	Public
011605_001	Banda Aceh Office of Spatial Planning and Settlement	csps	Local	Public
011605_002	Council of Buddhist Communities	cbe	International	Non-Profit
011605_003	Indonesian Contractors Association	ica	National	Non-Profit
011605_004	PT Nindiya Karya	ptninkar	National	Public
011605_005	PT Hutama Karya	pthutkar	National	Public

<u>Number</u>	<u>Organization Name</u>	<u>Acronym</u>	<u>Jurisdiction</u>	<u>Source of Funding</u>
011605_007	Camp 85L in Lhok Nga	85cmp	Local	Public
011605_008	Firemen Without Borders	fwb	International	Non-Profit
011605_009	Total E&P Indonesia	tepid	National	Private
011605_010	PT Perumnas	ptperum	National	Public
011605_017	Perusahaan Daerah Air Minum	pdam	Local	Public

APPENDIX I Hamming Results for the Domestic Sub-System

		Nodes	Edges	26-Dec-04	27-Dec-04	28-Dec-04	29-Dec-04	30-Dec-04	31-Dec-04	1-Jan-05	2-Jan-05	3-Jan-05	4-Jan-05	5-Jan-05	6-Jan-05	7-Jan-05	8-Jan-05	9-Jan-05	10-Jan-05	11-Jan-05	12-Jan-05	13-Jan-05	14-Jan-05	15-Jan-05	16-Jan-05
T	12/26/04	302	22																						
Week 1	12/27/04	302	108	86																					
	12/28/04	302	60	36	-48																				
	12/29/04	302	38	14	-114	-22																			
	12/30/04	302	120	96	-32	20	82																		
	12/31/04	302	36	12	-116	-64	-146	-84																	
	1/1/05	302	36	12	-116	-64	-146	-150	0																
	1/2/05	302	36	12	-116	-64	-146	-150	-140	0															
Week 2	1/3/05	302	122	98	-30	22	-60	-64	-54	-18	86														
	1/4/05	302	38	14	-114	-62	-144	-148	-138	-102	-104	-84													
	1/5/05	302	90	66	-62	-10	-92	-96	-86	-50	-52	-142	52												
	1/6/05	302	36	12	-116	-64	-146	-150	-140	-104	-106	-196	-154	-54											
	1/7/05	302	34	10	-118	-66	-148	-152	-142	-106	-108	-198	-156	-186	-2										
	1/8/05	302	14	-10	-138	-86	-168	-172	-162	-126	-128	-218	-176	-206	-796	-20									
	1/9/05	302	42	18	-110	-58	-140	-144	-134	-98	-100	-190	-148	-178	-768	-768	28								
Week 3	1/10/05	302	56	32	-96	-44	-126	-130	-120	-84	-86	-176	-134	-164	-754	-754	-72	14							
	1/11/05	302	24	0	-128	-76	-158	-162	-152	-116	-118	-208	-166	-196	-786	-786	-104	-118	-32						
	1/12/05	302	28	4	-124	-72	-154	-158	-148	-112	-114	-204	-162	-192	-782	-782	-100	-114	-884	4					
	1/13/05	302	10	-14	-142	-90	-172	-176	-166	-130	-132	-222	-180	-210	-800	-800	-118	-132	-902	-82	-18				
	1/14/05	302	8	-16	-144	-92	-174	-178	-168	-132	-134	-224	-182	-212	-802	-802	-120	-134	-904	-84	-758	-2			
	1/15/05	302	22	-2	-130	-78	-160	-164	-154	-118	-120	-210	-168	-198	-788	-788	-106	-120	-890	-70	-744	-62	14		
	1/16/05	302	50	26	-102	-50	-132	-136	-126	-90	-92	-182	-140	-170	-760	-760	-78	-92	-862	-42	-716	-34	-4401	28	

