THE INTEGRATION OF INTERGOVERNMENTAL COORDINATION AND INFORMATION MANAGEMENT IN RESPONSE TO IMMEDIATE CRISES

THAILAND EMERGENCY MANAGEMENT

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Recent occurrences of natural disasters and severe manmade hazards have increased awareness of the need for effective mitigation and response to extreme events. States of emergency require multiple agencies to perform multiple tasks simultaneously to return the situation to normal. This study proposes an inter-organizational model supported by the efficient use of information and communication technologies to assist multiple agencies in coordinating their actions more effectively during states of emergency. The model will assist participating agencies to develop the capacity to adapt to emergency conditions as well as the ability to replace other functions that fail in order to maintain the continuity of basic operations for the community until the state of emergency is cleared.

Three recent cases of emergency operations in Thailand are examined to assess whether coordination among response agencies can be improved by using appropriately designed interagency operations. The complex environment of emergency response operations offers an extraordinary opportunity to investigate methods that may be used to understand and identify factors that build strength or lead to weakness in practice. The interdependence of sequential failures from sudden impacts such as the collapse of electrical transmission lines or a communication system provides a practical challenge for assessing the use of information and communication technologies in managing emergencies. Insights gained from this project may assist public agencies to work together more effectively.

This research is conducted as an exploratory study with a nested case design. It employs both qualitative and quantitative methods of observation, interviews, social network analysis, document review and structured surveys to identify complementary characteristics rather than advocating a single style of research. Units of analysis are the emergency response organizations at national, provincial and local levels while units of observation are emergency response personnel in each organization. In addition, units of observation are stratified into top, middle, and operational levels of management in order to obtain information that may vary by levels of authority. Information obtained from multiple sources is analyzed to understand better the existing emergency response operations and how to improve the system effectively and efficiently.

An alternative approach based on lessons learned from this study is to build systematic and adaptive collaboration among agencies, national, provincial and local levels, in emergency management of Thailand. The primary actors**,** Department of Disaster Prevention and Mitigation (DDPM), Bangkok Metropolitan Authority (BMA), Civil Emergency Relief Department (CERD), and District Offices (DO) can play effective roles in emergency response network under different scales of emergency. Insufficient information support and communication channels increase the difficulties of activating the action plan in wider response in states of emergency. Information technology and communication systems allow multiple agencies to share their knowledge and information they need in making informed decisions. Communication is a significant means to enable participating agencies to coordinate their operations simultaneously. These functions of information technology and communication help connect the entire emergency operation into a well-organized direction.

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PREFACE

My dissertation research owes much to the loss of lives and property resulting from the Indian Ocean Tsunami. This devastating event has provided me with innumerable lessons and the opportunity to further my studies and my desire to assist the government of Thailand to better manage its emergency response and recovery.

This dissertation would not be successful without the help, encouragement, and support from my advisor, Dr. Louise Comfort. She has guided me through the problems in my research, and dedicated her time to work with me all through these years. She has always been my inspiration to pursue a doctoral degree at the University of Pittsburgh. I would like to thank my committee members, Dr. William Dunn, Dr. David Miller and Dr. Toni Carbo for their time and effort in reading and giving comments to improve the quality of my work. I would like to give my special thank to Dr. Angela Foster who provided me with supplementary documents and assisted me in the analysis of my research.

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1.0 INTRODUCTION

The importance of public safety has gained recognition from governments of all countries around the world. Public safety includes how well communities cope with extreme phenomena, such as natural disasters and threats of manmade hazards, as well as how effectively emergency response agencies respond to such crises. The uncertainty and unexpected consequences of these extreme events create severe conditions such as large scale destruction of buildings, dramatic change in geography, destruction of communication and electrical infrastructure, exacerbated by a lack of understanding of risks to which communities are exposed. Natural disasters may create heavy damage across wide areas that require public agencies to work together nationally and locally to manage states of emergency. Such crises require a clear understanding of risks and skillfully coordinated operations to return the situation to normal. Under urgent constraints of time and threat to life, information and communication facilities are critical to enable multiple agencies to coordinate their actions simultaneously and make timely informed decisions. In states of emergency, all participating response agencies need to work together and communicate with each other. This study examines how emergency management policies are implemented in Thailand at national and local levels separately and cooperatively, and what information and communication processes are essential to emergency management.

1.1 RESEARCH PROBLEM: THE SEARCH FOR COLLABORATIVE EMERGENCY RESPONSE

Recent occurrences of natural disasters and severe manmade hazards have increased awareness of the need for effective mitigation and response to such extreme events. Such events cause devastation and unpredictable impacts, spreading widely across communities, resulting in sudden damage to infrastructure, transportation, communication, property, and losses of life, health, and livelihood. States of emergency require multiple agencies to perform multiple tasks simultaneously to return the situation to normal. Unorganized and inexperienced response can delay disaster assistance and recovery processes. In addition, lack of understanding of risks to which communities are exposed leads to an unprepared state of emergency services to cope with sudden threats and changed conditions. Increasing manpower alone will not be effective in facilitating emergency response operations, if those personnel have insufficient skills and knowledge.

Intergovernmental management raises the question of what roles and authorities should be assigned to participating agencies individually and cooperatively. Radin, et al, (1996) argue that multi-organizational arrangements are solutions for inter-organizational problems that cannot be achieved by a single organization working alone. States of emergency need to take into account the adaptive capacity of single unit and effective coordination of multilevel governmental agencies. The tsunami disaster in six provinces in southern Thailand is a good example of how the national government works with the provincial and local authorities across provincial jurisdictions, while the flood risk and massive accidents in Bangkok reflect how the provincial government manages through its district units and other agencies to respond to states of emergency locally.

Thai governmental agencies, even though they have absorbed the new public management concept of decentralization, have been managed under a traditional bureaucracy for a long period of time. Kettl (2002) and Salamon (2002) argue that new governance moves its focus to networks rather than hierarchy in organizational forms. Under states of emergency, public managers have the obligation and responsibility for making decisions regarding life and death. Their training may have focused on command and control as a traditional means of disaster management. Public executives may believe that strictly top-down decision making and a single operational unit will result in more efficient disaster management. Yet, the tsunami disaster demonstrates that large scale of states of emergency require interagency coordination to manage an effective response while the flooding crisis and massive accidents in metropolitan Bangkok show the need for collaboration among their agencies as well as across sectors.

With low awareness of tsunami risk and lack of understanding in such states of emergency especially with a large scale of devastation as of 6 provinces along a coastal area, Thai national and provincial governments have many difficulties in working together to provide assistance to damaged communities. Lack of experience in crisis management leads agencies to misinterpret severe risk and creates an unorganized and inadequate response. This study assesses the flood crisis management and massive accident emergency plan of Bangkok as well as response to the tsunami in southern Thailand, expecting to learn of emergency management from Bangkok that emergency personnel has longer and more frequent experience. It seeks to identify the patterns of self organization and adaptation in complex systems in emergency operation. These two approaches explain and clarify the adaptive capacity of organizations to benefit participating agencies and affected communities. Lessons and experiences shared among agencies foster organizational flexibility to adapt to changes and deal with complexity.

Preliminary assessment shows that Bangkok Metropolitan Authority (BMA) and its emergency response agencies need to review their crisis operations and emergency policy, especially regarding how to get all the participating agencies to work together under the constraints of time, resources, experience, and technical equipments. Members of relatively new established emergency mitigation department, Civil Emergency Relief Department (CERD), may obtain their long experience from being fire fighters, yet confronting different emergency needs with adaptive capacity and learning from the experience of others. Since an increased awareness and recognition of the need for emergency preparedness has emerged, this study examines the alternatives for reducing the costs involved in improving public safety and the need to relocate budget priorities to achieve this goal. BMA also focuses on developing strategies for the CERD to assist the communities in building cooperation and preparing for emergency situations. This is especially important for the Civil Defense Volunteer Units (CDVU), operating together with the District Offices (DO) as front line emergency personnel, which are also trained and supported by Department of Disaster Prevention and Mitigation (DDPM) who is the primary emergency response personnel and operates nation wide. Good relationships and frequent communication are bases of trust and sharing information they need in conducting an effective emergency response operations.

A dramatic change in geography and unstable structures make disaster areas more difficult for agencies to access efficiently and coordinate actions with other participating agencies simultaneously without effective communication facilities. The unexpected failure of communication and electrical systems worsens the situation since the agencies could not communicate and update the information. The information and communication facilities are crucial to managing states of emergency especially across a large scale of devastation. A typical communication and information system can fail due to the lack of power or the black-out of electricity. This research also examines the role of information technology in order to pursue the alternative solution for communication under system failure. Emergency response agencies need sufficient information in order to make more informed decisions, and such information sharing and decision making need to be supported by an efficient communication system.

1.2 EMERGENCY MANAGEMENT IN THAILAND

1.2.1 Emergency Management in Tsunami Response

On 26 December 2004, the first tsunami wave generated by the 7:58 a.m. magnitude 9.1 earthquake off the west coast of Sumatra, Indonesia struck Thailand at approximately 9:30 am, local time. Most heavily damaged were the tourist areas and communities on Phuket and PhiPhi Islands, Krabi province, and the west coast of PhangNga province. The local population had almost no knowledge of tsunamis or the potential risk of a tsunami following a powerful earthquake. In Thailand, this lack of local knowledge was attributed in part to the fact that the area had been designated as “low risk” for earthquake and tsunami hazards.

This study investigates and assesses two areas of devastation with two objectives. First, it examines the two provinces that were the most damaged from the effects from December 26, 2004 tsunami, Phuket and PhangNga. Second, it compares the two provinces in terms of the significant differences in their local environments. Phuket is a tourist area with a particular geographic structure that makes the area relatively less affected from tsunami. The Phuket coastline has a deep beachfront area, which reduces a tsunami’s energy and its ability to create high destructive waves. However, the beach hotels on Phuket Island were filled with tourists for the Christmas holiday, many from Europe with little experience with tsunami hazard.

In contrast, PhangNga has a shallow beachfront area, a geological structure that exposes the area to the highest level of risk in a tsunami. PhangNga additionally occupies a geographical location with one main road to access the area that makes effective rescue difficult. PhangNga has two different communities, the hotel and resort community and the local communities. The differences between the settings inside PhangNga make the province more complicated to both mitigate and recover from disaster. Hotels and resorts occupy well-structured locations, enabling response agencies to access those areas more easily than in the crowded local communities. Locals, however, are more familiar with the area, which helps them to escape to a more secure location than tourists and transients around the hotel and resort areas.

1.2.2 Emergency Management in Flood Crisis in Bangkok Metropolitan

Bangkok Metropolitan Authority (BMA) is a special governing system for a capital city. BMA has its own administration operating locally through the district units and financed by its own budget. There will definitely be questions regarding exercise of the hierarchy and political control when examining cross sectional cooperation of the personnel from different agencies. Understanding of the structure and authority of BMA and its relation to the national government will give a better assessment of the status and the probability of approaching the system with network analysis. Like or unlike other developing countries, Bangkok Metropolitan Authority may have an effective pattern of emergency operation and management that the other studies can apply or build upon.

For the past eight years, Bangkok has seemingly mitigated the severity of flood risks because of both the implementation of a comprehensive drainage system and fortunate nature. As the statistical data (BMA report from 1998 to 2004) show, the accumulation of water from rain, seawater, and north stream has not increased for the past eight years. The uncertainty is that these three causes of excess water have never occurred in Bangkok at the same time. BMA needs to operate its flood management plan along with other generic plan for water usage.

The Department of Water Drainage under BMA is likely to have the opposite goal from the Department of Irrigation under the Ministry of Agriculture in preserving a specific amount of water. The Flood Control Center is used as the center of prediction and coordination and as the information and communication center of command operations. The 50 district office (DO) units are the operational team responsible for implementing the water release plan as well as working together with the traffic police trying to ease the traffic congestion regarding the excess amount of water on the main road. Most of the time, Bangkok is prioritized by the national government to clear its flood prone area to the boundaries of the natural water shed in vicinity areas. This research explores whether coordination is needed for these affected jurisdictions. In that sense, the coordination pattern may exist and function as routine operations.

BMA has a relatively new emergency relief unit, Civil Emergency Relief Department which was transferred from the Fire Department at the end of 2003. This may be one reason that this organization did not respond as expected to the emergency situations included in this study. In the past, under a state of emergency or massive accident, BMA operated its emergency unit under the command and control of Fire Department and National Police Department along with rescue units from private foundations and paramedic teams. As a result, BMA did not have its own specialists and experienced personnel to perform emergency operations.

1.2.3 Emergency Management in Massive Accident in Districts of Bangkok

In the fire case, the building collapse unfortunately resulted in the deaths of rescue personnel from both the National Police Department and the voluntary rescue team of BMA. The need for public safety raised the awareness of the communities regarding how BMA manages its own emergency policy. In this case, the state of emergency created a demand for an intensive operation that caused all personnel to respond. Unfortunately, the lack of experienced coordination and low awareness of the structure of the building after a long period of burning caused the building to collapse with five rescue personnel buried under the debris.

In the underground train accident, there were no deaths but a lot of injuries. The accident portrayed a chaotic atmosphere and unorganized rescue and emergency operations. The underground train is a relatively new operation which reveals that the entire system as well as the accident plan is not yet stable. Once again BMA had to rely on private rescue units as the center of emergency management with supports from voluntary rescue team and paramedics to evacuate and give the primary treatment to the injured.

Both incidents raise questions for the Bangkok governor and the management team regarding the current capacity of BMA and CERD for emergency management and their experience and skill in activating emergency operations effectively. As a result of these incidents, from January to March 2005, BMA restructured and retrained CERD to be a single reliable emergency unit that would assume responsibility for the entire emergency operation. This unit would implement the emergency plan and coordinate with other participating agencies. The training programs developed for this department not only address their specific operations but also relations with their co-agencies. In addition, CERD is expected to reach out to the communities so that the first emergency response can be primarily done by households.

1.3 RECENT RESPONSE TO EMERGENCIES

1.3.1 Tsunami Response

1.3.1.1 Nation-Wide Early Warning System

The National Disaster Warning Center was established on May 30th, 2005, functioning as a focal point to integrate and analyze all information coming from international information providers, domestic governmental agencies and general public networks in order to decide whether or not a warning message will be disseminated. The warning would be directed to emergency response personnel, governmental agencies and the general public to start an evacuation process and prepare for emergency response operations. The warning message is automatically disseminated through different channels of communication to different targets. The national television pool, national radio stations network, and amateur radio network are used purposely to reach the general public. Cell phone text messages, email and facsimile are sent to relevant governmental organizations and personnel at national and provincial areas. Police, Military and Department of Disaster Prevention and Mitigation emergency personnel receive the same warning message through their trunk-radio and assigned-frequency radio networks. Another instant warning message is disseminated by siren towers. As of April 2006, 57 out of 77 siren towers have been installed in southern Thailand in tsunami affected areas.

Along a coastline within tsunami inundation coverage, siren towers have been installed with the broadcast of warning messages in five different languages to warn people who are out on the beach and the locals who are not reachable by any other means of communication. The siren towers are automatically activated from the national center in Bangkok with a relay time of 2 minutes. The assigned emergency personnel from different public agencies will respond to a warning message sent from the national center and will proceed with their tasks as planned and drilled. Emergency personnel will update situations periodically to NDWC and wait until a termination of state of emergency is released from the center to allow people to return accordingly.

Problems and difficulties fall under a classic argument of bureaucracy regarding how governmental organizations and public agencies cope with change. First, NDWC as a national organization needs not only legislation to support its existence and authorities requiring other agencies to cooperate, but also competent staff in emergency management to perform all procedures effectively. The recruitment of new personnel is time consuming, and skillful human resources in the field are rare. Secondly, NDWC is trying to enlarge and enrich its responsibilities by taking not only tsunami but all natural hazards into account. It creates a large amount of concern and hesitation from governmental agencies who originally are taking responsibility for issuing warnings such as the Departments of Meteorology, Mineral Resources, Royal Irrigation and Hydrographic of the Royal Navy. Last but very important, provincial governors have to clearly understand and willingly accept the role of the national center as a decision maker who has full authority to issue a warning message that requires provincial and local authorities to react accordingly. The nation-wide warning system and management require the integration of intergovernmental coordination, information sharing and communication networks for a warning message to be effectively disseminated in order to save lives and property.

1.3.1.2 Nation Wide Emergency Response

The Department of Disaster Prevention and Mitigation (DDPM) has relocated more personnel and resources to the southern regional centers and provinces. All resources and facilities have been prepared and assessed to be ready for emergency response. Evacuation map, risk assessment, building codes, and evacuation procedures have been developed. DDPM is working to adapt their action plan to a generic action plan for other provincial emergency agencies and responsible governmental organizations such as the Department of Mineral Resources who also has responsibility for the geographical assessment of risk areas.

It is clear that technical infrastructure and resources can be placed in position and made available. However, organizational authority and inter-organizational structure require clear direction and procedures to follow. Legislation needs to support the authority and guide how interagency coordination should be conducted effectively. More importantly, DDPM also needs the cooperation of other emergency agencies and communities in evacuation management in order to carry out an action plan appropriately. Coordinating emergency operations also requires a skillful and well-trained workforce. Tsunami drills that are conducted periodically to test the warning system and the evacuation procedures can help them to understand how to work together in implementing evacuation operations. However, all emergency personnel, police, military, coastguard, provincial officers and medical units, need to learn to work together in emergency response operations and disaster mitigation. Failure or malfunction of one unit should be effectively compensated by the other neighboring units' operations, so that the entire emergency response system has the capacity to continue to deliver assistance to those in need.

The DDPM Academy joined by international disaster reduction agencies and emergency experts, provides training courses to emergency response personnel around the country in areas exposed to multi-hazards. The problems and difficulties of the tsunami response triggered an awareness and recognition of the basic requirement for emergency operations, well-trained emergency personnel. However, training courses provided by the DDPM academy need to consider the nature of natural disaster in the nation as well. Flood problems, drought crises and fire have a higher potential for occurrence than earthquake and tsunami. DDPM emergency personnel and action plans need to adapt to such facts. Technology and training programs from experts can not be used at their highest potential if local emergency personnel can not apply them to their operations and the situations they confront. Those training programs need to be developed, so that the skills trained are applicable to multiple hazards. Further, co-training programs among different geographical units and among different agencies need to be developed accordingly.

1.3.2 Flood Crisis and Massive Accidents in Bangkok Metropolis

1.3.2.1 The Establishment of Central Emergency Agency

In April 2005, Bangkok Metropolitan Authority (BMA) established its central emergency agency, Civil Emergency Relief Department (CERD), to be responsible for multi-hazards emergency operations in a large scale especially fire in Bangkok metropolis. CERD is functioning as coordinator of emergency field personnel when the scale of emergency is considered too large for district emergency units. CERD was transformed from a Fire Fighter Unit under National Police Department. There are not enough personnel, equipment, and fire stations to support multi-hazards operations. From an organizational competency perspective, CERD confronts with the same problems as NDWC in recruiting new personnel and in providing those training courses as well as reaching out for expert consultation. In addition, CERD is still adjusting to its position as the central emergency agency working with other agencies of BMA, and to the new status of its personnel as civil servants rather than police officers. Norms and cultures of organizations still play significant roles and affect how personnel work and view their respective lines of authority.

BMA approved a budget to purchase fire trucks and build more fire stations in the outer city area of Bangkok metropolis. Action plans of emergency management are designed and translated to all emergency personnel. The Civil Emergency Relief Department has recruited more personnel and built facilities and mapped the city construction and traffic in emergency response. CERD also provide many training programs to emergency personnel in other hazards than fire. Those training programs are also conducted with the participation of district officers, volunteers, communities and private sector companies.

1.3.2.2 New Assignments to District Offices in Bangkok Metropolis

BMA tasked the district offices to increase the number of members in district Civil Defense Volunteer Units (CDVU) to be able to create a stronger network of frontline emergency personnel to expand its emergency response coverage. CDVU volunteers also work closely with district enforcement officers in coordinating night-surveillance to protect communities from crimes and day-surveillance to inspect any malfunction of public construction or equipment that can cause an emergency or accident. BMA expects the district offices to reach out to communities more effectively by initiating a coordination activity between the two units as mentioned. Problems arise because the CDVU is composed of volunteers who have less incentive to participate in preparedness activities unless district offices can encourage them to accept responsibility for the safety of the communities. At the same time, district officers lack the motivation to do more work.

In addition to emergency management preparedness, BMA assigned every district office the task of implementing an action plan for an effective a one-stop-service mobile operation to access district areas in emergency maintenance, such as street pipe damage, road destruction and drainage problems. This unit, which is called Bangkok Emergency Service Team (BEST), structurally includes different divisions under the district office which are Civil Engineering, Enforcement, and Drainage. This unit is expected to deliver services effectively and efficiently to create a satisfactory relationship between communities and district offices. The problem is how to draw the lines of responsibility among BEST, CDVU, and district office emergency personnel.

1.4 SCOPE OF THE RESEARCH

Both national and local levels of emergency operations are expected to have cooperation from each other. The approach of intergovernmental management requires mutual understanding and partnership practice among all the agencies as well as communities. Effective coordination is limited by spatial distance and simultaneous operations. The use of information technology and computation produces virtual access to the geographical area and facilitates continuous communication among the agencies. This study explores existing emergency management plans and operations that are currently in practice. As the Thai government is working at national, provincial and local levels to accomplish the same goal of public safety by preparing effective crisis and emergency management policies, officials need to understand their capability and limitations. This understanding will assist them in developing alternatives for improving their emergency structure and operations to manage states of emergency more effectively. In addition, the mutual understanding of operations through multiple levels of jurisdiction will help to coordinate the emergency response appropriately.

To explore these issues, this study addresses the following research questions:

1. To what extent do the key agencies responsible for disaster operations collaborate in large scale emergencies?
2. To what extent are authority and responsibility for emergency management assigned to specific public agencies?
3. To what extent does an intergovernmental coordination process operate in emergency management in practice?
4. To what extent does the use of information technology facilitate inter-organizational coordination and communication in emergency management?
5. In what ways are intergovernmental coordination and information management integrated in Thai emergency management?
6. What are the significant factors that move existing emergency response systems toward auto adaptation, and how?

1.5 SIGNIFICANCE OF THE STUDY

Many researchers have addressed the problem of getting participating agencies to work together (Bardach 1998). Intergovernmental management is one approach that has received attention from scholars and government officials. Careful preparation for crises in communities is important to their capacity to manage risk. Increasing the awareness and understanding of the risks they confront can help both communities and the public agencies to work faster and more efficiently. This research examines disaster and emergency management practice in Thailand and explores the role of scalable inter-organizational emergency management through multiple agencies. It emphasizes the study of the possible integration of intergovernmental management, uses of information technology, and the activation of smart communities to increase efficiency and effectiveness in reducing risk. These three concepts support the process of self organization that helps multiple participating parties to understand the limits of their knowledge. Recognizing their limits will help them to support collaborative decision making and understand the demands placed on other units in their operations. Coping with states of emergency and extreme events requires competent response agencies, coordinated operations, and efficient information and communication management. This study contributes to understanding the processes of self organization and the initiation of learning environment for emergency personnel. In turn, self organization assists agencies to translate the emergency management policy into practice effectively.

1.6 ANTICIPATED FINDINGS

A strong foundation of command and control is evident in the national, provincial and local governmental emergency management units since all levels of management have been operating under a hierarchical bureaucratic structure for a long time. Even though the new constitution (1999) states its recognition of the power of local authorities and emphasizes decentralization, command and control patterns still exist in public agencies' operations. Recent events indicate the potential for change. The complexity of the environment such as crowded population and structures, and advances in information and communication technology convince Thai government officials at both levels to accept the lack of their effectiveness in emergency management and the significance of getting agencies to work together in performing multiple tasks in complex environments with the help of information and communication technology to expand processes of coordination.