APPENDIX J Hamming Results for International Sub-System

		Nodes	Edges	26-Dec-04	27-Dec-04	28-Dec-04	29-Dec-04	30-Dec-04	31-Dec-04	1-Jan-05	2-Jan-05	3-Jan-05	4-Jan-05	5-Jan-05	6-Jan-05	7-Jan-05	8-Jan-05	9-Jan-05	10-Jan-05	11-Jan-05	12-Jan-05	13-Jan-05	14-Jan-05	15-Jan-05	16-Jan-05
T	12/26/04	258	0																						
Week 1	12/27/04	258	16	16																					
	12/28/04	258	14	-10	-2																				
	12/29/04	258	114	90	-38	100																			
	12/30/04	258	32	8	-120	-68	-82																		
	12/31/04	258	90	66	-62	-10	-92	58																	
	1/1/05	258	42	18	-110	-58	-140	-144	-48																
Week 2	1/2/05	258	48	24	-104	-52	-134	-138	-128	6															
	1/3/05	258	78	54	-74	-22	-104	-108	-98	-62	30														
	1/4/05	258	80	56	-72	-20	-102	-106	-96	-60	-62	2													
	1/5/05	258	56	32	-96	-44	-126	-130	-120	-84	-86	-176	-24												
	1/6/05	258	624	600	472	524	442	438	448	484	482	392	434	568											
	1/7/05	258	634	610	482	534	452	448	458	494	492	402	444	414	10										
Week 3	1/8/05	258	64	40	-88	-36	-118	-122	-112	-76	-78	-168	-126	-156	-746	-570									
	1/9/05	258	52	28	-100	-48	-130	-134	-124	-88	-90	-180	-138	-168	-758	-758	-12								
	1/10/05	258	660	636	508	560	478	474	484	520	518	428	470	440	-150	-150	532	608							
	1/11/05	258	26	2	-126	-74	-156	-160	-150	-114	-116	-206	-164	-194	-784	-784	-102	-116	-634						
	1/12/05	258	588	564	436	488	406	402	412	448	446	356	398	368	-222	-222	460	446	-324	562					
	1/13/05	258	46	22	-106	-54	-136	-140	-130	-94	-96	-186	-144	-174	-764	-764	-82	-96	-866	-46	-542				
Week 3	1/14/05	258	558	534	406	458	376	372	382	418	416	326	368	338	-252	-252	430	416	-354	466	-208	512			
	1/15/05	258	24	0	-128	-76	-158	-162	-152	-116	-118	-208	-166	-196	-786	-786	-104	-118	-888	-68	-742	-60	-534		
	1/16/05	258	6	-18	-146	-94	-176	-180	-170	-134	-136	-226	-184	-214	-804	-804	-122	-136	-906	-86	-760	-78	-4445	-18	

APPENDIX K Hamming Results for the Core System

		Nodes	Edges	26-Dec-04	27-Dec-04	28-Dec-04	29-Dec-04	30-Dec-04	31-Dec-04	1-Jan-05	2-Jan-05	3-Jan-05	4-Jan-05	5-Jan-05	6-Jan-05	7-Jan-05	8-Jan-05	9-Jan-05	10-Jan-05	11-Jan-05	12-Jan-05	13-Jan-05	14-Jan-05	15-Jan-05	16-Jan-05
T	12/26/04	560	24																						
Week 1	12/27/04	560	152	128																					
	12/28/04	560	100	76	-52																				
	12/29/04	560	182	158	30	82																			
	12/30/04	560	186	162	34	86	4																		
	12/31/04	560	176	152	24	76	-6	-10																	
	1/1/05	560	140	116	-12	40	-42	-46	-36																
	1/2/05	560	142	118	-10	42	-40	-44	-34	2															
Week 2	1/3/05	560	232	208	80	132	50	46	56	92	90														
	1/4/05	560	190	166	38	90	8	4	14	50	48	-42													
	1/5/05	560	220	196	68	120	38	34	44	80	78	-12	30												
	1/6/05	560	810	786	658	710	628	624	634	670	668	578	620	590											
	1/7/05	560	810	786	658	710	628	624	634	670	668	578	620	590	0										
	1/8/05	560	128	104	-24	28	-54	-58	-48	-12	-14	-104	-62	-92	-682	-682									
	1/9/05	560	142	118	-10	42	-40	-44	-34	2	0	-90	-48	-78	-668	-668	14								
Week 3	1/10/05	560	912	888	760	812	730	726	736	772	770	680	722	692	102	102	784	770							
	1/11/05	560	92	68	-60	-8	-90	-94	-84	-48	-50	-140	-98	-128	-718	-718	-36	-50	-820						
	1/12/05	560	766	742	614	666	584	580	590	626	624	534	576	546	-44	-44	638	624	-146	674					
	1/13/05	560	84	60	-68	-16	-98	-102	-92	-56	-58	-148	-106	-136	-726	-726	-44	-58	-828	-8	-682				
	1/14/05	560	680	656	528	580	498	494	504	540	538	448	490	460	-130	-130	552	538	-232	588	-86	596			
	1/15/05	560	86	62	-66	-14	-96	-100	-90	-54	-56	-146	-104	-134	-724	-724	-42	-56	-826	-6	-680	2	-594		
	1/16/05	560	98	74	-54	-2	-84	-88	-78	-42	-44	-134	-92	-122	-712	-712	-30	-44	-814	6	-668	14	-4353	12	