A complex environment and bureaucratic culture are not the only difficulties in managing the multi-agencies operation in emergency situations. Being in a designated low-risk geographic zone, the people of Thailand were unaware and unprepared for large scale devastation and powerful destruction of disaster. The misinterpretation of the devastation and severity of the tsunami disaster are also expected to be one of the obstacles of any emergency mitigation plan. Not only do the national authorities and local agencies need to understand the risks to which they are exposed, but the communities also have to learn to be well prepared to confront the threats and cooperate with the agencies to activate the emergency plan effectively. This study expects to find that the less knowledge and understanding the communities have, the less effective response and recovery operations are. This study will provide the assessment and analysis of the existing emergency management and operations and offer recommendations for improving the structure of operations and plans as well as involving the public and communities in emergency management.

States of emergency can create unorganized mobilization of multiple agencies. Emergency response units are trained to cope with such procedures. Under conditions of uncertainty and unpredictable effects, the devastation and damage may require cooperative skills in operations, as well as adaptive capacity from all participating parties nationally and locally. The flood threat in Bangkok is a good case to identify a network of operational agencies to illustrate how Bangkok Metropolitan Authority has been enabling its agencies to work together, using all resources and facilities they have at hand. The experience of such crisis management should be a valuable asset for Bangkok government to apply to other threats and prepare its central and district emergency personnel to cope with multi-hazards effectively. It is also expected that the result will support the integration of the local, provincial and national emergency response agencies of emergency organizational structure, authority, operation, and cooperative emergency management action plans.

An alternative approach learned from the lessons of this study is to build systematic and adaptive collaboration among agencies, national, provincial and local levels, in emergency management of Thailand. The primary actors**,** Department of Disaster Prevention and Mitigation (DDPM), Bangkok Metropolitan Authority (BMA), Civil Emergency Relief Department (CERD), and District Offices (DO) can play effective roles in the emergency response network under different scales of emergency. This research assesses all levels of emergency agencies and operations under the analytical frameworks of 1) assessment of the intergovernmental network, communities' involvement and the use of information technology, 2) knowledge sharing and information exchange assessment within and between the three cases, 3) integration of the intergovernmental network and information technology in implementing the emergency management policy, and 4) a proposed strategic plan and structure of collaboration among District Offices and CERD under BMA and DDPM under the Ministry of Interior.

Information exchange and communications are important in managing emergency operations. This study expects to find evidence that insufficient information support, communication channels, and equipment increase the difficulties of activating the action plan for wider response in states of emergency. Information technology and communication systems allow multiple agencies to share their knowledge and the information they need in making informed decisions. Communication is a significant means to enable participating agencies to coordinate their operations simultaneously. These functions of information technology and communication help to organize the entire emergency operation.

1.7 ORGANIZATION OF CHAPTERS

This dissertation is organized in seven chapters. **The first chapter**, states the problem of lack of systematically organized and adaptive emergency response in Thailand. This problem led to an exploration of states of emergency management at three levels of jurisdictional operations; 1) national-provincial-local scale in the tsunami response and 2) Bangkok Metropolitan area response to flood crisis and 3) the district level response to massive accidents within Bangkok Metropolitan area. There is a need for the Thai national government to understand the emergency response system in a larger scale and to learn how to improve such system.

The **second chapter** reviews the literature related to emergency response in Thailand. This study proposes a conceptual model of the integration of intergovernmental networks in response to immediate crises built upon concepts of complex adaptive systems, interagency management, social networks, and information and communication management. Studies in the interdisciplinary area of emergency management approach this problem using a range of conceptual frameworks.

Chapter three presents the multiple approaches used in research methodology. Each methodology has its weaknesses which, in turn, become strengths of the others. This study explores the three cases of emergency responses in Thailand, by employing participant observation, content analysis, interviews and surveys. Each methodology complements the others in the analyses and interpretations.

Findings from the analyses are presented in **Chapter 4** characterizing the December 26, 2004 tsunami response and in **Chapter 5**, characterizing the emergency response to the flood crisis and a massive accident in Bangkok Metropolis. The two cases of emergency response in Bangkok are under the same Emergency Act, directed by the Bangkok Metropolitan Authority and managed by the District Offices and Volunteer Units. This approach organizes the two cases in one chapter under the management of the Bangkok Metropolitan Authority. Both cases share the same emergency structure and support of central agencies and the Civil Emergency Relief Department, in case of overloaded operations. The significant roles and critical functions of the Flood Control Center and Vicinity's involvement in flood crisis management will be discussed as well.

Chapter 6 illustrates how emergency response in each of the three cases is managed through a scalable intergovernmental network. The interpretation of the performance of the three emergency response systems is later identified in terms of non-adaptive and emergent adaptive systems. How to improve the performance of the entire emergency response system to a state of auto-adaptive emergency response is considered.

Chapter 7 of this study integrates all findings and analyses to suggest four concepts of effective emergency response that include; 1) a scalable intergovernmental network, 2) information and communication management, 3) resilient community network and 4) self learning in adaptive capacities. These four concepts, based on the concept of an auto-adaptive system with socio-technical components, are analyzed and integrated into the practices of disaster warning management and emergency response operations. These two steps are considered very important to help save lives and properties.

1.8 SUMMARY

This study expects to translate the concepts of emergency operations and management into practice at different scales of implementation throughout the country. It also emphasizes the effective coordination of multiple levels of agencies as well as the adoption of information technology to help reduce the obstacle of large scale complex tasks. Three cases are explored and analyzed throughout the study to reflect how Thailand emergency personnel at different levels of jurisdiction manage its emergency response operations in states of emergency of different scales of severity. Those cases are December 26, 2004 tsunami, flood crisis in Bangkok Metropolis, and massive accidents in districts of metropolitan Bangkok. The findings are expected to help district emergency personnel to reach out to the community for their effective participation, if an unexpected event occurs. In addition, this study explores the feasibility of integrating information technology into intergovernmental emergency management to generate back-up utilities in case of system failure and to enhance the performance of participating agencies for an effective emergency response.

2.0 A CONCEPTUAL MODEL FOR EFFECTIVE EMERGENCY MANAGEMENT

Many researchers have addressed both structural and nonstructural solutions in seeking to mitigate disaster. Nonstructural mechanisms offer an alternative approach of organizational management and policy implementation to address the effectiveness and efficiency of emergency management. Policy scientists have argued that disaster preparedness can lessen the vulnerability of human communities to unforeseen natural events (Rosenthal, Boin, and Comfort 2001). States of emergency can be managed effectively, if communities foster readiness through organizational adaptive capacities of households and response agencies. Emergency management policy and practice can be constructed and conducted with a clear understanding of the crucial elements of participating agencies in the operations. This study employs the concepts of self organization, complex adaptive systems, intergovernmental management, and information and communication management to explore the capability of organizations and agencies in managing states of emergency.

In order to address the research questions posed earlier (P.14), this chapter will review the relevant literature in reference to organizational adaptive capacities, the power of information and communication technology, and the use of interagency management under states of emergency. The three central theoretical concepts will be used to examine the state of emergency management practice in Thailand in two dimensions. The complex adaptive systems and self organization models help explain the individual and organizational adaptive capacities and functions in dealing with emergency and crises, while the intergovernmental coordination and social network concepts address the significance of getting agencies to work together effectively. In addition, research on information and communication technologies explore how networks empower the adaptive capacity and operational performance of interagency operations. This study proposes a conceptual model of how a country could manage its states of emergency effectively. The integration of intergovernmental coordination and information and communication management is critical to achieving effective and efficient emergency management. In order to integrate the two concepts to appropriately increase the performance of emergency management practice, it is essential to understand how participating agencies manage their specific operations as well as cooperative ones. This study will discuss each of the theoretical concepts in application to actual emergency management and practice, and proposes a conceptual model as an alternative approach respectively.

2.1 COMPLEX ADAPTIVE SYSTEMS (CAS) AND SELF ORGANIZATION

This research examines the problem of crisis management in an environment of complexity, placing the crisis into mega city and urbanized settings. The problem involves a wide range of activities under many levels of solutions that include the processes of response, mitigation, and recovery. Axelrod and Cohen (1999) state that complexity means the system consists of parts interacting in ways that heavily influence the probabilities of later events. They suggest a concept of harnessing complexity, which means living with, and taking advantage of, complexity, rather than trying to ignore or eliminate it.

Axelrod and Cohen attempt to explore how the dynamism of a Complex Adaptive System can be used for productive ends in order to help managers and policy makers harness complexity in rapidly changing and hard-to-predict environments. They explore three key processes in a complex adaptive system: variation, interaction, and selection, whether to encourage variation in a rapidly changing circumstance, how to assess the impact of manipulating interactions in an organization, and how to select and support the most viable individuals, teams, systems or strategies that emerge. They argue that most complex adaptive systems have distinctive interaction patterns and these patterns are neither random nor completely structured. Interaction patterns help determine what will be successful for the agents and the system, and this in turn helps to shape the dynamics of the interaction patterns themselves.

Based on these hallmarks of a complex adaptive system, Axelrod and Cohen offer a framework, a way of thinking through a complex setting that takes advantage of complexity, harnessing it to generate new questions and new possibilities for action and designing organizations and strategies in complex settings. They also pay special attention to the role of information in complex adaptive systems and thus make heavy use of examples derived from the Information Revolution. The Information Revolution not only promotes faster and wider adaptation, but also promotes a new mode of thinking about social systems. It engenders complex adaptive systems that capture the fundamental relationships of information to complexity and adaptation to secure the benefits of enormous change.

The study applies the model of complex adaptive system (CAS) to analyze the state of preparedness in communities. CAS assumes an infrastructure for communication and decision support among participants in the system along with the flexibility to adapt to the changing conditions. Kaufman's proposition (1993, P.212) suggests that the most creative action occurs at the edge of chaos where the system is operating with "sufficient structure to hold and exchange information and sufficient flexibility to adapt to changing conditions." Comfort (1999) agrees with Kauffman on the importance of information infrastructure and organizational flexibility as the main factors in enhancing the capability of the organizations to deal with uncertainty such as natural disaster and unexpected consequences. However, once the balance of the structure and the flexibility is set, it is crucial to anticipate the resistance to the transition.

In her discussion of shared risk, Comfort applies a model to explain different combinations of crucial components in emergency operation. These components include the two dimensions of technical infrastructure and organizational flexibility but also cultural openness. Technical infrastructure refers to the existence of a sufficient level of information and communication exchange regarding risks and operations to enable communities and their emergency response agencies to function effectively. Organizational flexibility is the extent to which emergency personnel are able to reduce complexity in the environment through functional differentiation of tasks among participating organizations and reintegration of sets of related tasks under the basic function of disaster response. Comfort points out that cultural openness; willingness to accept changes, improve performance, correct mistakes, learn new methods of work, and solve conflicts, is a crucial component in developing an adaptive organization. This study takes into account the significance of the culture as one of principal factors in challenging the effectiveness and efficiency of a concept of centralization with command and control in emergency response and management. Cultural openness needs to be rooted in local operations as a high value and new norm of the agencies implementing emergency procedures and delivering public services. Common understanding toward the primary goal will help guide the agencies to operate and coordinate in a clear and effective direction.

Comfort uses a three-dimensional model to capture the interaction among technical structure, organizational flexibility, and cultural openness that leads to successful transition for inter-organizational disaster response systems. Comfort introduces four types of response systems; non-adaptive, emergent adaptive, operative adaptive and auto-adaptive systems, which represent the dominant patterns found in actual cases. These four types of response systems provide a useful illustration of the process of transition, and the characteristics that both facilitate and hinder the emergence of self-organizing processes. This model will be used to analyze the performance of emergency response systems in actual cases of emergency operations in Thailand. Non-adaptive and emergent adaptive systems are those characterized by low technical structure which illustrates the lack of preparation and awareness of disaster risk in Thailand.

While non-adaptive systems explain the low organizational flexibility and low cultural openness that characterized the response to December 26, 2004 tsunami, medium organization flexibility and emerging openness to new cultural meanings of seismic risk demonstrate increased investment for flood crisis management in Bangkok, especially the awareness of flash flood and dam collapse. This study seeks indicators of the other two types, operative adaptive systems and self organizing systems, to explore the potential for change in the emergency management system in Thailand. This study also takes into account the concept of collaboration between the core emergency agencies in a large scale disaster across jurisdictions and the balance of cooperation and competence needed for sustainable disaster management.

A three-dimensional model is used to identify states of emergency response systems and how to make a transition to self-organization. "Self organization is the spontaneous reallocation of energy and action to achieve a collective goal in changing environment (Kauffman, 1993, P. 223).” The complex adaptive system (CAS) model recognizes that social systems engage in continuous learning and self organization in reciprocal interactions with the environment in which they are embedded (Comfort, 2000). Change in any one level may be perceived as a threat to the security and privileges at other levels. Specifically, in a developing country, the characteristics of the bureaucratic system and the learning environment of the organizations are likely to create resistance and obstruction to transition and change. The recent perception of smart communities as learning organizations is likely to increase the awareness of emergency and risk preparedness for the communities as well as participating agencies to confront uncertainty effectively. As such, the basic community institutions and functions demonstrate instances of self organization to cope with the crisis. This study examines the concept of self organization as a means of developing a learning environment and a new culture of work. All agencies have to clearly understand their own operations and prepare themselves well for a state of emergency. Under conditions of uncertainty, all agencies need to adapt to cope with negative events.

2.2 INTERGOVERNMENTAL NETWORK AND INTERAGENCY MANAGEMENT

Radin et al., 1996, states that multi-organizational arrangements are solutions for independent problems that cannot be achieved by a single organization. Managing states of emergency requires multiple participants across jurisdictions and organizational sectors. Many tasks in emergency management such as evacuation, medical care, transporting victims, and recovery operations need effective coordination across sectors public, private and non profit. States of emergency cannot be managed without cooperative inter-agency operations. With this environment, organizational transition represents a significant increase in complexity from behavioral change in an individual. It involves engaging multiple organizations simultaneously in many types of actions to address a complex problem (Simon 1981, Comfort, 1991). Bardach (1998) is concerned with the potential of public agencies to work together as a way of adding public value, and explores interagency collaboration within and across sectors. He measures the level of integration achieved in a variety of partnerships and in particular, concentrates on building interagency collaborative capacity. This study explores how emergency response operations are conducted in different environments to identify coordination among different agencies. The tsunami disaster in southern Thailand and massive accidents in Bangkok show the lack of effectiveness and coordination in managing states of emergency.

Thai government has implemented its policies under perceptions of command and control, and centralization to ensure quality control and the accuracy of rules compilation. Lack of experience in understanding a disaster like tsunami and coordinating emergency response resulted in ineffectiveness and inefficiency in delivering put another perspective into Thai governance to answer why emergency response is difficult or fails. Kettl and Salamon (2002) argue that command and control government in the past must be transformed into decentralized governance because earlier governmental solutions fail to resolve the problems that face governments now. Pfeffer (1992) also asserts that the exercise of control, influence and authority relying on the existence of recognized hierarchies is now rarer. Such changes have undermined hierarchies and made collaboration and co-operation more useful management tools than the old methods of command and control.

In less hierarchical organizations, the most effective managers are those who take the time to win others round to their way of thinking--campaigning rather than coercing. This also tends to produce wiser decisions. Pfeffer suggests that there are three ways of getting things done: 1. through hierarchical authority, which is badly out of fashion, 2. through developing a strongly shared vision or organizational culture, which is very time and resource consuming, 3. through use of power and influence. He focuses attention on this third strategy, stating that it emphasizes method rather than the structure. This study seeks to balance command and control, which is believed to achieve accuracy in policy implementation, with interagency networks of operations, which are believed to be more effective and efficient in managing emergency response of multiple agencies performing many tasks.

Provan and Milward, 2001, comment that the delivery of public service at multiple levels requires the integration and coordination of a variety of organizations into service delivery while Meyers et al., 2001, assert that the devolution appears to have moved the boundaries of program authority and responsibility both downward and outward. Getting agencies to work together needs not only self reaction readiness. Personnel can be well trained and learn about their partners' operations but they also need to bring knowledge and skills to practice. This study approaches the network of intergovernmental management by asserting the idea of knowledge sharing into the emergency networks both internally and externally regarding geographical limitations. The lack of knowledge and experience regarding the characteristics of the disaster increases the difficulty of adaptive capacity of organization to react individually and cooperatively.

Self organization and complex adaptive systems will help build a strong foundation to develop the organizational adaptive capacity. This capacity will enhance the trust among each other to work together (Bardach, 1998), but all participating agencies still need to learn how to work together effectively and efficiently. He proposes that interagency collaboration is defined as activities by agencies intended to increase, or add, public value by having the agencies working together rather than separately. Many institutional features of our policy making system suggest that unexploited opportunities to create value in this way are abundant. The process of trying to exploit such opportunities involves leveraging personnel and financial resources for collaborative purposes, designing and managing an effective operating system, reaching and maintaining consensus on basic goals and on tradeoffs among relevant sub-goals, creating an effective culture or ethos of interpersonal working relationships, and securing the implicit or explicit consent of elected officials. It is a complex developmental process that unfolds over a long time period and requires the government to shift its administration from hierarchy to networks.

2.3 THE SOCIAL NETWORK PERSPECTIVE AND ANALYSIS

The social network perspective is a comprehensive analytical strategy and conceptual approach for how resources, goods and information flow through particular configuration of social ties. Social networks cut across discrete communities and other entities, even though in certain cases they may also congeal into bounded groups and clusters. Transactions unfolding within social networks are not always symmetrical and the patterning of invisible relations among actions such as structural holes or gaps in a network usually means disparities in access to both information and control benefits. The social network approach provides a framework for studying the structure of interaction among emergency response agencies and the communities. These interactions reflect how emergency agencies engage in response operations during states of emergency that illustrates a pattern of intergovernmental coordination. In emergency management, coordinating operations requires an understanding of how the network of response actions is conducted and what communication processes are used, especially in large scale operations that require multiple agencies to perform many tasks simultaneously under urgent time constraints and threats to life.

Public policy makers, planners, and managers are increasingly relying on what might be called large-group interaction methods to involve large numbers of people in planning and implementing major change efforts. These methods are structured processes for engaging large numbers of people to: (1) enhance the amount of relevant information brought to bear on a problem; (2) build commitment to problem definitions and solutions; (3) fuse planning and implementation; and (4) shorten the amount of time needed to conceive and execute major policies, programs, services, or projects. Proponents of such methods claim that they provide sets of concepts, procedures, and tools that can help public and nonprofit organizations and communities deal effectively with change.

This study borrows the network perspective from the structuralism school using a variety of network analytic concepts and techniques to address substantive issues that have preoccupied most sociologists. The field of network studies describes the comprehensive structure of relationships in a social system. Through manipulating matrices, analysts can find patterns of connectivity and cleavage among members within social systems. This perspective also reflects changes in network structures over time and ways in which system members are directly and indirectly connected. It enables analysts to trace lateral and vertical flows of information, identify sources and targets, and detect structural constraints operating on flows of resources.

This study inquires into how different emergency personnel operate and interact which helps to identify critical roles and coordination patterns in order to seek an appropriate alternative for improving in coordination within and among jurisdictions. This study acknowledges that network studies are not always methodologically feasible or analytically appropriate, and uses multiple methodologies, for collecting data and defining boundaries regarding the demographic characteristics of, network members. The study employs a range of statistical and mathematical techniques to tease out the underlying structural properties of the emergency response system.

Carley and Hill (2001) argue that organizations are composed of intelligent adaptive agents constrained and enabled by their positions in networks that link agents and knowledge. Here, information can include beliefs, values, goals, graphs, pictures, words, numbers, information on the task, on what others know and with whom they interact, on one's own and other's demographic characteristics,. Most models of network evolution overlook the fact that the social network does not exist independent from the knowledge network. Although the social network and knowledge network co-evolve, they can stabilize at different times, which can have a great effect on an organization's behavior. When the organization is viewed as a meta-network, it is easier to see how a change in one of the sub-networks can cause changes in the other sub-networks. It pays a lot of attention to critical nodes that link other sub-networks together. This study examines the roles of governmental, nongovernmental and communities' sub-networks in the national emergency response system. Each sub-network performs its functions in order to adapt and survive from states of disaster while it also mobilizes resources and personnel to help the entire emergency operations system. Information and resources that flow in sub-networks also affect the performance of the meta-network since managing a large scale emergency response needs effective coordination and linkage between active sub-networks in particular areas and the specific functions they perform to integrate their operations through a common framework for the entire network of response operations.

Watts (1999) also supports the emerging recognition of social networks in his book, *Small Worlds.* Watts notes that the recent development of organizations includes 1) emergence and evolution of cooperative behaviors in large organizations, 2) processing of information in spatially extended and irregularly connected networks such as the human brain, 3) design of power and communications networks, and 4) emergence of global computational capability from locally connected systems. This study focuses on the area of integrating intergovernmental coordination, information and communication into emergency response network as later discussed in a proposed conceptual model.

Provan and Milward (2001) state that although cooperative, inter-organizational networks have become a common mechanism for delivery of public services, evaluating their effectiveness is extremely complex and has generally been neglected. To help resolve this problem, they discuss the evaluation of networks of community-based, mostly publicly funded health, human service, and public welfare organizations. Consistent with pressures to perform effectively from a broad range of key stakeholders, they argue that networks must be evaluated at three levels of analysis: community, network, and organization or participant levels. While the three levels are related, each has its own set of effectiveness criteria that must be considered. They suggest that effectiveness at one level of network analysis may or may not match effectiveness criteria at another level, and discuss the extent to which integration across levels may be possible.

Social networks also serve as the means to integrate local citizens' groups into an organizational framework to work together with the government agencies to reduce risk and manage emergencies. Putnam (1993) argues that networks of civic engagement facilitate coordination and communication, and amplify information about the trustworthiness of other individuals. Local communities have knowledge of their area and people. This familiarity of location and resources becomes crucial when the authorities and participating agencies are unable to access this potential. This study examines the process of enlisting community representatives to work together with the public agencies from the very first step of emergency management. It allows local representatives to share their specific knowledge of the area as well as understand the developing response process. This exchange of knowledge facilitates the implementation of the emergency operations.

2.4 THE INFORMATION TECHNOLOGY AND COMMUNICATION MANAGEMENT

Self organization, complex adaptive systems, and intergovernmental coordination need an effective information management and communication system not only to build a common pool of information and knowledge to share between agencies but also to ease the situation of working across jurisdictions of many different government agencies and organizations. Sufficient information and knowledge exchanged among agencies also help emergency personnel to make more informed decisions and increase the efficiency of their actions under time constraints. Dunn (2003) points out that for emergency managers, problem sensing and structuring are key. The lack of precise information leads to ill or, at best, moderate structuring of the problems. The limitations of decision making for organizations operating under uncertainty have spurred researchers to explore means of reformulating the concept of problem solving capacity (Comfort, 1991). This study also examines the use of information technology mechanisms to enhance the power of communication and means of facilitating information flow through social networks to help policy makers share knowledge and communicate more effectively in states of emergency.

For organizations to function well, Graber (2003) suggests that they must have structures that are appropriate to organizational goals. "Structures refer to the patterns of information flow inherent in formal organization charts and reflected in work manuals." These official structures provide a restricted, standardized communication environment that enhances the stability and predictability of organizational behavior (J. March and H. Simon notes the importance of structures). Structure explains how information networks are constructed, and why they are formed. Graber also discusses network analysis, the significance of network positions, and the roles of networks in information management. She notes that the chief goal of networking is "to establish communication links with significant others to share information about mutually relevant situations" while that of network analysis is "to explain the communication roles played by organization members and the consequences for the performance of the organization.'

In public organization, the options for designing organizational structures are to use: geographical divisions, functional divisions, line and staff functions or client types. Graber addresses the impact of the previous steps on public managers' ability to use information effectively to make sound decisions. She discusses the four phases of decision making - problem analysis, option exploration, selection of models for decision (rational-choice, incremental-bargaining, aggregative, and garbage can model), and monitoring feedback. Graber also discusses common errors in decision making at the individual, group and organizational level, and suggests strategies that can be used to avoid errors such as enhancing the supply of information, fostering policy coherence and coping with crisis. With regard to the designing of structures for decision making, she argues that structures can be either top-level (formalistic, competitive and collegial models) or can be formed from external advisors who are authorities in the field.

Cahan and Cresswell emphasize that technology, information, and professional and organizational relationships played critically important roles in government, business, and community responses to the event. Effective use of a variety of information technologies helped government agencies to cope with, and respond to, the multiple crises and ongoing recovery demands resulting from the crises. Meanwhile, the severity of the crisis was exacerbated by damage to critical communications and infrastructure as well as the absence, outdated nature, loss, or inaccessibility of needed information resources. Bardach (1998) states that in his study of a geographically based network of human services agencies that collaborated to match clients with appropriate services, the communications processes among the participants were embedded in interpersonal relationships and also in an infrastructure of various connection mechanisms.

The information system infrastructure needs to be in place to facilitate reporting for emergency situations and give the workforce full information in order for them to make decisions. Communication channels as well as back up systems are required to keep all agencies connected and updated in order to support one another in unexpected events. The content of the information needs to be aggregated into a common knowledgebase for all parties involved in order to support accurate and timely decisions, especially during a state of emergency. Fountain (2001) argues that the use of information technology, such as in internet communication and networks of computing operations, allows networked organizations to extend control and coordination more easily across organizations. Information technology does not by itself create social capital or cooperation, but may enhance trust in the network through ease in communications. A government that forces network formation but eschews collaboration may increase, rather than decrease, the cost of collaboration. As Holland (1995) states, agents within the organizations represent collections of rules and rule syntaxes that use information as stimuli for response and adaptation, lever points for building the complex adaptive system. Making a transition to an adaptive socio-technical system requires the abilities to search and exchange information through communication channel that facilitates intra and inter organizational learning.

Peha (2005) investigates the effectiveness of communication in emergency response and states that emergency responders depend on reliable ad ubiquitous wireless communications. Failures in these communication systems can cost lives. He argues that a policy that required each public safety organization to independently make decisions about its communications system without a coherent plan and extensive coordination will produce an infrastructure that is more expensive than necessary. It is obvious that without effective coordination mechanisms, any communications infrastructure designed by many thousands of independent decision makers is prone to producing a tangle of systems that do not interoperate. With coordination, all of the inefficiency can be eliminated. Many public safety agencies would share multiple communications channels as well as costly infrastructure. Unless requiring emergency personnel to carry more than one type of equipment in case it fails, or having all representatives of all involved emergency agencies operate with their communication channels together in a central command center, communication equipment should be interoperable.

The impact of natural hazards upon human communities can be more effectively reduced through informed decisions regarding the location and construction of built environments, informed actions taken by the public exposed to risk, and timely communication and exchange of information among organizations and jurisdictions that have designated responsibilities for the protection of life and property (Comfort, 2000). In this sense, institutional design and a responsible learning environment provide crucial support. Private sector and citizen communities also need to know the status of risk for the area in which they have their business functions or their families. The information they share will also help organizations to decide how to provide assistance, if their actions change under unexpected situations.

2.5 CONCEPTUAL MODEL: THE INTEGRATION OF INTERGOVERNMENTAL COORDINATION, INFORMATION MANAGEMENT AND COMMUNICATION SYSTEMS

All four concepts of this study are crucial in creating and sustaining effective emergency management. This study proposes the integration of intergovernmental coordination and information technology with a strong foundation of organizational adaptive capacity in dealing with crises and complex changes. This integration will need the official collaboration of both national and local response units. Emergency situations are dynamic and the sequential effects are uncertain. The devastation can expand to a larger scale of the area which affects more of the population. Sometimes a state of emergency is declared across jurisdictions. It is clear that many directly authorized emergency response departments are out in the field. It is sometimes difficult to define where the authority and responsibility lie in the multi-agency work. In order to effectively coordinate multiple emergency agencies performing multiple tasks in multiple areas under time constraint and threats to lives, emergency response operations require efficient communication channels and equipment to keep all emergency personnel connected and updated. Information sharing and exchange are critical not only during the field operations but also in learning and training programs. Mutual understanding and clear direction of how emergency response and disaster management are conducted help multiple agencies to coordinate and compensate each other in case failure occurs among them effectively.

An intergovernmental network approach seeks to find an appropriate level of authority through the management of interagency emergency operations not only to prepare them to work together, but also to balance command-control and decentralization. Ironically, the idea of decentralization and empowerment of local authorities is the underlying value of giving the local governments the authority to control their emergency operations. Bangkok government will at best be able to control its resources and operations. A long history of bureaucratic culture makes the system vulnerable to change especially switching between rowing and steering. Government agencies have been trying to implement concepts of decentralization, street-level participation and citizen empowerment instead of command and control of centralization. Public agencies may still organize their work and responsibility using command and control techniques, especially under heavy pressure and urgent time constraints. Emergency operations are at their best strategic implementation, if the collaboration can be well structured. Since, emergency management is uncertain, strengthening response operations by having them support one another effectively is in the best interest of the affected population and rescue agencies.

Comfort's model of four types of adaptation in emergency response systems identifies a set of components needed for developing emergency response systems. The four types ranged from non-adaptive or emergent adaptive systems to an auto-adaptive system or self organization. This study uses Comfort's model to analyze the existing emergency model in Thailand. This study applies three crucial indicators, which are technical structure, organizational flexibility, and cultural openness, to identify the type of emergency management at each level.

At the national level, emergency response agencies confronted the devastation of the tsunami with a low level of technical structure, organizational flexibility, and cultural openness which this study defines as a non-adaptive system. Bangkok Metropolitan Authority's emergency response agencies conduct their emergency operations with higher levels of performance on the three components to illustrate an emergent adaptive system. This study examines the factors needed to improve the existing emergency management systems of national provincial and local levels from states of non-adaptive and emergent-adaptive to auto-adaptive. Such adaptive capacity and systems will be analyzed from two perspectives First, the study reviews the performance of an individual emergency agency and examines what factors affected its performance and its effectiveness in the emergency response system. Secondly, this study focuses on coordination among the emergency agencies, exploring a cooperative emergency response. Since managing states of emergency require multiple agencies to perform multiple tasks, the understanding of emergency management needs to take into account the interagency management accordingly. This study approaches an auto-adaptive emergency response system with a concept of intergovernmental management to collaborate emergency systems of both national and local levels for an entire country.

Effective intergovernmental networks and interagency coordination cannot function without the strong link created by effective information technology and communication system. Decision-making, under pressure of time constraints and threats to life, needs sufficient information to support participating agencies to make more accurate decisions. The knowledge, data, and information need to be integrated into a systematic database to share among all participating agencies and the public when necessary. The best information cannot serve organizations at the highest capacity without a good communication system and management. A communications system is crucial in facilitating the information flow among participating agencies and the public to keep all operations connected. Under a wide spread of devastation and disaster impacts, geographical distance and destruction make access to communications difficult, hindering cooperative emergency operations. Multiple tasks performed by multiple agencies also increase the complexity involved in following up each unit and monitoring the entire operation. In extreme cases, the electrical system fails when the entire power grid or electrical utilities black-out. For example, the recent tsunami disaster caused the loss of the entire electrical system in PhangNga area which created great difficulty for emergency operations. All participating agencies, in wide area operation, cannot physically see one another due to the distance and chaos of the situation. Communication channels need to be well structured and be designed with the knowledge that many communication stations can be destroyed and damaged, despite the fact that electricity is crucial for a communication system to work. This study explores alternative back-up methods for information and communication systems in extreme events. All agencies on duty confront such unexpected difficulties. States of emergency need effective interagency operations and such operations require sufficient information technology and efficient communications systems.

In addition to effective intergovernmental coordination and efficient information and communication management, this study also reviews community networks. Local residents are frontline emergency response personnel, if they are well-trained because they are closer to the incident and have more experience in the area. Their informed response to states of emergency can mitigate damage and reduce levels of severity, buying time for emergency personnel with more advanced equipment to arrive and operate. Community representatives and volunteers are also trusted by local residents. Evacuation and emergency regulations can be directed effectively by the assistance of these groups. In addition, the knowledge of members of communities will later help communicating feedback of search and rescue to the command center to avoid redundancy and repetition of emergency response that waste manpower and resources. Community networks also help connect small areas together without spending more resources to manage more complicated geographical operations. In employing effective networks, communities learn about potential risks they may confront as well as emergency procedures, creating resilient communities. In the chaos of extreme events, people tend to have less systematic decision making processes. Informed decisions require basic understanding and adaptive capacity to adapt to different situations and unexpected consequences. Information that emergency personnel shared through their database management and communication systems should be made available to general public to educate them regarding their exposure to disaster risk. Simulated operations exercises serve as an effective tool to enable emergency response personnel and communities to learn about emergency operations and to build trust with one another.

The integration of all networks of interagency coordination, information and communication create resilient communities that develop a constructive learning environment and adaptive capacity to enable all participants to maintain the levels of competency needed to deal with an extreme event. Training programs and education tools can be developed internally within a single agency as well as cooperatively among multiple agencies. Disaster is dynamic and less predictable. Emergency response personnel and communities exposed to risks need to adapt and be willing to learn new alternatives in addition to applying their previous knowledge. Adaptive capacity means continual updating and improving.

2.6 SUMMARY

Public safety is concerned with how emergency response is managed and how emergency personnel operate. Effective emergency response can help save lives and property. Disaster and emergency are complex and less predictable by their nature. Emergency response and management need to be flexible and have a high level of adaptive capacity to be able to manage the situation to return to normal. This study builds its conceptual model how emergency response and management should be operated on the notions of four significant concepts of Complex Adaptive System (CAS), Intergovernmental Coordination, Social Network, and Information sharing and Communication Managements. Previous studies have shown that emergency response systems increase their capacity to make informed decisions and cope with disaster situations more effectively when they have access to efficient communication channels.

In practice, emergency operations are implemented among different communities in which local residents necessarily become frontline emergency personnel. This study emphasizes the need for community participation in emergency management. The local knowledge of community residents helps to construct an appropriate emergency response for each area. In wide area operations, community networks can also help facilitate resources and connect the entire response system together. In order to encourage communities to work together and with public emergency personnel, values of self organization and adaptive capacity need to be strengthened. This study proposes that a model of auto-adaptation can improve the delivery of emergency services and reduce disaster risk.

3.0 RESEARCH DESIGN AND METHODOLOGIES

This research is an exploratory investigation of emergency management performance in which the operating contexts and the participating agencies differ. This exploratory research examines the complex system of emergency management in response to different types of threat and analyzes the effectiveness of operations in three cases in three different settings in order to illustrate the emergency management policy in Thailand. These cases include the December 26, 2004 tsunami in the southern Thailand, a flooding crisis in metropolitan Bangkok and massive accidents at the district levels in Bangkok. The cases are selected to represent emergency response operated by different primary agencies at national, provincial and local levels which, in turn, illustrate the emergency management of the country.

This chapter presents the following sections: 1) research design; 2) research questions exploring emergency responses in Thailand; 3) selection of cases; 4) units of analysis and observation; 5) qualitative and quantitative research methodologies , and discussion of threats to validity and reliability, 6) data collection procedures, including participant observation, semi-structured interviews and structured survey of emergency personnel , 7) analytical steps that guided the integration of multiple sources of data, and 8) anticipated findings.

3.1 RESEARCH DESIGN: EXPLORATORY NESTED CASE STUDY

This study conducted an exploratory case study for three cases of emergency response in Thailand which are 1) tsunami response of the national emergency agency, 2) Bangkok flood crisis response of the provincial agency and 3) massive accidents response of the district agency in Bangkok. An exploratory case study examines a set of actors bounded in time and place and the contextual material describing the setting of the case. It requires gathering extensive materials from multiple sources of information to provide an in-depth picture of the case (Creswell, 1998). Lincoln and Guba (1985) add that case studies structure the problem, the context, the issues, and the lessons learned. Creswell (1998) emphasized the use of within-case and cross-case analysis to identify the lessons learned.

This study seeks not only these two dimensions of analysis, but also the relationship among cases. This study tries to identify the appropriate solution for each case as well as the relationship among the three cases and collaboration among the three core actors in each case. In small scale emergencies like a massive accident in Bangkok Metropolitan Area, district or local level of agencies are likely to be able to manage emergency by coordinating with neighboring units to respond to the situation. However, in a medium scale emergency like flood crisis in Bangkok, which frequently affects more than one district or province across Bangkok's metropolitan area, emergency response requires coordination between district and provincial agencies as well as collaboration among provinces. In a large scale emergency like the tsunami response in six southern provinces of Thailand, national, provincial and local emergency agencies need to work together effectively to be able to deliver help to those in need. It is clear that emergency response in six provinces requires multiple levels of emergency agencies across many jurisdictions to perform a large number of tasks in different areas simultaneously. There is a need to explore and understand the relationship among these agencies' operations.

This tie between the three core actors leads to the concept of a "nested-set case study." Nested design exploits cross-unit variation and analysis to elucidate the features of an individual unit rather than examining an individual unit to explain a more general phenomenon (Coppedge 2002, Lieberman 2002). Each case in the nested design seeks to identify the positive and negative factors that influence the emergency plan of each core agency and to study the relationships among the agencies interacting in emergency operations. For example, emergency response to a flood crisis in the Bangkok Metropolitan Area and massive accident in a district of Bangkok reflect a nested case of how provincial administration, district officials, and volunteer emergency personnel react and perform their functions in response to extreme events at small and medium scales. Flood and massive accident operations share similarities and differences in emergency structure and agencies that need to be studied as an interacting system. The tsunami response reflects the interagency operations of the country at national, provincial and district levels in which a large scale disaster requires the coordination of all jurisdictional levels. Understanding the roles of single units and the interactions among them in emergency response operations will also inform the functions of scalable management of the entire emergency system for incidents at different degrees of severity.

As discussed in the conceptual model presented in Chapter Two, nested analysis also allows the investigation and comparison of the information and communication networks of the two settings within three cases. The first setting is the national emergency response network in tsunami event while the second setting buried within two events, flood crisis and massive accident managed by BMA emergency response. The strengths and weaknesses of each system affect the performance of the others while the relationships among the two sets of emergency operations reveal the structure of coordination and information shared among them. Understanding these interactions leads to improvement of existing information and communication networks and the innovation of emergency information sharing and communication managements of interagency operations.

3.2 RESEARCH QUESTIONS

In social science research, research questions should be relevant to real world problems and contribute to the framework of the existing literature in the field (King, et al, 1994). This study explores social phenomena that have occurred in reality and seeks to understand the mechanisms of operation and context of problems that affect human lives, and to verify this explanation. It addresses the functions of intergovernmental coordination, information network and communication management in increasing the effectiveness and efficiency of emergency response and management.

Command and control may be useful in the first stage of an emergency to direct operations and track specific tasks among multiple agencies, especially in a country that has relatively little experience in managing states of emergency. Conducting emergency operations for a large area across jurisdictions and among different agencies requires effective coordination among the participating agencies. This study examines the intra-agency and interagency networks to explain how participating agencies can work together more effectively and to balance centralized command and control with networking operations in emergency management.

The study will address the following research questions.

1. To what extent do the key agencies responsible for disaster operations collaborate in large scale emergencies?
2. To what extent are authority and responsibility for emergency management assigned to specific public agencies?
3. To what extent does intergovernmental coordination operate in emergency management in practice?
4. To what extent does the use of information technology facilitate inter-organizational coordination and communication in emergency management?
5. In what ways are intergovernmental coordination and information management integrated in Thai emergency management?
6. What significant factors would move existing emergency response systems in Thailand toward auto adaptation, and how?

3.3 SELECTION OF CASES

This study examines the emergency management system in Thailand and explores alternatives to improve emergency operations and crisis management. It addresses the operational management of district and provincial authorities as well as national. Thailand is selected because of its geographical exposure to hazards and its specific bureaucratic culture as a developing country. Located in reputedly a low-risk zone, Thailand is nonetheless vulnerable to unexpected powerful disaster attacks. The December 26, 2004 tsunami reflected the unprepared state of emergency management as well as the lack of experience, knowledge and awareness of the requirements for immediate response. Conducting rescue and mitigation operations from the national government throughout the south across six provinces challenged the ability and skill of the entire emergency management system.

Bangkok is a mega-city that illustrates multiple centers of every public and private activity. This research focuses in two cases of flooding and massive accidents in a metropolitan setting to consider the complexity of the environment as an additional factor in planning for emergency operations. Bangkok is a complex system in daily operations, let alone when the complexity is increased by the complicated circumstances such as flooding or massive accidents. Bangkok Metropolitan Authority has its own structure to manage its emergency operations. Bangkok has been addressing the flood threat for years and has reduced the flood release period from days to five or three hours, but not yet entirely. The first case examines Bangkok government's experience in dealing with flood crisis with the alternative approach of a non-structural solution by incorporating intergovernmental network management and information technology into the structure of coordination to enhance the performance of the agencies.

Flood Control Center of Bangkok Metropolitan Authority plays a central information provider and coordination agency in managing flood response although filed operation belongs to Civil Emergency Relief Department and District Offices. The second case examines the performance of the Bangkok emergency response units and their operation under the massive accidents. Existing policy assigns District Offices and Civil Emergency Relief Department total responsibility for all emergency incidents which includes flooding. District agencies which include district officers and local volunteer unit are frontline emergency personnel while Civil Emergency Relief Department personnel function as coordinating center in both cases. Flood crisis and massive accident responses share the same interagency coordination-action-plan when decisions should be made to share authority when scale of emergency is expanded. Nonetheless, flood crisis response reflects more frequent of coordination because of wider nature of flood prone area and illustrate a clearer picture of information sharing between central agencies, Flood Control Center and Civil Emergency Relief Department, and district emergency personnel.

The long term experience of flooding management of Bangkok government together with the changing experience of the national emergency response agencies should inform the response unit through their shared knowledge and organizational learning process more appropriately. The purpose of examining the experience of these three cases is to identify the potential for collaboration between the three major emergency response agencies, national, provincial and district. Well structured collaboration should provide an effective back-up operation for emergency management in the nation.

3.4 UNIT OF ANALYSIS AND CASE STUDIES

The unit of analysis for these three case studies is organization. Yin (2003) suggests that the selection of the unit of analysis is related to the way in which the initial research questions have been defined. The unit of analysis specifies the level being addressed by the study questions. This study examines the performance of emergency response organizations at three different levels of operation. Three different cases are analyzed and assessed. Since this research explores the network of intergovernmental interactions, the analysis will identify in the three sets of participating organizations. In each case, the study focuses on the organizations with primary responsibility for emergency response, the Department of Disaster Prevention and Mitigation (DDPM) under the Ministry of Interior, and Civil Emergency Relief Department (CERD) and

District Offices (DO) under Bangkok Metropolitan Authority's (BMA) management. This analysis investigates and assesses emergency management practice in these core agencies.

The units of observation are emergency personnel engaged in emergency operations. Included in observations are three groups of participating personnel in emergency management; 1) top management, as decision makers, such as ministers, directors general, provincial governors, deputy permanent secretaries and department directors, 2) middle management, as linking pins, such as district deputy, supervisors and chief of operations, and 3) operational level as frontline personnel performing emergency response in actions. The field observations were aggregated at three levels of performance; individual, organizational, and system wide. This study examines the actions, interactions, behavior, and response of emergency personnel to explain the effectiveness of their operations which, in turn, reflects how organizational operations and coordination are managed. The inter-organizational management also helps to understand the entire system of emergency management in the nation.

This research explores three cases of emergency management, tsunami disaster, flood crisis and massive accident to explain these cases:

1) How does DDPM implement the emergency management plan? How does DDPM work locally and nationally?
2) How does the BMA manage among its own agency, District Office (DO) and interact with other agencies and the community in flood crisis management? What are the patterns of coordination or command and control?
3) How would the model of flood crisis management implemented by the BMA apply to the practice of emergency management under the newly established response department, CERD?

4) To what extent did the DDPM, BMA/CERD, and BMA/District Offices work together, and how do they define their separation of responsibilities?

These three cases illustrate the work of core and participating agencies in emergency operations nationally, provincially, and locally. This study explores and examines the operation of each individual core agency to identify its adaptive capacity in states of emergency and further studies the interaction between all agencies to identify the existence of intergovernmental network in emergency operations and to explain how effective the coordination is functioning. The purpose of exploring theses applications is to understand the intergovernmental management as well as the use of information and communication technology in managing states of emergency.

The cases, outlined below, begin with the most severe case that involved disaster operations at national provincial and local levels, the tsunami of December 26, 2004. The second case addresses the flood crisis in metropolitan Bangkok, and the third case focuses on disaster operations in massive accidents at the district level in Bangkok. Noticeably, the two emergency operations in Bangkok share the same primary emergency actors.

Table3.1 Outline of Case Studies, Actors and Analytical Frameworks

	CASE 1 DECEMBER 26, 2004 TSUNAMI RESPONSE (NATIONAL LEVEL)	CASE 2 FLOOD CRISIS RESPONSE (PROVINCIAL LEVEL)	CASE 3 MASSIVE ACCIDENT RESPONSE (DISTRICT LEVEL)
PRIMARY ACTORS	1. DEPARTMENT OF DISASTER PREVENTION AND MITIGATION 2. PROVINCIAL GOVERNMENTS OF PHUKTE, PHANGNGA AND KRABI 3. CIVIL DEFENSE VOLUNTEER UNIT	1. BANGKOK METROPOLITAN AUTHORITY 2. FLOOD CONTROL CENTER 3. DISTRICT OFFICES (DO) 4. CIVIL DEFENSE VOLUNTEER UNIT 5. CIVIL EMERGENCY RELIEF DEPARTMENT (CERD)	1. BANGKOK METROPOLITAN AUTHORITY 2. DISTRICT OFFICES (DO) 3. CIVIL DEFENSE VOLUNTEER UNIT 4. CIVIL EMERGENCY RELIEF DEPARTMENT (CERD)
OTHER ACTORS	1. LOCAL COMMUNITIES 2. OTHER GOVERNMENTAL ORGANIZATIONS 3. OTHER NON-GOVERNMENTAL ORGANIZATIONS 4. NATIONAL POLICE DEPARTMENT	1. LOCAL COMMUNITIES 2. VICINITY'S ADMINISTRATION AND AUTHORITIES 3. NATIONAL POLICE DEPARTMENT 4. MINISTRY OF METEOROLOGY	1. PARAMEDIC AND MEDICAL CARE UNITS 2. PRIVATE RESCUE UNITS 3. NATIONAL POLICE DEPARTMENT
ANALYTICAL FRAMEWORKS	1. LEGAL STRUCTURE AND AUTHORITY OF DDPM 2. EMERGENCY MANAGEMENT PLAN OF DDPM 3. CONTEXT OF OPERATIONS IN ASSESSMENT OF TSUNAMI EVENT 4. INVOLVEMENT OF OTHER AGENCIES AND ORGANIZATIONS 5. APPLICATIONS OF INTERGOVERNMENTAL MANAGEMENT 6. USE OF INFORMATION TECHNOLOGY AND COMMUNICATION MANAGEMENT	1. BMA FLOODING MANAGEMENT STRUCTURE 2. ESTABLISHMENT OF THE FLOODING CONTROL CENTER AND ITS AUTHORITY THROUGH COMMAND AND CONTROL 3. COORDINATION AMONG THE PARTICIPATING AGENCIES, DO AND CERD 4. ASSESSMENT OF LOCAL COMMUNITIES INVOLVEMENT AND CIVIL DEFENSE VOLUNTEER UNIT 5. HIERARCHICAL AUTHORITY AND THE INTER-AGENCIES IMPLEMENTATION 6. USE OF INFORMATION TECHNOLOGY AND COMMUNICATION MANAGEMENT	1. STRUCTURE AND AUTHORITY OF CERD AND DO 2. RESPONSIBILITY AND COORDINATION OF CERD AND DO UNDER AN EMERGENCY 3. TRAINING PROGRAM AND ASSESSMENT OF CERD AND DO 4. EXPECTATION OF CERD AND THE EXPANSION OF RESPONSIBILITY 5. LOCAL COMMUNITIES AND CIVIL DEFENSE VOLUNTEER UNIT PARTICIPATION 6. USE OF INFORMATION TECHNOLOGY AND COMMUNICATION MANAGEMENT

In all cases, this research will take into account the role of a new established organization, the national disaster warning center (NDWC), Thailand.