APPENDIX L Indonesian Post-Tsunami Disaster Legislation

Disaster Management Law No. 24/2007: established the focus and scope of Indonesian disaster management policy and the rights, responsibilities and obligations of the government and society in responding to the threats posed by disaster. As a concept, disaster management policy must provide protection to Indonesian communities; harmonize existing laws and regulations; guarantee a coordinated and comprehensive response; respect local culture; develop partnerships, and create the conditions for peace. The Law specifically detailed the roles and authority of governmental bodies at the various levels of jurisdiction. Furthermore, the Law called for the creation of a National Disaster Relief Agency, whose functions include the formation and implementation of disaster relief policy. This Law stands as the legal framework upon which Indonesian Disaster Management policy and institutions would be developed. The law also imposes criminal sanctions on those who ignore their disaster management responsibilities and duties or inhibit disaster management efforts.

Presidential Regulation No. 8/ 2008: outlines the creation of the National Disaster Relief Agency and details the Agency's disaster management responsibilities, as well as the roles and responsibilities of the various government agencies and officials who, by law, are integrated into Indonesia's new disaster management system.

Government Regulation No. 21/2008: details disaster management operations as “a series of efforts that include the determination of risk management policy, disaster prevention activities, emergency response and rehabilitation. The regulation further indicates that the Indonesian disaster response plan shall be coordinated by the National Disaster Relief agency at the national level, and supported by complementary agencies at the provincial and district/city levels.

Government Regulation No. 22/2008: Outlines the tasks and responsibilities that must be managed during the period of emergency response. At the time of the emergency, specific response activities shall include: 1) the assessment of damages, losses and resources; 2) the statute of the disaster; 3) rescue and evacuation; 4) basic needs fulfillment; 5) protection of vulnerable groups; and 6) the immediate restoration of critical infrastructure and facilities. To accomplish these responsibilities, Indonesia's disaster management agencies have the authority to coordinate and manage human resources, tools, and logistics. Other issue areas addressed by this statute include: 1) immigration, customs and quarantine; 2) the procurement of goods and services, 3) the procurement of budgetary resources; 4) management and accountability; 5) search and rescue; and 6) command and control authority.

Government Regulation No: 23/2008: Covers the role of International Institutions and International Nongovernmental Institutions in Indonesian disaster management activities. These institutions will strengthen Indonesia's disaster management capacity, especially in the areas of disaster response, threat reduction, victim assistance and community recovery. This Regulation outlines the procedural steps that must be completed, including submission of work plans, letters of intent, lists of resources, personnel, equipment, location and activities, and coordination procedures, which must be in place prior participating in disaster response activities in Indonesia.

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- Respondent 17. 2009. Research interview, Jakarta, Indonesia, August.
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- Respondent 19. 2009. Research interview, Jakarta, Indonesia, August.
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