3.5 RESEARCH METHODOLOGY: MIXED METHODS

Social science research can be quantitative or qualitative in style (King, et. al, 1994). Research is designed to make inferences either in a descriptive or explanatory way on the basis of empirical information about the world. Descriptive inference is the process of understanding an intellectual construct on the basis of a set of observations while explanatory or causal inference seeks to identify causal effects from the data observed. Exploratory and descriptive case studies represent appropriate methods to analyze social phenomena.

In deploying case study research, Yin (2003) suggested that unlike a solely qualitative approach, case studies can be based on a mix of qualitative and quantitative evidence. King, Keohane, and Verba (1994) and Brady and Collier (2004) agree that both quantitative and qualitative analysis can be used successfully to achieve similar social scientific ends. Used appropriately, these two approaches complement one another in explaining and interpreting the findings of the study. This research is conducted as an exploratory study with the nested case design and employs both qualitative and quantitative methods of observations, interviews, social network analysis, documentations and structural surveys to identify complementary characteristics rather than advocating a single style of research.

3.5.1 Mixed Methods

3.5.1.1 Qualitative Approach: Observation and Interview

1) Participant observation

I conducted on-site observation in the affected communities and at the emergency operation centers in southern provinces, January 2005, as well as metropolitan Bangkok, July

2005, to examine emergency operations and to witness the situation at the peak of the crisis. In participant observation, information from non-structured conversations and documentation were collected and obtained. The purpose is to compare direct observations with other sources of information. Multiple sources could increase the reliability and validity of data and information which the researcher collects for analyses.

2) Interviews

I conducted interviews to get in-depth information of emergency operations and emergency management culture from every level of participating agencies, national, provincial and district. Semi-structured questions in the interview were designed and constructed from preliminary analysis of documentation and participant observation during the first phase of the field research. Detailed information obtained from interviews also supplemented the findings and results derived from other methodologies.

3.5.1.2 Qualitative and Quantitative Approach: Social Network Analysis

I did a content analysis, from a local newspaper (ThaiRath dated December 27, 2004 to January 17, 2005) for a tsunami response, and from the emergency operations reports for the emergency responses in Bangkok area, to extract the information needed for the analysis of social network. Social network analysis allows measurement of structures and systems quantitatively that would be difficult to describe without relational concepts, and provides understanding of structural properties. Such understanding was gained during a step of content analysis as well as additional information from the observation and interviews. UCINET software which was used to report a measurement of the networks also allowed us to map the relationships of actors in the network into a diagram. This function of UCINET helps visualize how actors interact clearly.

As Wasserman and Faust suggest that the methods of social network analysis provide explicit formal statements and measures of social structural properties that might otherwise be defined only in metaphorical terms, this study presented webs of relationships, closely knit networks of relations, social role, centrality, group cliques and so on are given mathematical definitions by social network analysis. Explicit mathematical statements were also used to compare the characteristics of the networks in this study.

3.5.1.3 Quantitative Approach: Structural Questionnaires

In addition to observation and interviews, this study collected data in a survey of emergency personnel regarding their assessment of work conditions under crises or emergency, inter-agency cooperation, and participation in crisis operations. The survey was intended to serve two purposes; to crosscheck with the reports obtained from observation and interview of similarities and differences, and to identify critical factors for improving emergency operations and building a strong emergency response network.

A stratified representative sample was used to collect data from emergency personnel at national, provincial and local levels of emergency operations and cover three groups of management levels which are top, middle and operational. How to distribute and conduct the survey and a description of the sampling design are presented in data collection.

3.5.2 Threats to Validity and Reliability

This study reviewed the criteria for internal validity, external validity, and reliability of the findings and analyses to determine whether there were inconsistencies that affected the generalization of findings across time and space.

A threat to internal validity was rose to question the effect of intergovernmental coordination, information sharing and communication management, and socio-technical components in emergency management. The exploration and assessment of this study were built upon the studies and practices of disaster and emergency management in complexity. Participant observation and interviews allowed this study to document and obtain information from the informants directly how they viewed the effects of factors proposed by the study on emergency responses to avoid such threat.

Threats to external validity arose differently since this study covered every emergency agency and organization with in the nation, Thailand. Instead of questioning whether research findings could be generalized with other actors or jurisdictions, the question was asked if the findings could be used by other developing countries and other types of emergency such as terrorism. This study emphasized the significance of culture and emergency structure as factors affecting to emergency response. Further study needs to take into consideration the similarities and differences in cases' characteristics if findings are analyzed in different settings. The other perception of external validity was the extent to which this study was drawn on the theoretical framework of "Shared Risk", Comfort 1999. Her socio-technical components were also used to apply and examine other emergency responses in other countries across the world. This study, although quantifying socio-technical components, shared the same theoretical fundamental as in Comfort's model. This study validated this concept of strong relationship between socio-technical components and emergency response in the next chapters.

Construct validity was taken into account of the study emphasizing empirical studies and practices of sources and theoretical frameworks upon which the operationalization of inferences is built. This study carefully modified socio-technical components from previous studies and practices to fit with specific characteristics of the Thai environments using preliminary field research and analyses of experts. The proposed conceptual model of critical roles of intergovernmental coordination, information sharing and communication management were evidenced by the event of ineffective tsunami response. A preliminary analysis of Bangkok emergency response from non-structured interview also reflected an agreement of the acceptance of critical roles of those factors in emergency responses.

Reliability has to do with the quality of measurement. In its everyday sense, reliability is the consistency or repeatability of the measure. This study paid attention to two types of reliabilities; 1) Inter-rater or inter-observer reliability, and 2) Internal consistency reliability. For the inter-rater reliability, this study was able to ask specific questions twice in a different way to determine the accuracy of the responses being provided. For the internal consistency reliability, this study performed a pre-analysis data screening before running factor analysis and multivariate analysis to make sure that all assumptions and restrictions are met. Tests of missing values, outliers, normality and linearity were performed. In addition, two different persons were performing manual verifications. However, reliability test can be performed mathematically by computing Cronbach's alpha value or calculating the estimation of a ratio between variances of true score and measured score. The closer to "1" the ratio is, the higher reliability the measurement has. Each of the reliability estimators gives a different value for reliability. In general, the test-retest and inter-rater reliability estimates will be lower in value than the parallel-forms and internal consistency estimates because they involve measuring at different times or with different raters.

We often think of reliability and validity as separate ideas but, in fact, they are related to each other. In many cases, the study is consistently and systematically measuring the wrong value for all respondents, or the study seldom hits the target but gets the right answer on the average. Statistical validity and reliability are a strong part of this research due to the coverage of cases and large sample size. Cases used in this study cover emergency response of national, provincial and district levels managed by every emergency personnel and organization in the nation. Sample size is large of total number of 424 informants (N=424) which include emergency personnel around the country, 75 provinces and a capital city, Bangkok province.

Multiple methods used in this study also complement each other. Generalization of quantitative analyses of statistical findings is also well explained in detail and depth of understanding by the qualitative analyses of interviews and documents review. Social network analysis as a qualitative-quantitative tool also allows this study to explain emergency response network in statistic interpretation and narrative assessment. Nested design helps relate the cases this research study to identify factors affected to both individual and networking emergency responses.

3.6 DATA COLLECTION

Data for case studies came from many sources of evidence. Sources of evidence commonly used in doing case studies include documentation, archival records, interviews, direct observations, participant observation, and physical artifacts. No single source has a complete advantage over all others. The various sources are highly complementary (Yin, 2003). This study used multiple sources of data collection in order to benefit from such complementary interaction. Preliminary work for this study consisted of interviews and participant observation to gather informed details of emergency cases in order to establish a baseline illustration of existing states of the emergencies and emergency management practice. Documentation, archive records and physical artifacts were collected and analyzed. These analytical reports were used as the basis for developing a semi-structured interview protocol and structured survey questionnaires for data collection.

3.6.1 Review of Documentary Evidence and Archival Data

The archival data and secondary information were collected from the regulation books, laws, annual reports, and the statistical data on both paper-based and computer-based from Bangkok Metropolitan Authority and its key agencies, Department of Disaster Prevention and Mitigation, National Disaster Warning Center, Military, national and provincial governments and other governmental agencies. All official documents were authorized for the academic purpose of the study. This study also refered to previous master thesis on civil society policy of Bangkok Metropolitan Administration and the graduate study project of information technology and intergovernmental coordination in flood crisis in Bangkok, Kamolvej (1997, 2002).

3.6.2 Field Trips (Participant Observation and Interviews)

3.6.2.1 Observation and Documentation

3.6.2.1.1 Phase 1: January-February 2005

I went back to Thailand during the second and third weeks after tsunami disaster to conduct exploratory field study of how tsunami responses were conducted at local communities, shelters and emergency command centers in Phuket, PhangNga provinces and headquarter in Bangkok. This first phase of field trip was to obtain first hand information from empirical study in the real situation. The observation and non-structured questions were also conducted with Bangkok Metropolitan Authority and its key agencies to obtain information of Bangkok emergency response and management.

3.6.2.1.2 Phase 2: March and May 2005

I went back to Thailand to update information of tsunami recovery and rehabilitation in the southern area, a development plan for the Department of Disaster Prevention and Mitigation and the newly established National Disaster Warning Center responsible for disseminating warning message to general public. During this period, the information of a newly established emergency organization of Bangkok Metropolitan, Civil Emergency Relief Department was also obtained.

3.6.2.1.3 Phase 3: July-August, 2005

During this period, the data and information from documents, media news release, organizational reports and statistical data collected by governmental agencies on the December 26, 2004 tsunami disaster management are reexamined and updated to valid the findings and results of previous data collection and analyses. Official documents from national government and Bangkok Metropolitan Authorities were also collected and authorized to be used. The development and progress of CERD was also obtained to update the study’s database. Operations, drills and training programs of DDPM, CERD, District Offices and Civil Defense Volunteer Units were observed and documented by the researcher.

3.6.2.2 Semi-structured interviews

I returned to Bangkok, Thailand during the flooding season from July to August 2005 to collect data and information. Open-ended questions and semi structured interviews were employed in extended data collection as well as for cross-validating the content analysis. Semi-structured interviews were constructed from preliminary analysis of observation from previous phases of filed trip and were conducted using representative stratified sample of two levels of decision makers (top and middle management) and the response units (operational staff) at national, provincial and local levels for all three cases. The interview data identify the relationships within each organization to explain how they manage their operations as well as between all participating agencies to examine their coordination patterns if one exists. This information helps to confirm or contradict findings from content analysis of preliminary field data collection as well as update the process of disaster preparation and prevention. The updated information and more explanation of unclear answer during this period of interviews were obtained in December 2005, the last filed trip. A description of the interviewee is presented in table 3.2.

3.6.3 Conducting Surveys

A survey with structured questions was conducted using a representative stratified sample of the top and middle managements as well as the operational personnel of the emergency action plan at national, provincial and local levels. The survey was designed to produce the quantitative data that was integrated and analyzed using network and statistical analysis (top management as decision makers, middle management as linking pins, and operational level as personal in actions). The data from the survey characterized the collective attitudes of personnel in their network of operation and how they viewed their coordinative and adaptive capacity under emergency management operation. Findings from this survey, in turn, provided an understanding of current states of collaboration both within and among agencies as well as reporting suggestions for improvement. Identifications of informants were obtained only for liability. Conversation and observation during surveys distribution were obtained and analyzed only for the purpose of understanding the findings of the study. Confidentiality of informants is kept and the results of the surveys and analysis will be reported to the agencies accordingly.

I conducted the survey after the interviews with top and middle managers of the core agencies, the Department of Disaster Prevention and Mitigation, headquarters and Bangkok Metropolitan Board of Administration. I asked for willingness and cooperation from the deputy generals and chiefs of divisions of DDPM and deputy permanent secretary and district deputies of Bangkok to allow the survey to be distributed to emergency response personnel as well as emergency defense volunteer units. I distributed questionnaires to DDPM headquarters, DDPM regional centers, provincial DDPM in Phuket, PhangNga and Krabi provinces, CERD, District Offices and CDVU in target districts allowing three weeks period to be completed and collected.

3.6.3.1 Sample Design (Presented in Table 3.2)

1. National level:

1.1 Department of Disaster Prevention and Mitigation

1.1.1 Headquarters

1.1.2 Regional Center (RDPM)

1.1.2.1 Central Center 1: Pathumtani

1.1.2.2 Southern Center 11: Songkla

1.1.2.3 Southern Center 12: Surat Thani

1.2 Military

2. Provincial level:

2.1 Phuket, PhangNga and Krabi provinces

2.1.1 Provincial Government

2.1.2 Provincial Disaster Prevention and Mitigation

2.2 Bangkok province (Metropolis)

2.2.1 Bangkok Metropolitan Administration (BMA)

2.2.2 Flood Control Center (FCC)

2.2.3 Civil Emergency Relief Department (CERD)

3. Local level: District Offices in Bangkok province

3.1 New Economic Zone: PayaThai, Dindeang

3.2 Preservation Zone: Bangkok Noi, Bangplad

3.3 Resident Zone: Laksi

3.6.3.2 Translation of interviews and questionnaires

Semi-structured questions in interviews and structured questions in the questionnaires were designed and constructed in English and translated into Thai by two professional translators who are faculty of the English Teaching School of University of Trade and Commerce, and School of Liberal Arts, Chulalongkorn University, Thailand. A translation of interviews was first done by the researcher and a back-translation of main concepts of interview transcription was also provided by the translators. I encountered difficulty regarding the level of literacy of the informants. Explanations of questions and time to obtain information were provided in person. The coding of scores and translation of demographic and detailed information from the questionnaires were processed and integrated into a database by the researchers. Manual verification of data coding is also provided by two graduate research assistants for accuracy.

Table 3.2. Sample Summary for Survey and Interview; Dated: June 20 - August 31, 2005

AGENCY AND LEVEL OF AGENCY	**INTERVIEWS**	**N**	**QUESTIONNAIRES**	**N**
DPM @ HEADQUARTER	1. DIRECTOR GENERAL 2. DIRECTOR OF OPERATION 3. CHIEF OF IT 4. CHIEF OF SOCIAL SUPPORT 5. SUPERVISOR OF PLANNING	5	ALL LEVELS OF MANAGEMENT AND OPERATION	43
DPM @ REGIONAL CENTER	1. DIRECTOR OF REGIONAL 1 (CENTRAL) 2. DEPUTY DIRECTOR OF REGIONAL 11 (SOUTH) 3. DEPUTY DIRECTOR OF REGIONAL 12 (SOUTH)	3	C1=20 C11=22 C12=19	61
DPM @ PROVINCIAL OFFICES	1. CHIEF OF PHANGNGA 2. CHIEF OF KRABI (PHUKET)	2	PHANGNGA=12 PHUKET=10 KRABI=10	32
DPM @ DPM ACADEMY (REPRESENTATIVES OF PROVINCIAL OFFICES AROUND THAILAND PARTICIPATED IN TOXIC PLANNING AND OPERATION TRAINING)			NORTHERN PROVINCES=13 N/E PROVINCES=17 EASTERN PROVINCES=5 CENTRAL PROVINCES=8 SOUTHERN PROVINCES=14 NOT SPECIFY PROVINCE=7	64
BMA HEADQUARTER	1. DEPUTY PERMANENT SECRETARY 2. COUNSELOR TO BMA ADMINISTRATION 3. DIRECTOR OF LOCAL DISTRICT ENFORCEMENT 4. DIRECTOR OF BMA BUDGET	4		
BMA @ FLOOD CONTROL CENTER (FCC)	1. DIRECTOR 2. DEPUTY DIRECTOR 3. CHIEF OF IT 4. OPERATIONAL PERSONNEL	4	ALL LEVELS OF MANAGEMENT AND OPERATIONS	21
BMA @ CIVIL EMERGENCY RELIEF DEPARTMENT (CERD)	1. DEPUTY DIRECTOR 2. DEPUTY DIRECTOR (CHIEF OF TSUNAMI OPERATION) 3. CHIEF OF OPERATION	3	ALL 4 OPERATIONAL CENTERS	45
BMA @ DISTRICT OFFICES	1. BANGKHEN DISTRICT DEPUTY, CHIEF, PERSONNEL, VOLUNTEER 2. BANGPLAD DISTRICT DEPUTY, CHIEF, PERSONNEL, VOLUNTEER 3. LAKSI DISTRICT CHIEF, PERSONNEL, VOLUNTEER 4. PAYATAI DISTRICT CHIEFS, PERSONNEL, VOLUNTEER 5. DINDAENG DISTRICT CHIEF, PERSONNEL, VOLUNTEERS	20	ALL PARTICIPATED PERSONNEL FROM DISTRICT OFFICE AND VOLUNTEER UNIT UNDER DISTRICT SUPERVISION	87

AGENCY AND LEVEL OF AGENCY	INTERVIEWS	N	QUESTIONNAIRES	N
MILITARY @ NAVY	1. COMMANDER OF NAVY BASE REGIONAL 3 (SOUTH) 2. CHIEF OF ENGINEER (R3) 3. CHIEF OF OPERATION (R3) 4. COMMANDER OF TUBLAMU NAVY BASE 5. CHIEF OF OPERATION, TUBLAMU NAVY BASE 6. COMMANDER OF SEISMIC MONITORING NAVY BASE	6	ALL MANAGEMENT AND PARTICIPATED PERSONNEL UNDER NAVY NETWORK	24
MILITARY @ ARMY	1. MEDICAL UNIT 2. COMMAND CENTER	2	ALL MANAGEMENT AND PARTICIPATED PERSONNEL UNDER ARMY NETWORK	20
MILITARY @ AIR FORCE	1. COMMAND CENTER 2. AIR TRANSPORTATION CENTER (TSUNAMI)	2	ALL MANAGEMENT AND PARTICIPATED PERSONNEL UNDER AIR FORCE NETWORK	10
MILITARY @ SUPREME COMMAND DEPARTMENT	1. CHIEF AIR MARSHALL 2. COMMAND CENTER 3. COORDINATION TO RESCUE AND RELIEF CENTER	3	ALL MANAGEMENT AND PARTICIPATED PERSONNEL	17
TOTAL		**54**		**424**
%				**85%**

3.7 STEPS IN DATA ANALYSIS

3.7.1 Analysis of Documents and Archive Data

3.7.1.1 I investigated the emergency operations and crisis management policies of national, provincial and local levels. Bureaucratic pattern assessment and intergovernmental management analysis were used to capture the characteristics of all agencies and to understand structures of authority and the nature of coordination.

3.7.1.2 I investigated the existence of coordination patterns in both levels and examined the effectiveness and efficiency in each level of response operations. Network and content analyses were conducted from regulation books of all core agencies, news, and reports to visualize the emergency response network which reflects how multiple agencies interact and identifies critical nodes in the network.

3.7.2 Analysis of Interviews and Participant Observation

3.7.2.1 I investigated attitudes of emergency personnel toward their coordination patterns and the use of their connection. The limitations of their adaptive capacity to emergency operations and unexpected change or consequences may derive from the existing regulations and laws. .

3.7.2.2 I assessed information technology and communication processes to identify the existing facilities and to examine how to make the best use of them. The use of an information network integrated into the warning process is also assessed from the concept of operations of the National Disaster Warning Center, Thailand.

3.7.2.3 I assessed and analyzed communication patterns to evaluate their existence and effectiveness for the degree of familiarity with alternatives that emergency personnel and communities have during the period of emergency.

3.7.2.4 I assessed the degree of self organization and learning in developing more appropriate solutions at the organizational level for 1) organizational adaptation, 2) cooperative capacity, and 3) local community participation.

3.7.3 Analysis of Structural Questionnaires (Survey)

3.7.3.1 I examined the characteristics and nature of emergency response for each emergency agency to identify factors affecting their performance and emergency operations. Information sharing and communication management patterns were analyzed to determine how emergency personnel used and exchanged their knowledge and experience to support problem solving in emergency response operations.

3.7.3.2 I analyzed survey data using multivariate and network analysis to assess the extent to which general patterns of collaboration and coordination exist, and to identify sources for improvement. In addition, the socio-technical components were assessed to identify statistically significant relations between the components and their performance in emergency response.

3.8 SUMMARY

Exploratory research using a nested case study gives an additional measure of the relationships among the three cases by using within-case and cross-case analyses to study the social phenomena. Analysis of each case in the nested design identified the factors affecting the performance and implementation of each core emergency agency and how it varied by case. This approach portrayed the effectiveness of intergovernmental coordination in emergency operations for the country.

Mixed methods were employed to obtain and assess findings because a single method, quantitative or qualitative, would not be able to cover the gaps in analyses or deal with the threats to validity. In addition, this study was designed to explore emergency management at all levels of emergency operations in the nation. This effort covered a wide scale of management actions that requires the capacity to generalize findings to the national level as well as the ability to explain in detail of how such generalizations and residuals are constructed. Relationships among cases and core actors in each case require quantitative analysis to measure the strength and degree of coordination and networking. Qualitative interpretation was used to explain the identified characteristics and why those relationships were initiated in the documented patterns. Both sets of findings contribute to understanding how a strong network of coordination develops.

In order to analyze the documents, newspaper reports, field observations, interviews, social network, and survey, I used extensive materials from a wide range of sources and invested eight months of time in data collection. An exploratory study of emergency response and management on the scale of an entire nation requires multiple analyses and sufficient time to design an appropriate structure of analysis, collect the data, and interpret the findings.

4.0 DECEMBER 26, 2004 TSUNAMI IN SOUTHERN THAILAND

In order to analyze emergency response to that 26 December 2004 Tsunami in Southern Thailand, several types of investigation were done. This research investigated the characteristics of affected areas and the operation of the participating agencies in disaster operations from five different perspectives. The geographical analysis identified the different physical structures of the area and the specific layout of the region, so that the emergency team can create appropriate hazard and evacuation maps. The organizational analysis characterized the content of the devastation and outlined the design of an information system. The knowledge database includes information regarding all participating agencies and demonstrates the gap in knowledge between plans and practice. A content analysis of news reports and secondary sources was done to document the chronology and details of the tsunami operation in order to build a systematic database and cross check the validity and reliability of different sources in their report of emergency conditions. A summary of findings from in-depth interviews with selected officials and managers was used to verify the facts of the situation and identify the strengths and weaknesses of emergency operations. Finally, an analysis of knowledge gained from seminars and workshops was done to identify obstacles and to develop back-up plans for response and communication systems.

4.1 EMERGENCY STRUCTURE AND ORGANIZATIONS

Thailand governs 75 provinces through provincial governments headed by governors under the Ministry of Interior, national government. Bangkok, as the capital city (76^{th} province) has its own system of government and a special law that is discussed in the next chapter.

In a state of emergency, all involved government agencies and organizations are managed under the Civil Defense Act 1979.

4.1.1 National level:

The Minister of Interior, as the director of civil defense, is automatically the commander in chief for emergency operations of the country. There are committees from responsible government agencies mobilized to support the emergency operations.

4.1.1.1 Civil Defense Committee

This committee is authorized to approve policies and strategic plans for civil defense operations as well as budget management. It includes representatives of decision makers from the responsible government agencies, Permanent Secretary of the Ministry of Defense, Ministry of Public Health, Bangkok Governor, Director General of the Department of Meteorology, Director General of the Fiscal Bureau and Director General of the Department of Disaster Prevention and Mitigation.

4.1.1.2 Office of the Secretary General for Civil Defense

This office is chaired by the Director General of the Department of Disaster Prevention and Mitigation as a Permanent Secretary. This office functions as a command center for the Director of Civil Defense (Minister of Interior)

4.1.2 Regional level:

By special emergency regulation and order of the Director of National Civil Defense, four regional offices of the Civil Defense are established as the Command Center to direct and support emergency operations in every province. This regional body of civil defense serves as the coordinator in order to manage the interaction and collaboration of multiple agencies from public, non-governmental and private sectors.

4.1.2.1 Lower Southern Region Command Center (Range of supervision: 7 provinces)

4.1.2.2 Upper Southern Regional Command Center (Range of supervision: 7 provinces)

4.1.2.3 Northern Regional Command Center (Range of supervision: 17 provinces)

4.1.2.4 Northeastern Regional Command Center (Range of supervision: 14 provinces)

In addition, the Department of Disaster Prevention and Mitigation (DDPM) has established 12 Regional Disaster Prevention and Mitigation Centers (RDPM) around the country to support and supervise emergency operations, function as emergency information centers as well as to conduct training for the Civil Defense Volunteers that serve in different areas in the 75 provinces and Bangkok.

4.1.3 Provincial and local levels: divided into 5 levels

4.1.3.1 Bangkok Metropolis: Bangkok Governor is commander in chief.

4.1.3.2 Provinces: Governors are the commanders in chief.

4.1.3.3 District/ City: District Deputy or Sheriff is commander in chief.

4.1.3.4 Sub-district/ Municipality: Mayor is commander in chief.

4.1.3.5 City of Pattaya: City Permanent Secretary is commander in chief.

Under the national emergency regulation, the commander in chief is also considered the Director of Civil Defense for the designated area. Each position has absolute authority to direct and manage operations during an emergency.

4.1.4 Civil Defense Volunteer Units

The Civil Defense Act 1979, chapter 26, authorizes the establishment of Civil Defense Volunteer Units in every district in Bangkok as well as for cities in provinces around the country to assist in the Civil defense activities. CDVU management is conducted under the Civil Defense Volunteer Regulation, 1988, of the Ministry of Interior. This study acknowledges the "two hatted" role of Civil Defense Volunteer Unit (CDVU) as emergency response personnel directed by local authorities and as representatives of community level.

4.2 ORGANIZATIONAL AND INTER-ORGANIZATIONAL RESPONSIBILITIES

Under the Civil Defense Act of 2002, the Provincial Civil Defense Command Center is responsible for emergency management in the respective provinces to direct the City or District and Municipality levels of emergency personnel through the jurisdictional Civil Defense Command Centers at each level. To manage emergency operations, the level of severity of disaster and emergency define the levels of emergency personnel assigned to implementing the emergency operations. The levels of response are:

4.2.1 The levels of response

Level 1: Low scale of severity in small area: municipality is in charge

Level 2: In case of overloaded capabilities, municipality should ask for assistance from neighboring local units.

Level 3: Medium scale of severity or a wider affected area: municipalities ask for assistance from district or city civil defense units to direct and manage the operations of multiple units. In addition, the mobile unit is activated 24 hours/ 7 days a week.

Level 4: High scale of severity: Provincial Civil Defense Unit is in charge.

Level 5: Very high scale of severity: National Civil Defense is in charge.

4.2.2 Operations on December 26, 2004

The devastation in southern Thailand from the December 26, 2004 tsunami was beyond the capability of each affected province to manage. The devastation expanded to six provinces along the southwestern coastline. After the devastation, the geography of some areas in Phuket province and almost all the area in PhangNga province was dramatically changed. It was difficult and complicated to get rescue teams into the area, especially with unskilled and inexperienced personnel. Main roads and bridges were washed away. The entire electrical system was blacked out. Other unexpected impacts were triggered by the first event. When the electricity failed, communication systems went down as well. All agencies worked blindly, physically in the dark, and they could not communicate with each other simultaneously. Radio frequencies as well as cell phone networks were overloaded. During this time, the use of cell phones increased from 3 million connections a day to 33 million connections (Manager Newspaper, March 21, 2005). The lack of communication made it difficult for participating agencies to update the situation and exchange information necessary for coordinating their operations with units from different areas and units. This period of blackout, even though it was shorter than in other areas affected by the tsunami, caused a significant delay in search and rescue.

Phuket and PhangNga are governed in the provincial system under the national government. The governors are appointed by the Minister of Interior. Under a state of emergency, the governor, by the constitution, automatically becomes the head of the emergency operations center of the province. The governor commands the emergency operations and coordinates with all the participating agencies in the area. A single provincial system was not capable to respond either to the situation or to coordinate the assistance from neighboring agencies from the other five provinces, since all six provinces shared the same damaged coastline. This limitation signaled to the national government the need to send a national rescue and mitigation team into the area. More equipment, more manpower, and more medical personnel and resources poured, unorganized, into the affected areas like a second wave of water. This lack of organization delayed the rescue and recovery process. The low level of local participation in organizing response and recovery operations led to misinterpretation of needs for disaster assistance and dissatisfaction with the recovery process. Lack of valid information inhibited the development of trust among emergency agencies, and between citizens and governmental agencies. Distrust, in turn, affected the effectiveness of emergency response coordination.

4.3 INTER-ORGANIZATIONAL EMERGENCY RESPONSE

On December 26, 2004 after 10.00 am, a huge number of organizations, agencies, individuals and small groups rushed into the damaged area, trying to find survivors and deliver medical care. Every individual suddenly confronted extraordinary complexity. An unfamiliar natural disaster and a very large number of organizations engaged in providing the assistance, and a wide geographic area to serve a large number of survivors and injured led to near chaos.

Lack of experience in disaster and emergency management and lack of skills in coordination created obstacles for organizations and agencies in adapting to unexpected events like the tsunami. Some of the survivors died because of delay in medical attention and lack of food, rather than suffering from blunt force trauma. There was no effective information and database management for the records of rescuers and rescued. Relatives reported missing persons twice with different centers because members of the families were separated in the disaster. This situation led to redundancy in sending multiple rescue teams to the same area for the same search. The reports reflected unorganized coordination, interaction, information sharing and communication patterns for the emergency management which cost greater loss of lives and property.

Figure 1 below shows a subsystem of 291 organizations that interacted with other organizations in the tsunami emergency response during the three week period from December 26, 2004 to January 16, 2005. This subsystem of 291 organizations was identified out of 393 organizations that were cited in news report (Thai Rath Newspaper, Bangkok, Thailand, December 27, 2004 – January 17, 2005). Information obtained from interviews on not-reported rescue and emergency operations will also be noted in the analysis.

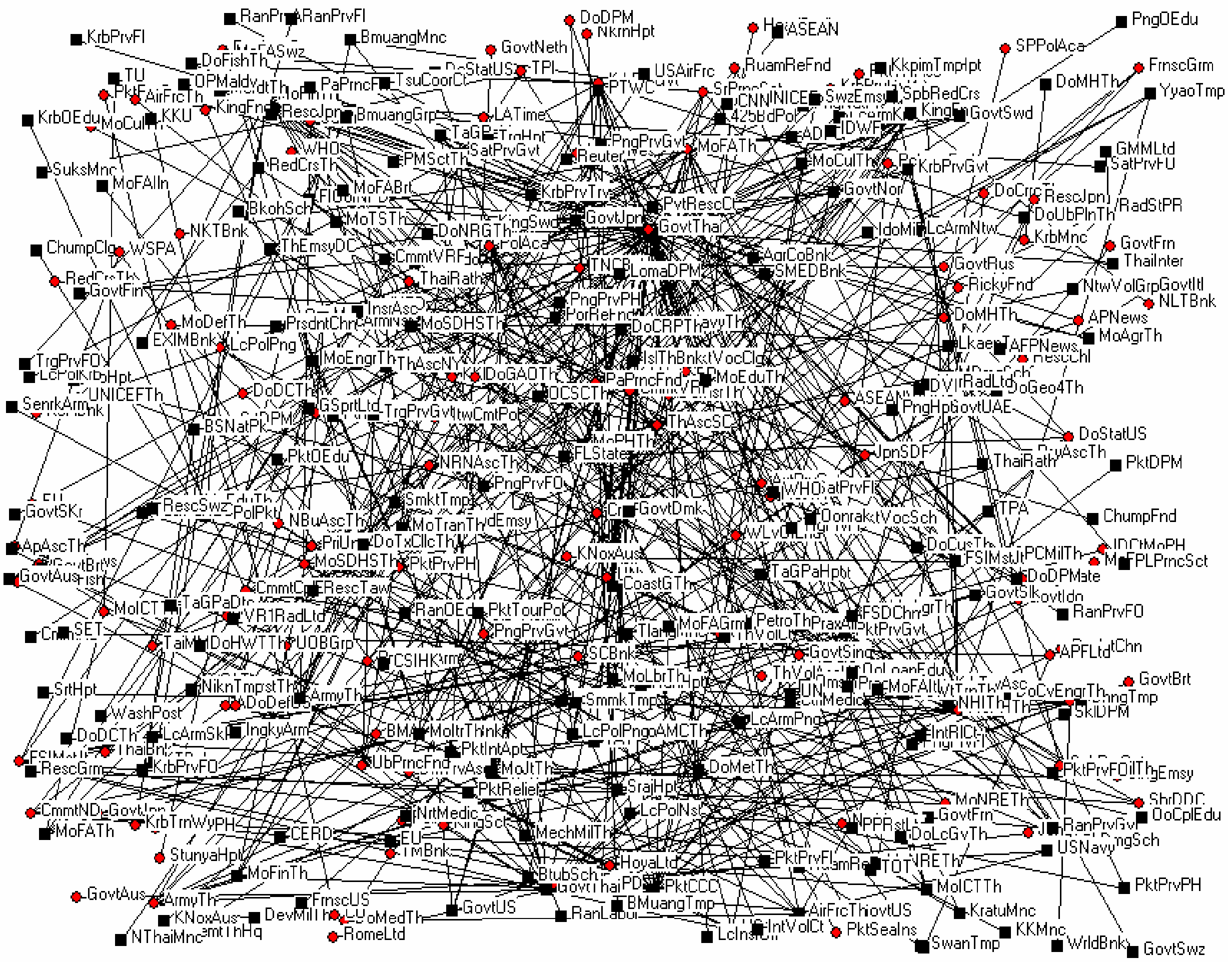


Figure 4.1 Map of Overall Organizational Interactions in the Thai Tsunami Response12/26/2004-1/16/2005

Source: Extracted from ThaiRath Newspaper dated December 27, 2004 – January 17, 2005
NOTE: Circles represent the initiators and squares represent correspondents in the interactions.

The organizational interaction matrix reflects the complexity and anarchy of the coordination among those organizations engaged in disaster assistance. The entire network contains 1,035 activities conducted by the total of 393 organizations. Analyzed further, 781 activities from this set of interactions created 531 ties among 320 organizations. Figure 4.1 shows an extremely dense network that requires careful study to interpret and analyze the patterns of interaction. To better understand the scalable emergency response of national, provincial and local organizations and agencies, this study extracted the characteristics of these organizations and agencies to identify their roles and operations in the emergency response. I then separated the domestic and international interaction networks, using national organizations and agencies as major players to present visual maps of the interaction matrix. This analysis also takes into account the chronological order of the organizations entering the system to discuss the readiness of response and the systems adaptive capabilities to cope with unexpected events or consequences. These analytical measures reveal the pattern of coordination across jurisdictions and sectors of funding work in the network.

In table 4.1, the total number of organizations participating in the whole emergency response system was 393 with 157 or 39.9% national organizations, 76 or 19.4% provincial organizations and 57 or 14.5% local organizations. The response system included 52 or 13.3% private and 50 or 12.7% non-profit organizations.

Table 4.1 Frequency Distribution of the 26 December 2004 Sumatran Earthquake and Tsunami Response, Thailand

	PUBLIC		NONPROFI		PRIVATE		TOTAL N O ORGANIZA ONS	
	N	%	N	%	N	%	N	%
INTERNATIONAL	**8**	**20**	**1**	**3.3**	**9**	**2.3**	**1**	**26.0**
NATIONAL	**1**	**26**	**2**	**5.1**	**3**	**7.9**	**1**	**39.9**
PROVINCIAL	**6**	**15**	**4**	**1.0**	**1**	**2.6**	**7**	**19.4**
LOCAL	**4**	**10**	**1**	**3.3**	**2**	**0.5**	**5**	**14.5**
SPECIAL INTERE GROUP*	**1**	**0.**	**0**	**0.0**	**0**	**0.0**	**1**	**0.2**
	2	74	5	12.	5	13.	3	100
*DEMOCRAT PARTY								

Source: Extracted from *Thai Rath Newspaper*, Thailand, December 27, 2004 – January 17, 2005. (see also Comfort and Haase (2005))

This characterization of the types of organizations participating in response operations reflects, first, less severe damage to the local infrastructure that enabled the local authorities and agencies to function in the response operations. Second, Table 4.1 documents the number of non-governmental organizations that assisted and participated in response operations and indicates their willingness to coordinate across sectors. Third, this pattern of interactions indicates a greater capacity for communication among organizations, despite the damage to local telecommunications. The communication channels in the affected area used substitute communications equipment, for example; mobile cars from telecommunication companies, trunk radios of the military, HAM or amateur radio, and several radio networks from the multiple emergency response agencies on scene. This redundancy in communications enabled multiple units to communicate with each other during the entire period of operations.

As presented in Figures 4.2 and 4.3, the number of organizations entering the response system is categorized by jurisdiction and source of funding. As shown, the number of organization entering the system was very high in the first day and dropped dramatically in the next two days. This drop reflects the difficulties of organizing and managing a large number of organizations in chaos. In addition, the lack of knowledge of the situation and how to deal with states of emergency made it more difficult to manage a single unit, let alone coordinate among multiple units. As reported from interviews and participant observation, many organizations and agencies involved in emergency response on the very first days had no coordination and little effective interaction. New organizations were unlikely to enter the response systematically. Disaster assistance and medical supplies were therefore delayed or lost in transportation and distribution. Some international organizations, such as private rescue teams from Hong Kong and Korea, managed their operations without initiating any interaction with Thai government agencies or help centers. These organizations entered the target areas where they were informed by local sources of location where it was likely people were present before the tsunami wave, and they proceeded independently with their search and rescue.

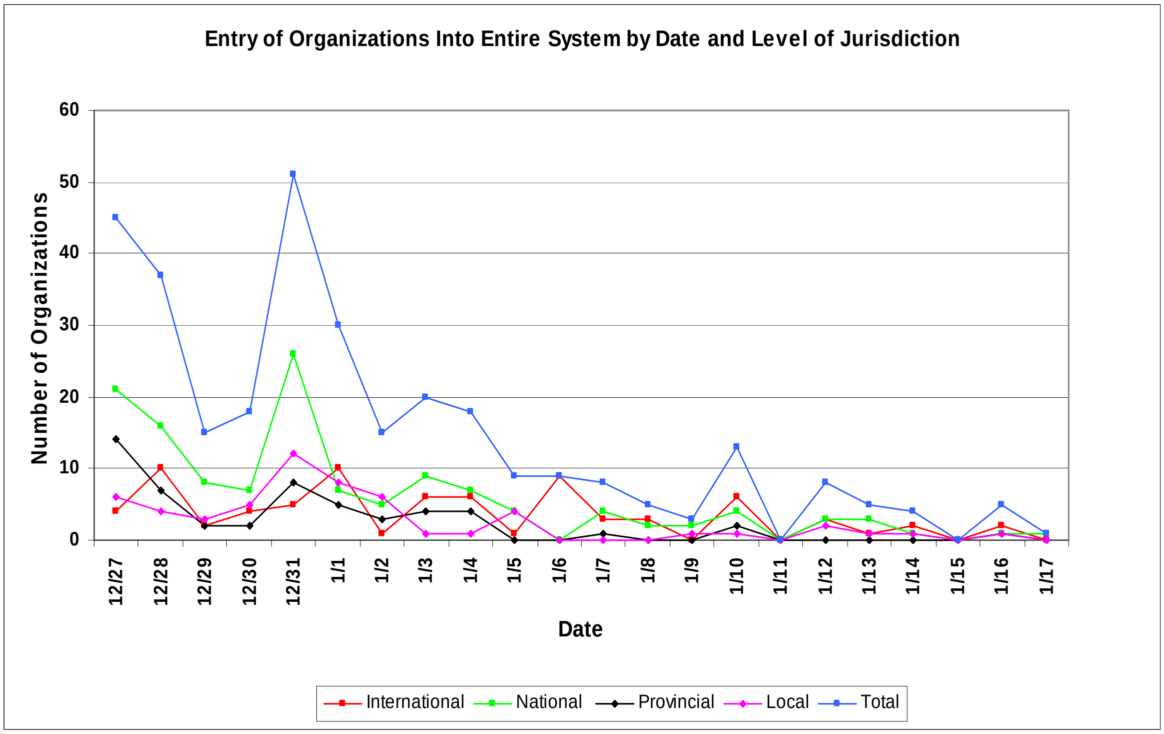


Figure 4.2 Graph shows the entry of organizations into entire system by date and level of jurisdiction

Source: Extracted from *Thai-Rath Newspaper*, Thailand December 27, 2004 – January 17, 2005.

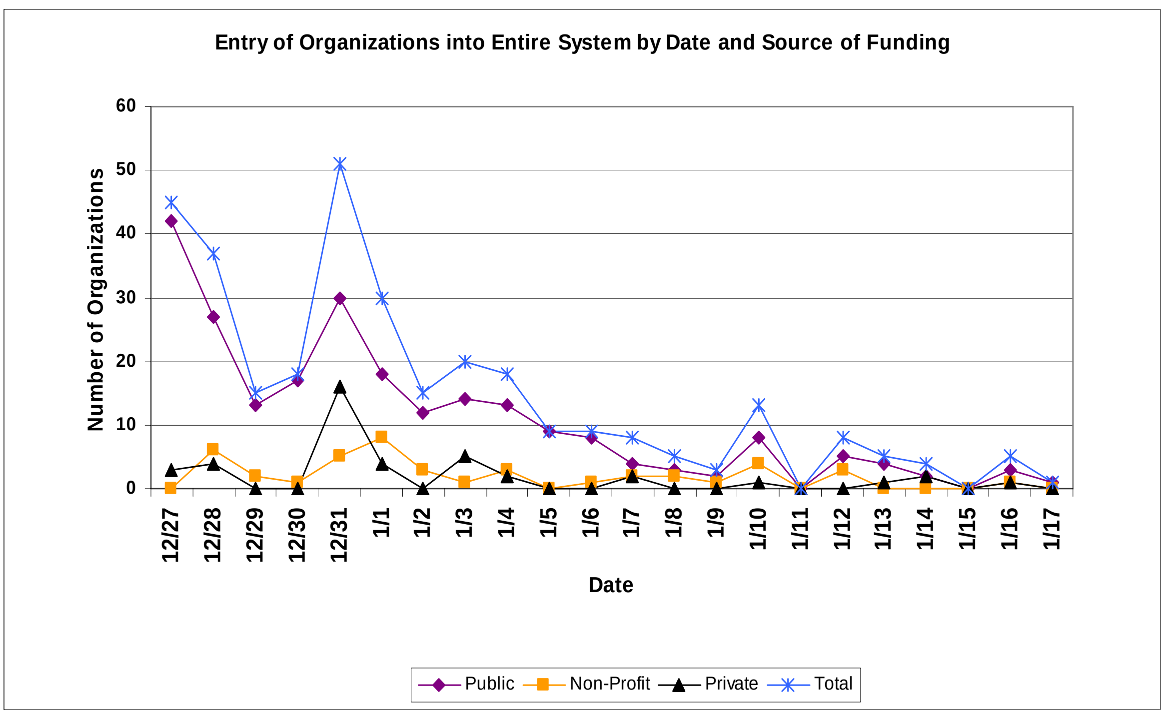


Figure 4.3 Graph shows the entry of organizations into response system by date and source of funding

Source: Extracted from *Thai-Rath Newspaper*, Thailand, December 27, 2004 – January 17, 2005.

The practice of avoiding bureaucratic procedures and confusion during the first days and operating within their own small network was a pattern adopted by international organizations. Several groups of Thai private investors also managed their resources and personnel to response to the damage conditions. They communicated through their private radio networks and had their business network in Bangkok arrange transportation of medical supplies and toolkits. Delivery was arranged by private jets to their temporary contact points. To make the use of private jets efficient, the companies flew over-flight of the area to locate survivors and deliver inter-island necessities before returning to the bases.

4.3.1 National-Provincial-Local Emergency Response

Scalable emergency management needs to be systematically organized and flexible in the same time. States of emergency require appropriate understanding and skills in single and inter agency tasks. Yet, disaster and emergency conditions produce unexpected consequences and nonlinear complications that need adaptive capabilities to deal well with such events. Extreme events require a more robust analytical framework, as they are characterized by hundreds of organizations engaged in response operations over a wide geographic area with diverse populations. Organizations cross sector and jurisdiction boundaries and form a distinct operational system that can effectively respond to the needs generated by a complex event (Comfort, 1999). This study used network analysis as a method to analyze and evaluate the performance of inter-organizational systems that have evolved in response to extreme events, acknowledging that each system is composed of sub-networks interacting with one another and shaping the dynamics of the whole system. A statistical analysis calculated with UCINET software (Borgatti, 2003) is applied to interpret the degree of network performance. In addition to the approach and application of social network analysis, this study also uses the information obtained from interviews and participant observation to create a comprehensive understanding of the response system.

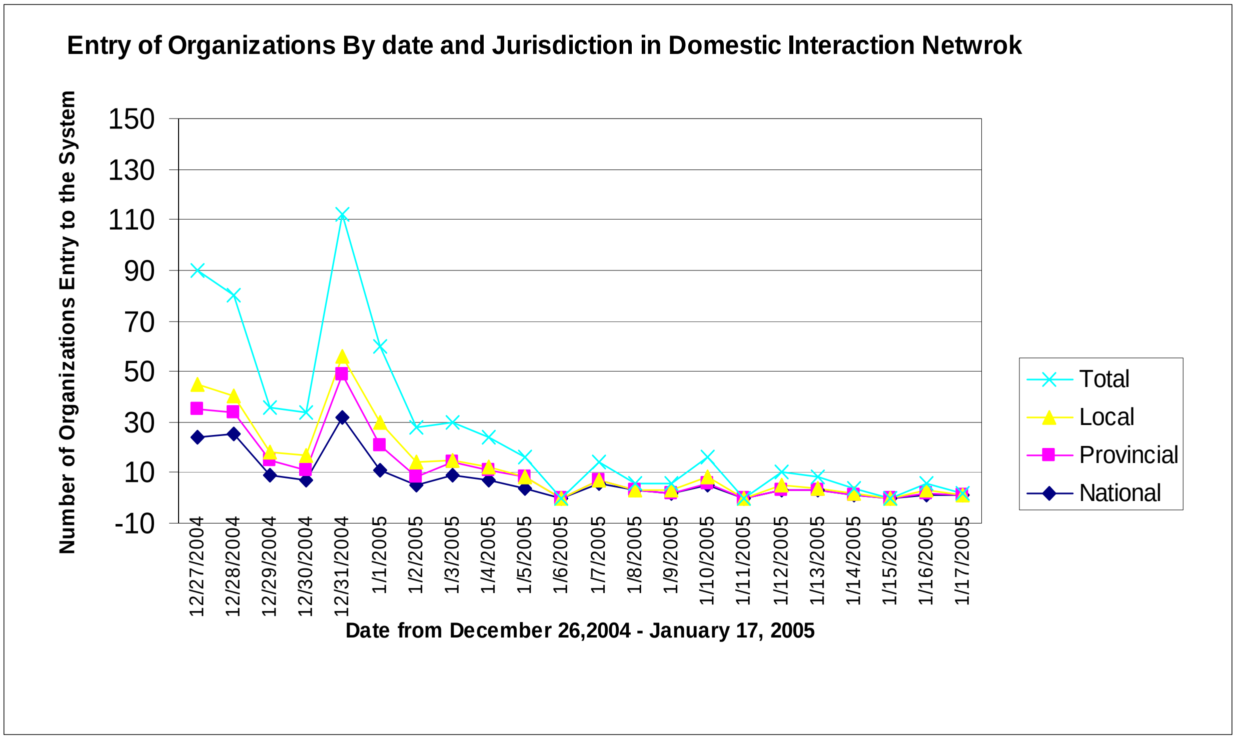


Figure 4.4 Graph shows the entry of organizations into response system by date and level of jurisdiction
Source: Extracted from *Thai-Rath Newspaper*, Thailand, December 27, 2004 – January 17, 2005.

In order to better understand how the scalable emergency response operated through national, provincial and local levels, this study focuses its first discussion into the domestic network of tsunami emergency response. The international organizations were excluded from this analysis to provide a measure of the national network. The full list of organizations is listed and the acronyms shown on the organizational map are spelled out in full in the Appendix C.

Table 4.2 Number of Organizations Entering Tsunami Response System in Domestic Interaction Network

Date	National	Provincial	Local	Total	Date	National	Provincial	Local	Total
12/27	24	11	10	45	**1/7**	6	1	0	7
12/28	25	9	6	40	**1/8**	3	0	0	3
12/29	9	6	3	18	**1/9**	2	0	1	3
12/30	7	4	6	17	**1/10**	5	1	2	8
12/31	32	17	7	56	**1/11**	0	0	0	0
1/1	11	10	9	30	**1/12**	3	0	2	5
1/2	5	3	6	14	**1/13**	3	0	1	4
1/3	9	5	1	15	**1/14**	1	0	1	2
1/4	7	4	1	12	**1/15**	0	0	0	0
1/5	4	4	0	8	**1/16**	1	1	1	3
1/6	0	0	0	0	**1/17**	1	0	0	1

Source: Extracted from *Thai-Rath Newspaper*, Thailand, December 27, 2004 – January 17, 2005.

Given the size of this domestic operational network of 291 organizations, several sets of organizations were combined into a single category. For example, local military units were combined into one organization, the Thai military. A chart showing the combinations is included in Appendix D. With these combinations, the total number of Thai organizations participating in the domestic emergency response network was reduced to 220. As shown in figure 4.5, the map of domestic organizational interaction lays out the network of the emergency operations conducted. The international domain interaction network will be presented separately to discuss how the international organizations functioned in the emergency operations and how they coordinate and interact among themselves as well as with organizations.

From the interaction matrix, circles represent organizations and lines represent interactions between organizations located in four different areas of the map. The first area on the right hand side of the map shows a scatter plot of organizations that interacted outside a main network. In the network, there are three layers of organizations, an outer layer of national organization circling around the edge, a middle layer of provincial organizations, and the center area shows those from local jurisdictions.

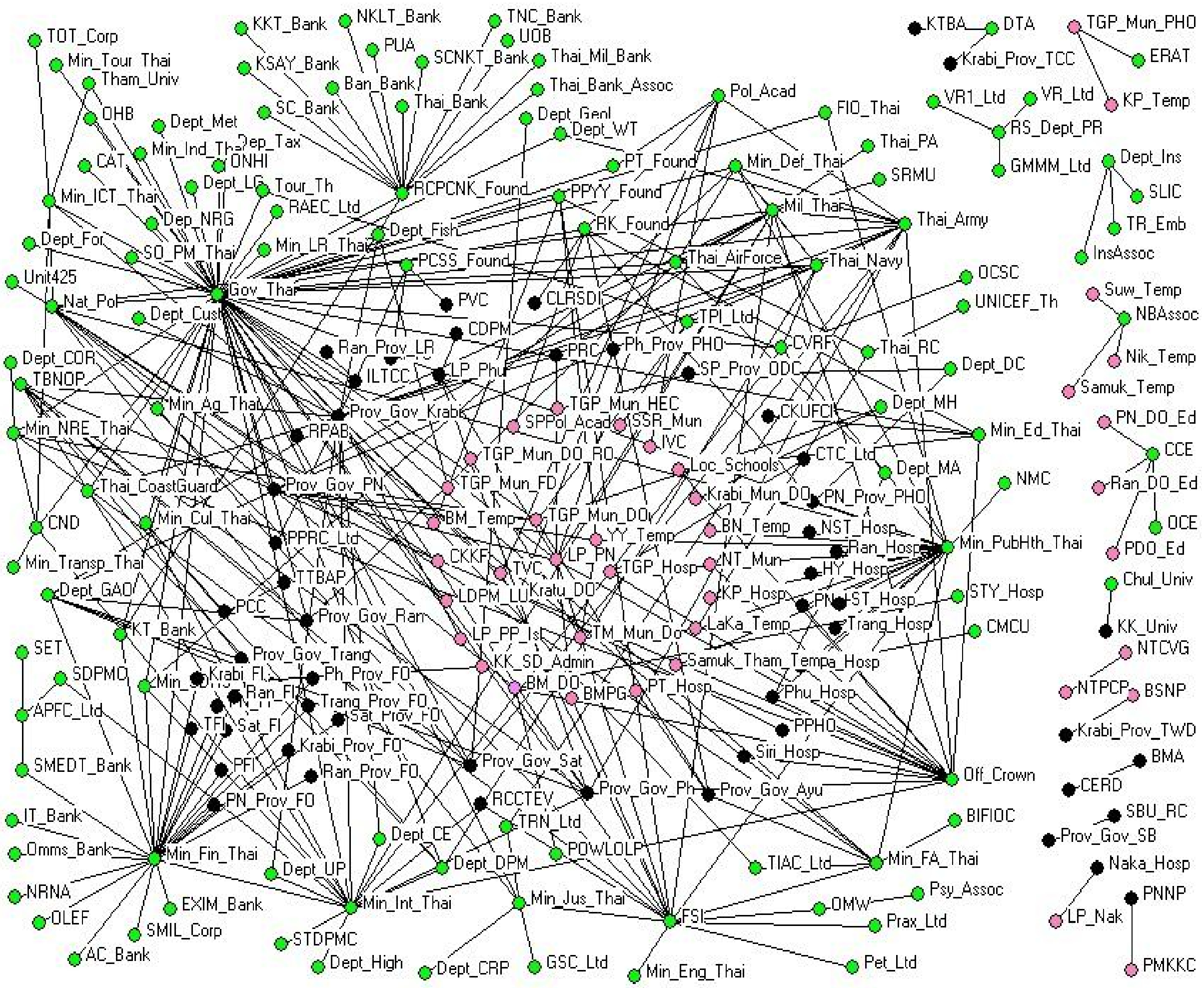


Figure 4.5 Map of Domestic Organizational Interactions in the Thai Tsunami Response 12/27/2004-1/17/2005

Source: Extracted from ThaiRath Newspaper dated December 27, 2004 – January 17, 2005

NOTE: (In color, green represents national organizations, black represents provincial organizations and pink represents local organizations)

(Scattered dots far right cannot be identified in black and white, please see acronym in Appendix C)

The map shows, first, at least fifteen distinctive clusters of nodes that serve as hubs for linking with other organizations. The Thai government is the main actor of the network, with 120 initiated interactions and 26 corresponding activities. Of the eleven identifiable hubs, four are anchored by Thai national ministries: Ministry of Finance; Ministry of Interior; Ministry of Public Health; and the Ministry of Foreign Affairs. The Thai government managed the emergency response operations and mitigation through the major ministries as assigned by the

Prime Minister. The most significant agency is the Ministry of Interior. By constitution, the Minister of Interior is a commander in chief as the Director of National Civil Defense reporting directly to the Prime Minister. The Minister of Interior by line of authority has absolute power to mobilize all resources around the country through provincial governments. The Department of Disaster Prevention and Mitigation operated under the order of the Minister of Interior. The second hub is anchored by the Ministry of Health. The devastation of tsunami caused a lot of death and injuries and personnel from the Ministry of Public Health are authorized to coordinate all medical attentions from several units and distribute supplies to meet public health needs. The outbreak prevention program and psychological consultancy were also conducted by this department. Next, since the time was a Christmas holiday and the southwestern coast of Phuket and PhangNga are the tourist area, 50% of the casualties were foreigners who needed a special attention for search and rescue. In response to this need, many nations contact the Ministry of Foreign Affairs directly and through their embassies in Thailand in order to bring in their experts and equipment in search and rescue as well as medical personnel to assist Thai agencies. Last, the Ministry of Finance is authorized to manage all budgets for emergency operations and recovery as well as approve the use of advance financial assistance to the local government agencies to pay the cost of living for the survivors. Many donations from private domestic organizations were also made through them.

Four hubs in the network are anchored by the Thai Navy, Army, Air Force and the Local units of the Thai Military (combined) agencies that had primary responsibility for search and rescue operations and immediate logistical operations. A tenth distinctive node was the Forensic Science Institution (FSI) under the Ministry of Justice. The head of the FSI and her team were the very first medical personnel in the area who tried to set up the center for missing persons and identification of the dead. Three other significant centers of contact are the provincial governments in the disaster affected region (Phuket, PhangNga, and Krabi provinces).

Interestingly, this map of inter-organizational interactions shows a significant involvement of private sector and nonprofit sector involvement. The final four hubs were anchored by nonprofit foundations. RaCahPraChaNuKroh foundation, supported by the beloved King of Thailand, became the main actor to distribute financial aid for recovery projects as well as receiving all the donations made. YanYao temple played the role of the center for identification of dead bodies. FSI coordinated with the temple and locals to set up the information center and shelter for both operational staff and the homeless. The last two non-profit organizations in the scene were in fact private rescue agencies, RuamKaTunYoo and PorTekTeung. In Thailand, these two agencies have the most experience in search and rescue during an emergency working in an unstable environment. Nonetheless, they are not well trained for tsunami response nor had they trained working with multiple agencies in a large scale area across six provinces. There still were problems and misunderstanding in coordinating operations.

The network does not appear to be strongly interconnected as an overall response system. The statistics from Freeman's degree centrality index show the degree of centralization within the whole network to be 24.11%. The Average Distance (among reachable pairs) = 3.390, the Distance-based cohesion = 0.229 (range 0 to 1; larger values indicate greater cohesiveness) and Distance-weighted Fragmentation = 0.771. The distance from one node to another is the length of a shortest path between them. This is the concept of "degree of separation" made familiar to many by a popular play. The density of the network shows a low average of 0.0134 with standard deviation of 0.1148. Dense networks are particularly good for coordination of activity among actors.

Table 4.3 Descriptive Statistics: Degree Centrality for Thai Domestic Tsunami Response Network

	DEGRI	NRMDEGR	SHARE
MEAN	**2.913**	**1.336**	**0.005**
STD DEV	**5078**	**2.329**	**0.008**
SUM	**638.00**	**292.661**	**1.000**
VARIAN	**25.787**	**5.426**	**0.000**
SSQ	**7506.0**	**1579.413**	**0.018**
MCSSQ	**5647.3**	**1188.316**	**0.014**
EUC NORM	**86.637**	**39.742**	**0.136**
MINIMU	**1.000**	**0.459**	**0.002**
MAXIMU	**55.000**	**25.229**	**0.086**

NETWORK CENTRALIZATION = 24.11%

HETEROGENEITY = 1.84%, NORMALIZED = 1.39%

Source: Extracted from *Thai-Rath Newspaper*, Thailand December 27, 2004 – January 17, 2005.

NOTE: SSQ = sum of square; MSCCQ = mean-centered sum of square; Euc Norm = Euclidean norm; NrmDegree = Normed Degree

Table 4.4 Betweeness Centrality of Thai Domestic Tsunami Response Network

DESCRIPTIVE STATISTICS FOR EACH MEASURE

	BETWEENNE	NBETWEENNESS
MEAN	**180.201**	**0.762**
STD DEV	**801.506**	**3.389**
SUM	**3946.000**	**166.846**
VARIANCE	**642411.938**	**11.483**
SSQ	**147799664.000**	**2641.807**
MCSSQ	**140688224.000**	**2514.695**
EUC NORM	**12157.288**	**51.399**
MINIMUM	**0.000**	**0.000**
MAXIMUM	**10383.357**	**43.899**

NETWORK CENTRALIZATION INDEX = 43.33%

Source: Extracted from *Thai-Rath Newspaper*, Thailand December 27, 2004 – January 17, 2005.

NOTE: SSQ = sum of square; MSCCQ = mean-centered sum of square; Euc Norm = Euclidean norm; NrmDegree = Normed Degree

Output distance: Geodesic Distance Analysis

For each pair of nodes, the algorithm finds the number of edges in the shortest path as follow.

Average distance 3.390

Distance-based cohesion 0.229

Distance-weighted Fragmentation 0.771

Centrality measures identify the most prominent actors that are extensively involved in relationships with other network members. Centrality indicates one type of “importance” of actors in a network: in lay terms, these are the “key” players, while degree of centrality is the sum of all other actors who are directly connected to key players. It signifies activity or popularity. Many ties coming in and going from an actor would increase degree centrality. Betweenness, in addition to degree of centrality, distance and density, is a measure of the potential for control as an actor who is high in betweenness is able to act as a gatekeeper, controlling the flow of resource between the alters with whom the actor connects.

There is a large variation in actor betweenness from 0 to 10383.357. This measure means that many connections can be made in this network without the aid of any intermediary. The centralization index for the Thai domestic network at 43.33% indicates the importance of the main actor, the Thai Government, in mobilizing response operations. Clearly, there is a structural basis for the Thai government to view themselves as a mover-and-shaker. This role, even though there is not very much betweenness power in the system, is important for group formation and stratification. Interestingly, the Thai domestic network revealed a group of organizations that had the best fit in terms of the interacting with one another in reference to disaster-related issues as shown in table 4.5.

In this group of ten organizations, the first six are governmental organizations. Four of these agencies, Forensic Science Institution, Thai Government, Ministries of Finance and Public Health, were discussed in the previous section (P.50). In addition, the Committee of Compulsory Education functioned as the contact point for assessment of damage and recovery needs for those schools affected from tsunami in the southern area. This committee was also indirectly assigned, by the King’s foundation, to expedite the process of resuming school activities. Second in the row of six, the Department of Insurance managed the process of making the financial claims and distributing financial support to those who suffered loss of life and damage to properties. The DOI also adapted their loan programs flexible to meet the needs of the survivors.

Table 4.5 Group Centrality of Thai Domestic Tsunami Response Network

STARTING FITNESS	**34.000**
ROUND 0, 3 ITERATIONS	**0.000**
OBSERVED NUMBER REACHED	**139.000 (63.4%)**

<u>GROUP MEMBER ORGANIZATIONS</u>

1. **COMMITTEE OF COMPULSORY EDUCATION**
2. **DEPARTMENT OF INSURANCE**
3. **FORENSIC SCIENCE INSTITUTE**
4. **GOVERNMENT OF THAILAND**
5. **MINISTRY OF FINANCE, THAILAND**
6. **MINISTRY OF PUBLIC HEALTH, THAILAND**
7. **OFFICE OF THE CROWN**
8. **RADIO STATION, DEPARTMENT OF PUBLIC RELATIONS**
9. **PROVINCIAL GOVERNMENT, KRABI**
10. **RAJ CHA PRA CHA NU KROH (RCPCNK) FOUNDATION**

Source: Extracted from *Thai-Rath Newspaper*, Thailand December 27, 2004 – January 17, 2005.

An obviously important seventh hub in the Thai domestic network is the Office of the Crown, led by the crown prince, crown princess and their family who are beloved by the Thai people. Respectfully trusted by public, the programs and projects under the offices of the prince and princess were delivered to the affected communities very effectively and with a lot of willingness to coordinate and participate in voluntary activities from public, private, and non-profit organizations. Local residents also volunteered to help facilitate resources through their community networks which helped to expedite the recovery operations.

The eighth organization is, notably, a radio station of the Department of Public Relations that had the responsibility of reporting information about the tsunami and its consequences to the Thai people. A wide range of communication channels managed by the Department of Public Relation allowed the organization to deliver the information and update the situation to public as well as emergency personnel. Although many mobile phones or satellite communications were available, local residents still relied on the information they obtained from transistor radios and local radio station, or through their megaphone network which in fact retrieved information from the department broadcast.

The participation of the Krabi provincial government in this group indicates the active role played by this government. The characteristics of Krabi province and the emergency response operations were different from Phuket and PhangNga provinces. The damaged areas in Phuket and PhangNga were within the province and reachable by road. Even though the main road in PhangnNga was washed away for couple hours, a road along Phuket beach was still intact. This road condition made transportation available for every agency and organization to access the area while the most damaged area in Krabi, PP Island, was only accessible by boat. There was no electricity and telecommunication for five days which made the search and rescue very difficult. All agencies from every unit had to gather together in order to make the trip to the island optimally productive. Krabi provincial government therefore automatically turned out to be a point of contact.

Last, the inclusion of the RajChaPraChaNuKroh (RCPCNK) Foundation underscores the substantive role played by nonprofit organizations in this response system. The RCPCNK foundation is directly supported by the King and the Crown Princess, and provides an important model of humanitarian assistance for the Thai people.

The analysis of subgroups in the network further confirms this observation. The clique analysis in UCINET identified 59 subgroups in the network, as listed in Appendix E. The following list indicates the top 15 cliques in the Thai response system. Clique analysis proposes that information spreads rapidly through densely knit subgroups because actors are strongly connected to one another and they directly share the information.

Table 4.6 Cliques of Thai Domestic Tsunami Response Network

1. DEPARTMENT OF DISASTER PREVENTION AND MITIGATION; GOVERNMENT OF THAILAND, MINISTRY OF CULTURE, MINISTRY OF INTERIOR
2. COMMITTEE OF VICTIM RELIEF FUND, GOVERNMENT OF THAILAND, MINISTRY OF INTERIOR
3. COMMITTEE OF NATIONAL DISASTER, GOVERNMENT OF THAILAND, MINISTRY OF INTERIOR
4. GOVERNMENT OF THAILAND, MINISTRY OF INTERIOR, MINISTRY OF FINANCE, MINISTRY OF SOCIAL DEVELOPMENT
5. GOVERNMENT OF THAILAND, MINISTRY OF INTERIOR, KRABI GOVERNMENT, PHANGNGA GOVERNMENT
6. DEPARTMENT OF FISHERY, GOVERNMENT OF THAILAND, KRABI GOVERNMENT
7. DEPARTMENT OF WATER TRANSPORTATION, GOVERNMENT OF THAILAND, THAI ARMY
8. FORENSIC INVESTIGATION OFFICE, GOVERNMENT OF THAILAND, MINISTRY OF PUBLIC HEALTH
9. FORENSIC SCIENCE INSTITUTION, GOVERNMENT OF THAILAND, MINISTRY OF FOREIGN AFFAIRS, NATIONAL POLICE
10. FORENSIC SCIENCE INSTITUTION, GOVERNMENT OF THAILAND, MINISTRY OF JUSTICE, NATIONAL POLICE
11. FORENSIC SCIENCE INSTITUTION, GOVERNMENT OF THAILAND, MINISTRY OF NATURAL RESOURCE AND ENVIRONMENT
12. FORENSIC SCIENCE INSTITUTION, GOVERNMENT OF THAILAND, PHANGNGA LOCAL POLICE
13. FORENSIC SCIENCE INSTITUTION, GOVERNMENT OF THAILAND, PEANPUNGPAYAMYAK FOUDATION
14. GOVERNMENT OF THAILAND, KRUNGTHAI BANK, MINISTRY OF FINANCE
15. GOVERNMENT OF THAILAND, KRUNGTHAI BANK, RAJCHAPRACHANUKROH FOUNDATION

Source: Extracted from *Thai-Rath Newspaper*, Thailand December 27, 2004 – January 17, 2005.

The cliques show overlapping memberships among the organizations, but the sheer number of cliques indicates that the response system was functioning essentially as a set of separate groups formed around specific problems rather than as a coherent system addressing this extreme event with a common strategy (Comfort and Haase 2005). 15 of the 59 Thai domestic tsunami response network cliques are identified by their acronyms. All 59 cliques are listed in Appendix E. Significant in a review of this list is the participation of the Government of Thailand. While the Government of Thailand is not always the first named actor, it is clearly a primary actor in mobilizing response organizations. Also noteworthy is the interaction among the Government of Thailand and national ministries with the disaster-affected provincial governments.

Nonetheless, the response system appears to be loosely connected, although with many organizations participating, but not necessarily interacting efficiently with one another. Group centrality reflects the operation by function. In addition, a more comprehensive look at the network maps on the right side of Figure 4.5 shows several organizations scattered and interacting outside of the network boundary. Those organizations represent public, private and non-profit sources of funding as well as national, provincial and local levels. This pattern reflects the poor connection and coordination among all levels of agencies. Those organizations entered the system by themselves and chose to interact with fewer organizations to accomplish specific tasks. In their interactions, these organizations frequently interacted with lower or higher levels of jurisdiction. Such interactions are functional. Most of those organizations finished their operations and withdrew from the damaged area on schedule. Those operations were more likely to be repeated because of lack of feedback and communication difficulties.

This pattern of interaction also affects the coordination with international organizations discussed in the next section as the network will show the dependency of international organizations on those national agencies to manage activities through its network of operations and to move the tasks along to those in the front-base. The information obtained from the content analysis and interviews shows the significant reflection of how the international organizations interacted in the network.

4.3.2 International Interaction in Thai Emergency Response System

The exclusion of international organizations (102 of the total 393) from the analysis of the interaction of domestic agencies specifically focused the analysis on Thai emergency management. However, the content analysis also documented a significance of international interaction, coordination and operation during the first three weeks of tsunami response. Analyzing this pattern of interaction shows how the Thai agencies functioned with international organizations.

Table 4.7 Frequency Distribution, Tsunami Disaster Response System, Thailand

	Public		**Nonprofit**		**Private**		**Total N of ALL Organizations**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
International	63	53.8%	9	7.7%	8	6.8%	**80**	68.4%
National	22	18.8%	3	2.6%	0	0.0%	**25**	21.4%
Provincial	8	6.8%	0	0.0%	0	0.0%	**8**	6.8%
Local	3	2.6%	0	0.0%	1	0.9%	**4**	3.4%
Totals	**96**	**82.1%**	**12**	**10.3%**	**9**	**7.7%**	**117**	**100.0%**

Source: Extracted from ThaiRath Newspaper, Thailand dated December 27, 2004 – January 17, 2005

Table 4.7 shows the number of international organizations that interacted with the Thai domestic tsunami response system. The international organizations that entered the system were from public, private, and non-profit sectors and interacted with all levels of domestic organizations. The highest proportion of international public organizations, 68.4%, indicates the significant role of the governments of several nations and their embassies in search and rescue effort for their citizens. Most of the entries were made by representative of the governments of those nations trying to send their expert teams with specialized equipment into the emergency response operations as well as financial support. Most of the interactions were between international organizations and the national agencies (21.4%) in the system. This pattern reflects the high level of dependency of international organizations on the Thai government to manage operations through its network.

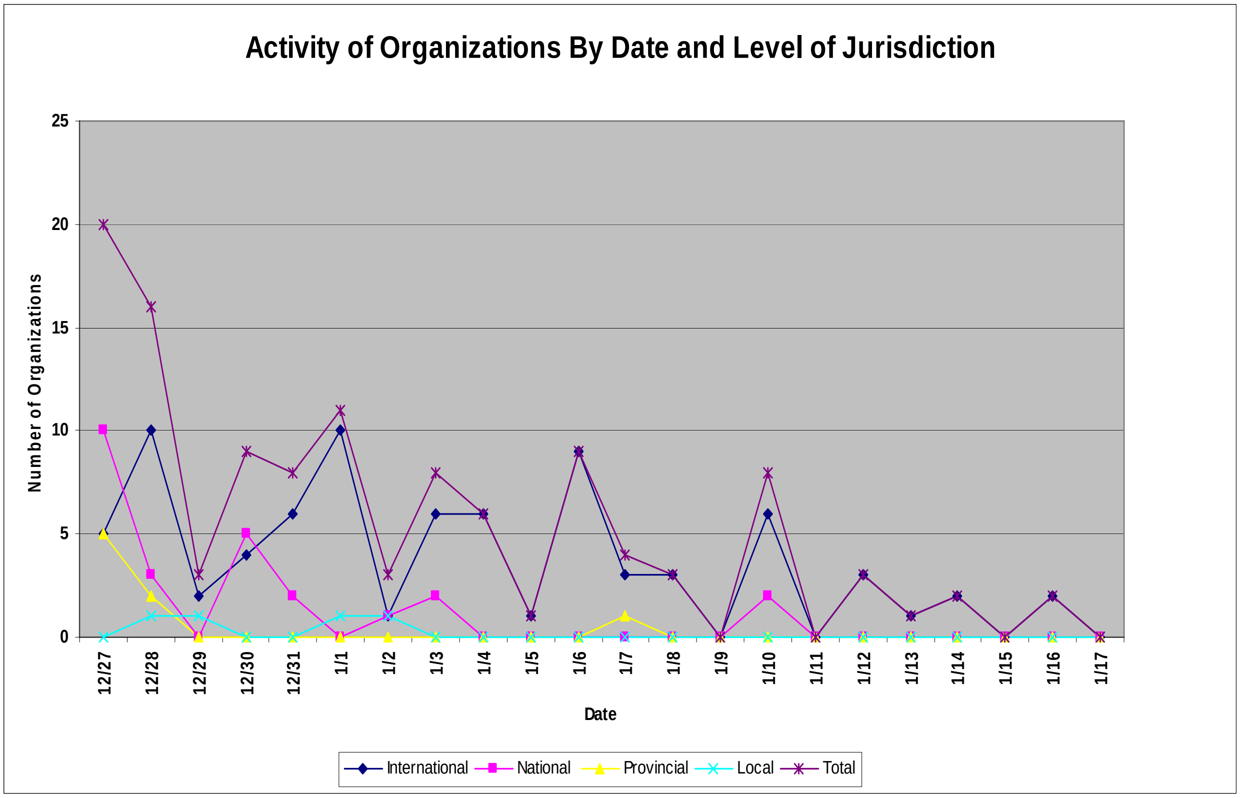


Figure 4.6 Number of organizations in international domain activities entering into the response system by date and level of jurisdiction

Source: Extracted from *Thai-Rath Newspaper*, Thailand, December 27, 2004 – January 17, 2005.

The graph of international organizations interacting with other international or Thai agencies shows an increasing number of organizations entered the system on the second day after the tsunami attack. From the content analysis of news reports and semi-structured interviews, this study obtained information that many of these governments sent their expert teams, especially in search and rescue, to assist the emergency operations in Thailand. They recognized the lack of skilled emergency personnel and effective equipment in Thailand for complicated tasks resulting from unexpected consequences. Later, the number of international organizations dropped dramatically because search and rescue operations were limited to authorized personnel only in order to organize a systematic process with feedback. When the significance of bringing those experts and equipment together in a more systematic operation emerged, the numbers of international organization again increased. The interactions among international organizations are mapped in an international interaction network to illustrate how and when those organizations entered the tsunami response system.

Figure 4.7 shows the interactions of international organizations in the Thai tsunami response system. The analysis includes only the interactions that have at least one international organization involved. The map shows the obvious pattern of interactions among international organizations and Thai organizations. Those interactions were made mostly between international organizations and Thai national agencies. Only two local organizations were directly interacting with international organizations while there were six provincial organizations in the same direct interaction. Interestingly, one interaction, with Krabi provincial government (kpg) at the center, is in fact initiated by the Thai government to the State of Palis representative from Malaysia (spm), as well as other domestic organizations in the same activity. A visualization of the network map shows the high degree of dependency of international organizations on Thai national agencies to facilitate their involvement in the tsunami response system.

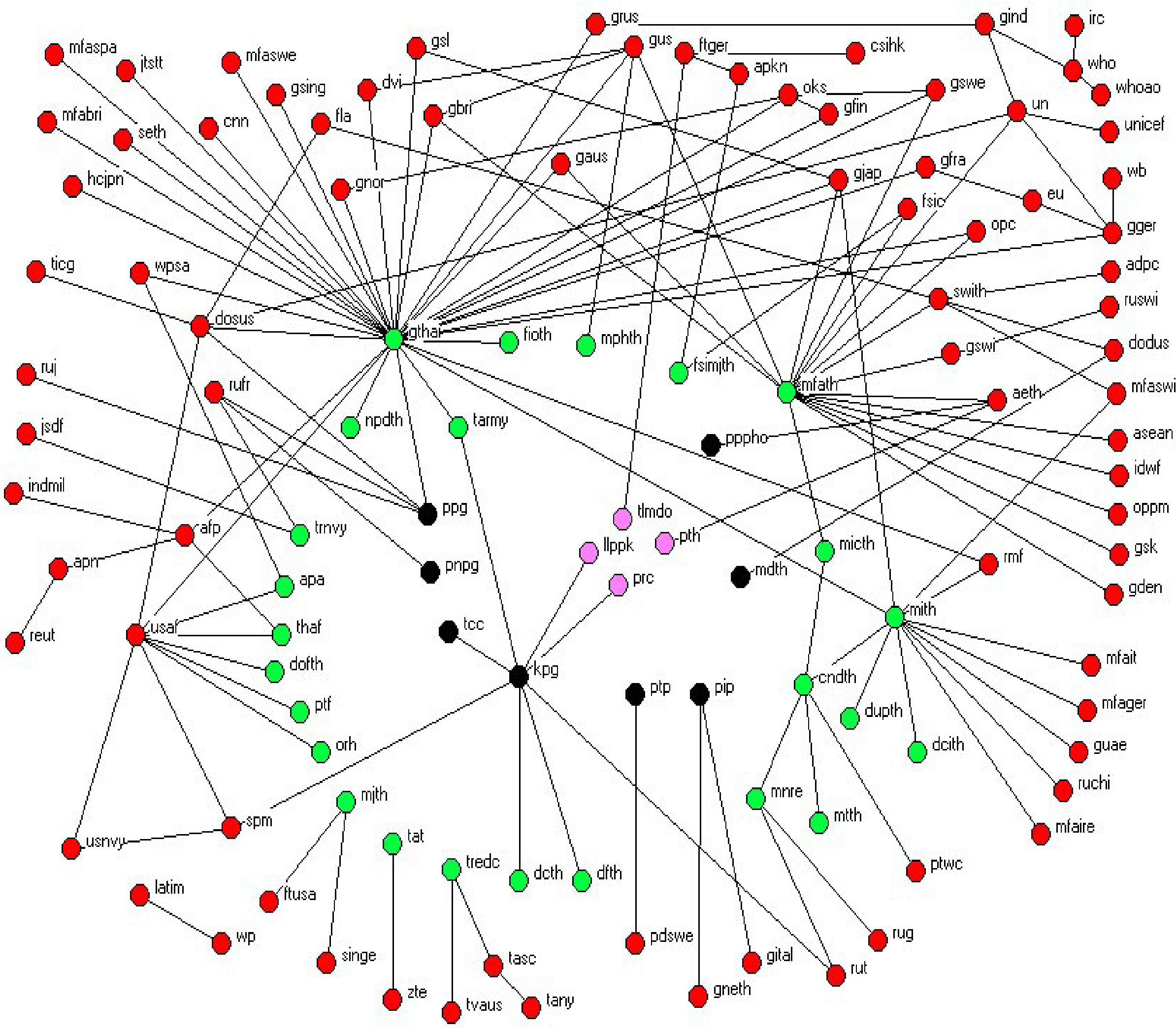


Figure 4.7 Map of International Organizational Interactions in the Thai Tsunami Response 12/27/2004-1/17/2005

Source: Extracted from ThaiRath Newspaper dated December 27, 2004 – January 17, 2005
NOTE: Acronyms of organizations are spelt out in Appendix C

As shown in table 4.8, the statistic of centrality confirms the importance of the Thai government, Ministry of Foreign Affairs and Ministry of Interior in connecting their actions with those in the lower levels of emergency response.

Table 4.8 Centrality Degree Analysis of International Interaction Network in Thailand Tsunami Disaster Response System

	1	2	3
ORGANIZATIONS	DEGRE	NRMDEG	SHARE
GOVERNMENT OF THAILAND	32.000	27.586	0.117
MINISTRY OF FINANCE, THAILAND	17.000	14.655	0.062
MINISTRY OF INTERIOR, THAILAND	12.000	10.345	0.044
UNITED STATE AIR FORCE	9.000	7.759	0.033
KRABI PROVINCIAL GOVERNMENT	8.000	6.897	0.029
UNITED STATE DEPARTMENT OF STATE	6.000	5.172	0.022
COMMITTEE OF NATIONAL DISASTER, THAILAND	5.000	4.310	0.018
GOVERNMENT OF THE UNITED STATE	5.000	4.310	0.018
UNITED NATIONS	5.000	4.310	0.018
SWITZERLAND EMBASSY IN THAILAND	5.000	4.310	0.018

Source: Extracted from *Thai-Rath Newspaper*, Thailand December 27, 2004 – January 17, 2005.
NOTE: SSQ = sum of square; MSCCQ = mean-centered sum of square; Euc Norm = Euclidean norm; NrmDegree = Normed Degree

The most interesting organizations are those from the United States, the US Air Force (usaf), the US Department of State (dosus) and the US government (gus). From the content analysis and interviews, these US agencies reacted very quickly to the news of tsunami and the large numbers of US citizens were also missing and deaths in the affected area. The US Air Force was one of the first agencies, even among Thai organizations, that accessed the area and proceeded with their search and rescue operations.

The last three organizations entered into the system differently. The Committee of National Disaster of Thailand (cndth) was appointed right after the tsunami disaster to study disaster and technology management. It approved the strategic policies to prepare and enhance capabilities of the Thai government and agencies to manage such disaster in the near future. This committee became the focal point of all international experts especially those from Pacific Tsunami Warning Center (PTWC) based in Hawaii, USA. United Nations (UN) was definitely functioning as a focal point for those international governments and organizations that offered assistant in every form. Last, The Swiss Embassy in Thailand reacted quickly since they were informed that a large number of Swiss citizens were on vacation and holiday in the southern coastal area of Thailand. The Swiss Embassy helped to coordinate the search and rescue from other nations as well as other activities initiated by other international organizations.

The network does not appear to be strongly interconnected as an overall response system. The statistics from Freeman's degree centrality index show the centralization within the whole network to be 26.01%. Yet the Average Distance (among reachable pairs) = 1.00 and the Distance-based cohesion = 1.00 (range 0 to 1; larger values indicate greater cohesiveness) and Distance-weighted Fragmentation = 1.00. These functions indicate a high level of cohesiveness which can be explained by the fact that those international organizations mostly interacted through one major Thai national agency. Nonetheless, the whole network is still not well connected since the major Thai national agencies were not well connected to their own domestic network, as previously discussed. The international interactions were based on specific tasks of their own sub networks.

Table 4.9 Centrality Descriptive Statistic of International Interaction Network in Thailand Tsunami Disaster Response System

	1	2	3	
	DEGREE	NRMDEGREE	SHARE	
				NETWORK CENTRALIZATION = 26.01%
MEAN	2.342	2.019	0.009	
STD DEV	3.509	3.025	0.013	
SUM	274.000	236.207	1.000	
VARIANCE	12.310	9.149	0.000	
SSQ	2082.000	1547.265	0.028	
MCSSQ	1440.325	1070.396	0.019	
EUC NORM	45.629	39.335	0.167	
MINIMUM	1.000	0.862	0.004	
MAXIMUM	32.000	27.586	0.117	

Source: Extracted from *Thai-Rath Newspaper*, Thailand December 27, 2004 – January 17, 2005.
NOTE: SSQ = sum of square; MSCCQ = mean-centered sum of square; Euc Norm = Euclidean norm; NrmDegree = Normed Degree

Table 4.10 and Table 4.11 show the betweenness centrality and its descriptive statistic emphasizing the significant roles of the Thai government as well as those national agencies as the main actors in the network. Network centralization index gives a relatively similar index of 45.5% as the domestic network, 43.33%. This finding confirms the degree of dependency of the international organizations on Thai national agencies to connect their activities to those agencies involved in the domestic network. There is a lot of variation in actor betweenness from 0 to 3135.92. This finding indicates that a lot of connections can be made in this network without the aid of any intermediary.

Table 4.10 Betweenness Centrality Analysis of International Interaction Network in Thailand Tsunami Disaster Response System

	BETWEENNESS	NBETWEENNESS
MEAN	26.838	1.902
STD DEV	359.329	5.387
SUM	14840.000	222.489
VARIANCE	129117.273	29.022
SSQ	16988992.000	3818.703
MCSSQ	15106721.000	3395.616
EUC NORM	4121.771	61.796
MINIMUM	0.000	0.000
MAXIMUM	3135.922	47.015
NETWORK CENTRALIZATION INDEX = 45.50%	NORMALIZEDCENTRALIZATION: 352062.859	

Source: Extracted from *Thai-Rath Newspaper*, Thailand December 27, 2004 – January 17, 2005.
NOTE: SSQ = sum of square; MSCCQ = mean-centered sum of square; Euc Norm = Euclidean norm; NrmDegree = Normed Degree

The centralization index for the Thai network at 45.5% underscores the importance of the main actor, the Thai Government, in connecting the interactions in entire response operations. Clearly, there is a structural basis for the Thai government to view itself as a central 'mover-and-shaker'. Even though there is not much betweenness power in the system, it could be important for group formation and stratification.

Table 4.11 Descriptive Betweenness of International Interaction Network in Thailand Tsunami Disaster Response System

ORGANIZATIONS	BETWEENNESS	NBETWEENNESS
GOVERNMENT OF THAILAND	3135.922	47.015
MINISTRY OF FOREIGN AFFAIRS, THAILAND	1761.023	26.402
MINISTRY OF INTERIOR, THAILAND	1012.628	15.182
UNITED STATES AIR FORCE	594.263	8.909
KRABI PROVINCIAL GOVERNMENT	555.944	8.335
THAI ARMY	503.833	7.554
PHUKET PROVINCIAL GOVERNMENT	479.000	7.181
FORENSIC SCIENCE DEPARTMENT, CHINA	475.000	7.121
COMMITTEE OF NATIONAL DISASTER, THAILAND	416.477	6.244
UNITED NATIONS	406.042	6.088
FORENSIC SCIENCE INSTITUTION, THAILAND	384.000	5.757
DEPARTMENT OF DEFENSE, UNITED STATE	381.878	5.725
SWITZERLAND EMBASSY IN THAILAND	348.333	5.222
AFP NEWS	326.646	4.897
GOVERNMENT OF JAPAN	303.216	4.546
GOVERNMENT OF INDONESIA	295.998	4.438
RESCUE UNIT OF FRANCE	293.000	4.393
AUSTRALIAN POLICE	291.000	4.363
GOVERNMENT OF UNITED STATES	251.954	3.777
GOVERNMENT OF RUSSIA	211.333	3.168

Source: Extracted from *Thai-Rath Newspaper*, Thailand December 27, 2004 – January 17, 2005.

Interestingly, the international domain interaction network revealed a group of organizations that had the best fit in terms of the interacting with one another in reference to disaster-related issues as shown below in table 4.12. In this group, three new members appeared in this sub-network. They include the Forensic Team of Germany who helped search and rescue operations as a team of experts, and the Thai Royal Embassy in Washington DC that functioned as a focal point of donations from the United States to Thailand. The World Health Organization stepped in to investigate the probability of an outbreak of disease and to run the prevention program if needed. The analysis of subgroups in the network further confirms this observation.

Table 4.12 Group Centrality of International Interaction Network in Thailand Tsunami Disaster Response System

STARTING FITNESS: 20.000, ROUND 0, 3 ITERATIONS FIT = 0.000, OBSERVED NO. REACHED = 85.000 (72.6%)
GROUP MEMBERS:
COMMITTEE OF NATIONAL DISASTER, THAILAND
FORENSIC TEAM, GERMANY
GOVERNMENT OF THAILAND
KRABI PROVINCIAL GOVERNMENT
MINISTRY OF FOREIGN AFFAIRS, THAILAND
MINISTRY OF INTERIOR, THAILAND
MISTY OF JUSTICE, THAILAND
THAI ROYAL EMBASSY, WASHINGTON DC
UNITED STATES AIR FORCE
WORLD HEALTH ORGANIZATION

Source: Extracted from *Thai-Rath Newspaper*, Thailand December 27, 2004 – January 17, 2005.

The clique analysis of the international domain interaction network from UCINET identified 12 subgroups in the network. Clique analysis proposes that information spreads rapidly through densely knit subgroups because the actors are strongly connected to one another and they directly share the information. The cliques show overlapping memberships among the organizations, but the high number of cliques indicates that the response system was functioning essentially as a set of separate groups formed around specific problems rather than as a coherent system addressing this extreme event with a common strategy.

All cliques, identified by their acronyms, are listed above. Significant in a review of this list is the participation of the Government of Thailand. While the Government of Thailand is not always the first named actor in the 12 cliques, it is clearly a primary actor in mobilizing response organizations. Also noteworthy is the interaction among the Government of Thailand and Office of the King of Sweden and also with the United States government and agencies with the governments of other nations such as Switzerland, United Kingdom and Japan. Phuket Provincial government was active in the fourth clique as well. The Ministry of Interior participated in two of the 12 cliques. Nonetheless, the international interaction in the response system appears to be loosely connected, with many organizations participating, but not necessarily interacting efficiently with one another. The group centrality reflects the operation by function. Each organization tended to make their own connections and to perform their specific tasks with their own connections.

Table 4.13 Cliques Analysis of International Interaction Network in Thailand Tsunami Disaster Response System

12 CLIQUES ARE FOUND
1: GOVERNMENT OF FINLAND, GOVERNMENT OF THAILAND, OFFICE OF THE KING (SWEDEN)
2: GOVERNMENT OF NORWAY, GOVERNMENT OF THAILAND, OFFICE OF THE KING (SWEDEN)
3: GOVERNMENT OF SWEDEN, GOVERNMENT OF THAILAND, OFFICE OF THE KING (SWEDEN)
4: DEPT OF STATE (US), GOVERNMENT OF THAILAND, PHUKET PROVINCIAL GOVERNMENT
5: DEPT OF STATE (US), GOVERNMENT OF THAILAND, UNITED STATES AIR FORCE
6: DISSECTOR VICTIM IDENTIFICATION, GOVERNMENT OF THAILAND, GOVERNMENT OF THE US
7: GOVERNMENT OF UNITED KINGDOM, GOVERNMENT OF THAILAND, GOVERNMENT OF THE US
8: GOVERNMENT OF JAPAN, GOVERNMENT OF SRI LANKA, GOVERNMENT OF THAILAND
9: GOVERNMENT OF JAPAN, GOVERNMENT OF THAILAND, MINISTRY OF INTERIOR (TH)
10: GOVERNMENT OF THAILAND, MINISTRY OF INTERIOR (TH), RICKY MARTIN FOUNDATION
11: GOVERNMENT OF BRITAIN, GOVERNMENT OF THE US, MINISTRY OF FOREIGN AFFAIRS (TH)
12: STATE OF PALIS (ML), UNITED STATES AIR FORCE, UNITED STATES NAVY

Source: Extracted from *Thai-Rath Newspaper*, Thailand December 27, 2004 – January 17, 2005.

4.4 THE ANALYSIS OF EMERGENCY RESPONSE MANAGEMENT

From the discussions of emergency regulations, structure, organizations, and operations, it is clear that the Government of Thailand plays critical roles in mobilizing response operations as well as connecting the interaction from international organizations through the response network. Furthermore, Ministry of Interior is second in line to command the operations. This complies with the emergency regulation in the constitution that, under state of emergency of a large scale, the Minister of Interior is a commander in chief and the Ministry of Interior becomes a national command center.

The frontline emergency response personnel were the agencies from Department of Disaster Prevention and Mitigation of Regional Center, Provincial Unit and Headquarter in Bangkok, Private Rescue Foundations and Civil Defense Volunteer Units. The response operations were slow and difficult due to lack of information and understanding in such disaster, less experience in dealing with tsunami response and consequence management and the absence of electricity, power and effective communication. Besides, there were many organizations and agencies in the area that tried to work the process of search and rescue without an understanding of how the other units worked. The problems of redundancy and repetition delayed the help to the victims and wasted manpower and resource needed for the operations.

From the content analyses, this study shows the importance of the Ministry of Interior through the front line emergency personnel of the Department of Disaster Prevention and Mitigation (DDPM) as an agency. In addition, this study also identifies the significance of knowledge and information sharing, and communication channel to keep DDPM agencies connected among themselves as well as with the other agencies in the response operation in different areas.

The next analysis of surveys data responds to the research questions posed earlier in Chapter Three. These questions address how emergency response agencies at the national level like DDPM function in the emergency operations and understand the elements that have effects toward their performance. Quantitative analysis on each factor proposed in the research design is also interpreted with a more informed discussion supported by data from the interviews conducted with those key personnel. Discussions of interaction pattern, information used and communication management are also provided.

4.4.1 Socio-Technical Components Analysis

The three components are shown below in Table 4.14.

Table 4.14 Socio-Technical Components Frequency Distribution

I. ORGANIZATIONAL FLEXIBILITY COMPONENT	HIGH N (%)	MED N (%)	LOW N (%)	NONE N (%)	NA N (%)	TOTAL (N) 100%
O1 NATIONAL EMERGENCY LAWS	17.61	51.70	19.60	3.69	7.39	352
O2 SPECIAL EMERGENCY REGULATIONS	13.07	57.67	23.01	1.42	4.83	352
O3 EMERGENCY INTEGRATED RESPONSE PLANS	16.19	61.08	17.61	1.14	3.98	352
O4 EMERGENCY COMMANDS AND COORDINATION	15.06	61.36	19.03	1.70	2.84	352
O5 EMERGENCY INTER-ORGANIZATION FOR COMMUNITIES	15.91	56.25	20.17	3.13	4.55	352
O6 EMERGENCY INTER-ORGANIZATION FOR AGENCIES	1.65	56.82	25.85	1.99	3.69	352
O7 MULTI-WAYS OF INFO EXCHANGE BETWEEN AGENCIES	9.38	54.26	28.98	3.41	3.98	352
O8 MULTI-WAYS OF INFO EXCHANGE ACROSS SECTORS	8.24	52.27	30.40	3.69	5.40	352
O9 TRAINED PROFESSIONAL MANAGERS ON DUTY	9.09	49.15	34.66	3.13	3.98	352
O10 TRAINED RESERVED PERSONNEL ON RECALL	5.06	51.99	26.70	2.84	3.41	352
II. TECHNICAL INFRASTRUCTURE	HIGH N (%)	MED N (%)	LOW N (%)	NONE N (%)	NA N (%)	TOTAL (N)
T1 RISK ASSESSMENT	9.09	61.93	21.59	1.70	5.68	352
T2 BUILDING CODES	4.55	46.88	30.40	9.66	8.52	352
T3 STRUCTURAL INSPECTION	7.39	36.93	29.83	15.34	10.51	352
T4 ALTERNATIVE COMMUNICATION	8.81	51.70	26.14	5.40	7.95	352
T5 ALTERNATIVE ELECTRICAL FACILITIES	10.80	46.31	28.13	6.82	7.95	352
T6 SPECIAL EMERGENCY OPERATION AND EQUIPMENT	11.08	48.58	27.27	3.69	9.38	352
T7 IDENTIFICATION OF MAJOR FACILITIES	11.65	55.97	22.16	3.69	6.53	352
T8 ALTERNATIVE RESCUE OR EMERGENCY RESPONSE	13.35	53.41	24.43	3.69	5.11	352
T9 SELF TECHNICAL MANUAL PROCEDURE	7.95	47.16	30.40	8.52	5.97	352
T10 OTHER TECHNICAL SUPPORT*	0.57	13.07	9.38	2.56	74.43	352
III. CULTURAL OPENNESS	HIGH N (%)	MED N (%)	LOW N (%)	NONE N (%)	NA N (%)	TOTAL (N)
C1 SHARED VALUE OF HUMANITARIAN ASSISTANCE	44.60	44.89	5.40	.85	4.26	352
C2 COMMITMENT TO GOAL OF PROTECTING LIFE	33.24	55.11	6.82	.28	4.55	352
C3 WILLINGNESS TO SHARE INFORMATION NEEDED	27.27	56.25	11.36	.28	4.83	352
C4 ACCEPTANCE OF NEW INFORMATION	26.70	59.66	7.95	.57	5.11	352
C5 OPENNESS TO NEW METHODS	28.13	51.70	14.49	1.42	4.26	352
C6 WILLINGNESS TO REVIEW ACTIONS TAKEN	28.13	53.98	13.35	.85	3.69	352
C7 WILLINGNESS TO CORRECT MISTAKES	9.26	51.70	13.07	.57	5.40	352
C8 WILLINGNESS TO ACCEPT RESPONSIBILITY, SOLVE CONFLICTS	30.11	49.43	13.35	.85	6.25	352
C9 WILLINGNESS TO SERVICE PUBLIC	41.19	47.73	6.25	.28	4.55	352
C10 CONTINUAL SEARCH FOR RELEVANT, ACCURATE INFO	27.84	56.82	9.38	.85	5.11	352

Source: Structural Survey of Emergency Personnel of National-Provincial-Local Levels of Jurisdiction, Thailand July – August 2005

NOTE: * described as the capacity to obtain other information regarding known technical elements

As discussed in Chapter Two that this study uses Comfort’s model to explain the existing emergency model in Thailand. This study applies three crucial indicators, which are technical structure, organizational flexibility, and cultural openness, to identify the type of emergency management at each level. This study modifies three socio-technical components from Comfort’s work in Shared Risk into a numerical scale 1-5 which 5 is the highest degree of a particular indicator. The comparison of the three components across multiple levels of operations for emergency response personnel will be discussed in Chapter Six. In addition, interaction patterns, extent of information flow and presence of communication channels are measured using ordinal scales.

4.4.1.1 Pre-Analysis Data Screening

There are four main purposes for screening data prior to conducting factor and multivariate analyses. The first deals with the accuracy of the data that have been collected because the results of any statistical analysis are only as good as the data that were analyzed. If inaccurate data are used, the computer program will run the analysis, and the researcher will obtain output that is inaccurate. This study uses frequency distributions and descriptive statistics to examine the range of values present the data to ensure that no cases have values outside the range of possible values. In addition, this study used two different data-entry personnel to perform a manual verification of the data entry list.

The second purpose deals with missing data and attempts to assess the effect of, and ways to deal with, incomplete data. Missing data occur when measurement design fails, subjects do not respond to all items, or errors occur during data entry. The survey used an ordinal scale from 1 to 5, which 5 is the highest score while 2 is the lowest which equal to none, and 1 is not applicable or do not answer. A no-response or blank answer of any question is declared “0” in value. Therefore, the values “0” and “1” are coded as missing values and recoded as “9” and “8” respectively. A total number of questionnaires are 358 from three levels of emergency personnel. Three questionnaires were dropped from the analysis because they contained “0” scores in all 30 questions of socio-technical components, which bring the total number of questionnaires before considering other cases of missing value in the analysis to 355. This study also analyzes the distribution of missing data to identify whether any pattern can be observed in the responses.

There are twenty-one questionnaires with more than 5 significant missing values. Thirteen questionnaires are the responses of emergency personnel from the Bangkok Metropolitan Authority (BMA) while the other eight questionnaires are of the Department of Disaster Prevention and Mitigation (DDPM). The missing values were contained within the responses to the questionnaires that were distributed to every level of jurisdiction in both the BMA and DDPM. The data reveal that those who are emergency personnel within the BMA, twelve out of thirteen, did not respond to technical-infrastructure questions. This result is explained, also in Chapter 5, by the fact that BMA emergency personnel have less experience in using technical infrastructure and equipment as well as managing in multi-hazard operations, let alone the insufficient emergency response facilities. Interestingly, those who are emergency personnel within DDPM, seven out of eight, did not respond to questions relating to cultural openness. It is clear that the 26 December, 2004 tsunami disaster response event triggered many questions about the DDPM’s performance and capability in managing emergency response. These missing answers may be the result of respondents being uncomfortable giving their opinion about issues related to their agency’s performance which may undermine their job security.

Hence, this study will exclude all 21 missing respondents in the analysis since they constitute only 5.9% of the total number of 355 cases. Moreover, these missing values are scattered throughout the BMA and DDPM in the patterns that are significant to the analyses of emergency response operations and performance. The total number of valid cases is 334.

The third purpose in data screening is to assess the effects of extreme values on the analysis. Outliers often create problems in multivariate data analyses because they distort the results of a statistical test. This study uses the Box-Plot technique, shown in Figure 4.8, to identify outliers and investigate them further.

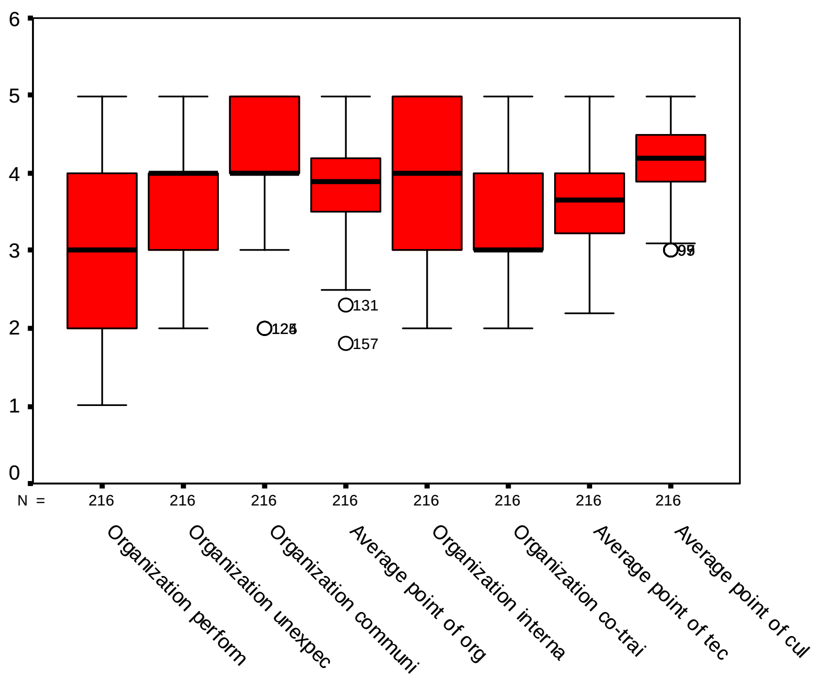


Figure 4.8 Box-Plot of Structural Survey of Emergency Personnel of National-Provincial-Local Levels of Jurisdiction, Thailand July – August 2005

Source: Structural Survey of Emergency Personnel of National-Provincial-Local Levels of Jurisdiction, Thailand July – August 2005

NOTE: Box-Plot from left to right; Organization Performance, Organization Readiness for Unexpected Event, Organization Communication, Average Point of Organizational Flexibility, Organizational Internal Training, Organizational Co-Training, Average Point of Technical Infrastructure, Average Point of Cultural Openness

In the outlier analysis, there are five outliers identified as extreme values from the sample population. When examining the values, there is a reasonable explanation for keeping these values. These values identified as outliers share the same characteristic of being “too low” scores. This causes by the combination of a low scores of “2” which indicate “none” and “1” which is “not applicable”. Although “1” is declared as “missing value”, the state of “none” and “not applicable” indicates lack of availability and information to be known which are significant to the study.

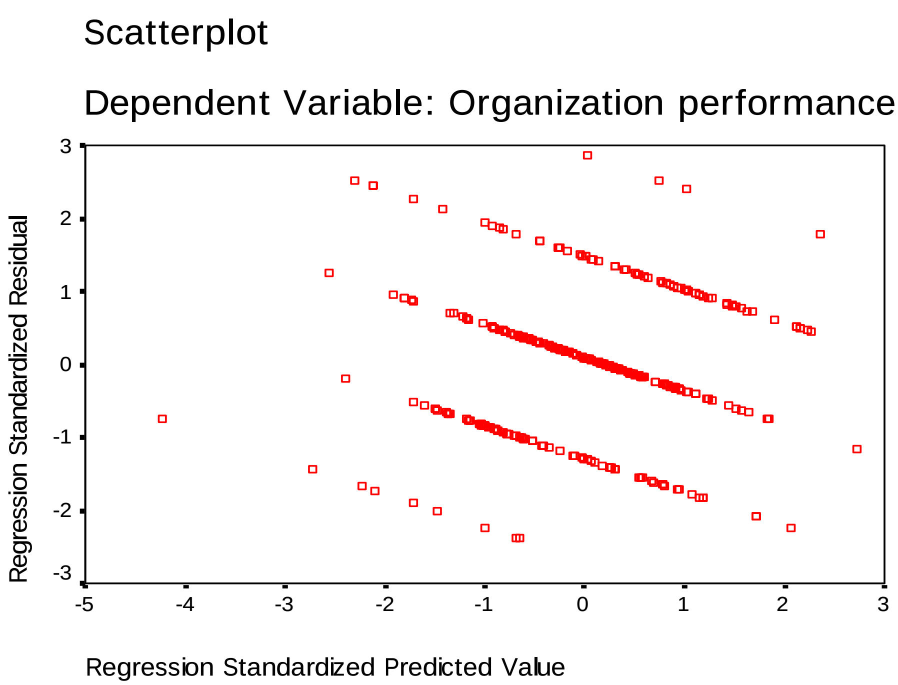


Figure 4.9 Scatter-Plot of Organization Performance of Structural Survey of Emergency Personnel of National-Provincial-Local Levels of Jurisdiction, Thailand July – August 2005

Source: Structural Survey of Emergency Personnel of National-Provincial-Local Levels of Jurisdiction, Thailand July – August 2005

NOTE: Scatter-Plot of Regression; Dependent Variable is Organization Performance; Independent Variables are Socio-Technical Components

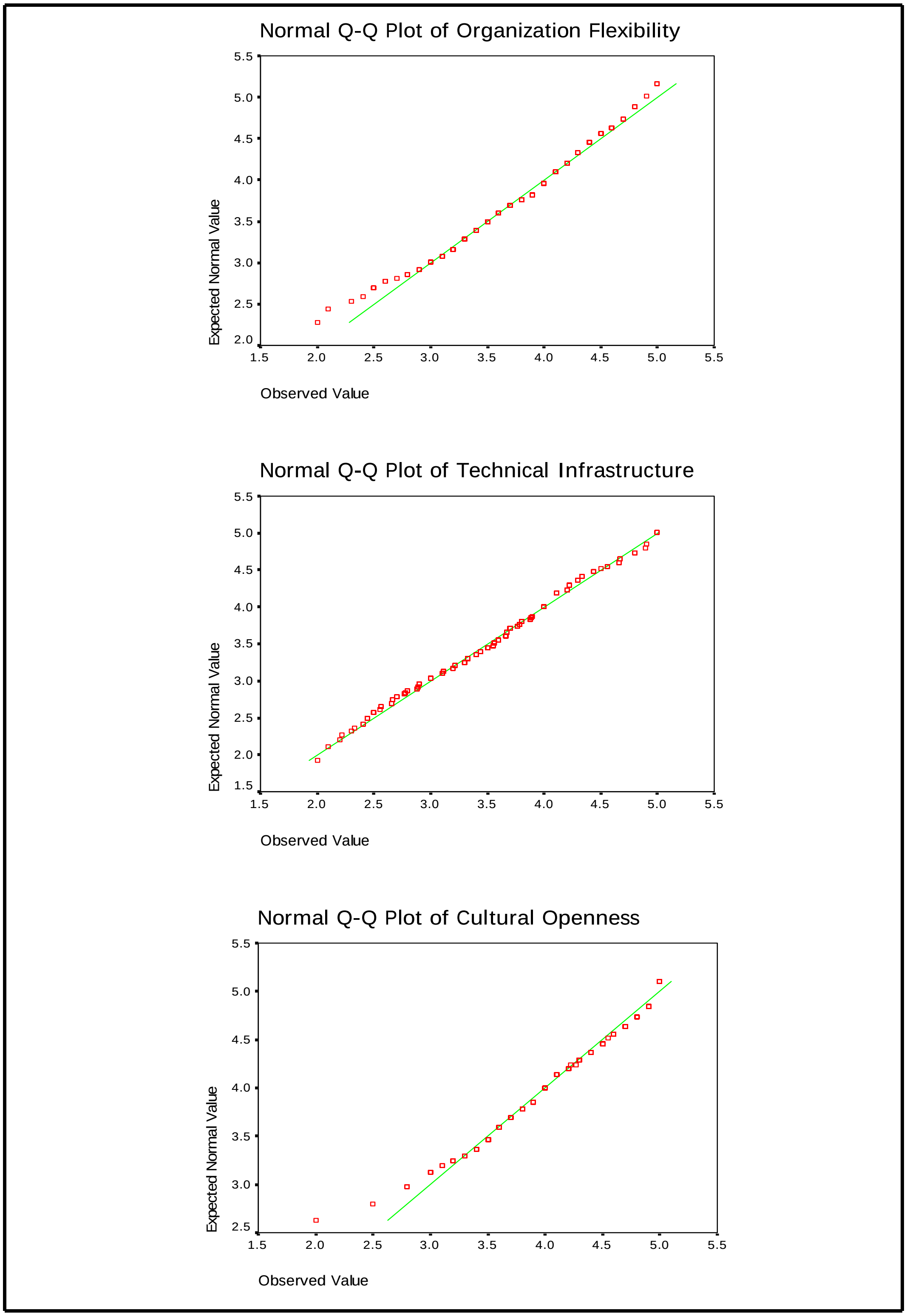


Figure 4.10 Q-Q Plot of Socio-Technical Components of Structural Survey of Emergency Personnel of National-Provincial-Local Levels of Jurisdiction, Thailand July – August 2005

Source: Structural Survey of Emergency Personnel of National-Provincial-Local Levels of Jurisdiction, Thailand July – August 2005

The last purpose of data screening is to assess the adequacy of fit between the data and the assumptions of a specific procedure. All multivariate statistical procedures are based on assumptions of normality, linearity, and independence. I examined the normal sample distribution by histogram and residual plot, shown in Figure 4.9, and Q-Q plot, shown below in Figure 4.10 for linearity. In addition, the statistics for “Skewness” and “Kurtosis” were used to identify the degree of normality. I used power-transformation to normalize the data, “Skewness” and Kurtosis” were recalculated to ensure the values are closer to “0” to indicate more normality, before running multivariate analysis.

4.4.1.2 Factor Analysis of Socio-Technical Components

Before proceeding with the analysis of the socio-technical components of the emergency operations under the Department of Disaster Prevention and Mitigation (also applied to an analysis in chapter 5), this study runs the principal component analysis to identify the factors, or clusters of variables, in the analysis. Factor analysis is a procedure used to determine the extent to which measurement overlap (Williams, 1992) or shared variance exists among a set of variables. Principal component analysis is usually the preferred method of factor extraction, especially when the focus of an analysis searching for underlying structure is truly exploratory, which is typically the case. To proceed with Factor analysis, I declared missing values, as discussed earlier, and recoded the scores of original data obtained from questionnaires. The ordinal scale of 5 to 1, when “1” is declared missing, is recoded from 5 to 4 as the highest, 4 to 3 as moderate, 3 to 2 as low, and 2 to 1 as non. This is only for the purpose of not elevating a value of result when running principal component analysis as well as later in regression analysis. This principal component of factor analysis serves to determine whether the three socio-technical components proposed in the theoretical framework are present in the data.

Table 4.15 Principal Component Analysis: Total Variance Explained of Socio-Technical Components

Components	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	%of Variance	Cumulative %	Total	%of Variance	Cumulative %
1	4.630	37.541	37.541	4.630	37.541	37.541	2.678	21.714	21.714
2	1.786	14.477	52.018	1.786	14.477	52.018	1.958	15.875	37.589
3	1.057	8.570	60.587	1.057	8.570	60.587	1.635	13.258	50.847
4	.883	7.162	67.749	.883	7.162	67.749	1.292	10.472	61.319
5	.542	4.391	72.141	.542	4.391	72.141	1.186	9.617	70.936
6	.495	4.012	76.153	.495	4.012	76.153	.643	5.217	76.153

Source: Structural Survey of Emergency Personnel of National-Provincial-Local Levels of Jurisdiction, Thailand July – August 2005

Table 4.16 Principal Component Analysis: Communalities of Socio-Technical Components

Code	Initial	Extraction	Code	Initial	Extraction	Code	Initial	Extraction
O1	1.000	.796	T1	1.000	.517	C1	1.000	.799
O2	1.000	.803	T2	1.000	.817	C2	1.000	.746
O3	1.000	.779	T3	1.000	.839	C3	1.000	.766
O4	1.000	.757	T4	1.000	.859	C4	1.000	.648
O5	1.000	.737	T5	1.000	.643	C5	1.000	.785
O6	1.000	.767	T6	1.000	.802	C6	1.000	.882
O7	1.000	.550	T7	1.000	.790	C7	1.000	.852
O8	1.000	.715	T8	1.000	.684	C8	1.000	.793
O9	1.000	.738	T9	1.000	.737	C9	1.000	.586
O10	1.000	.775	T10	1.000	.847	C10	1.000	.737

Source: Structural Survey of Emergency Personnel of National-Provincial-Local Levels of Jurisdiction, Thailand July – August 2005

NOTE: Extraction Method: Principal Component Analysis;

O1-10 are Organizational Flexibility Indicators (Variables)

T1-10 are Technical Infrastructure Indicators (Variables)

C1-10 are Cultural Openness Indicators (Variables)

Table 4.17 Rotated Component Matrix

INDICATORS \ COMPONENTS	Tech_1 1	Org_1 2	Cult_1 3	Cult_2 4	Tech_2 5	Org_2 6
National emergency laws	-.253	**.644**	.102	.181	.514	-.096
Special emergency regulations	-.157	**.610**	.177	.261	.545	-.101
Emergency integrated response plans	.120	.390	.308	.155	.268	**.649**
Emergency commands and coordination	.036	**.611**	.230	.238	.185	.488
Emergency inter-organization for communities	.498	**.513**	.089	.318	-.073	.333
Emergency inter-organization for agencies	.534	**.656**	.055	.199	-.049	.083
Multi-ways of info exchange between agencies	.202	**.540**	.329	.084	.188	.259
Multi-ways of info exchange across sectors	.235	**.770**	.226	-.093	.051	.069
Trained professional managers on duty	.232	**.792**	.108	.088	.190	.036
Trained reserved personnel on recall	.429	**.743**	.082	.055	-.174	.013
Risk assessment	**.524**	.308	-.072	.219	.304	-.042
Building codes	.323	.067	.256	-.016	**.789**	.139
Structural inspection	.285	.110	.107	.096	**.843**	.122
Alternative communication	**.704**	-.065	-.140	.199	.365	.407
Alternative electrical facilities	**.716**	.325	.048	.042	-.097	.102
Special emergency operation and equipment	**.878**	.058	.102	.072	.107	.031
Identification of major facilities	**.826**	.056	.052	.079	.256	-.173
Alternative rescue or emergency response	**.727**	.168	.318	-.032	-.019	-.155
Self technical manual procedure	**.672**	.266	.296	-.013	.347	.083
Other technical support	**.893**	.149	-.012	.082	.024	.142
Shared value of humanitarian assistance	-.072	.033	.266	**.810**	.166	.195
Commitment to goal of protecting life	-.054	-.005	.218	**.790**	.173	.204
Willingness to share information needed	.375	.066	.189	**.611**	.209	-.410
Acceptance of new information	.249	.323	.298	**.601**	-.136	.119
Openness to new methods	.067	.261	**.746**	.298	.060	.252
Willingness to review actions taken	.074	.198	**.820**	.341	.217	-.037
Willingness to correct mistakes	.069	.214	**.824**	.302	.111	.133
Willingness to accept responsibility, solve conflicts	.094	.071	**.790**	.363	.144	-.050
Willingness to service public	.287	.059	**.426**	**.559**	-.076	.014
Continual search for relevant, accurate info	.161	.236	.326	**.724**	-.028	-.157

Source: Structural Survey of Emergency Personnel of National-Provincial-Local Levels of Jurisdiction, Thailand July – August 2005

Principal component analysis was conducted utilizing a Varimax rotation. The initial analysis retained three components. This study used the Eigenvalue of at least 1.0, the Communality of over 0.5, allowed by the rule of sample size over 250, and Scree plot (Figure 4.11) of a cut point at the third component. Criteria indicated that retaining the first three components should be investigated. However, I also investigated the fourth, fifth, and sixth components because of the high value of communality.

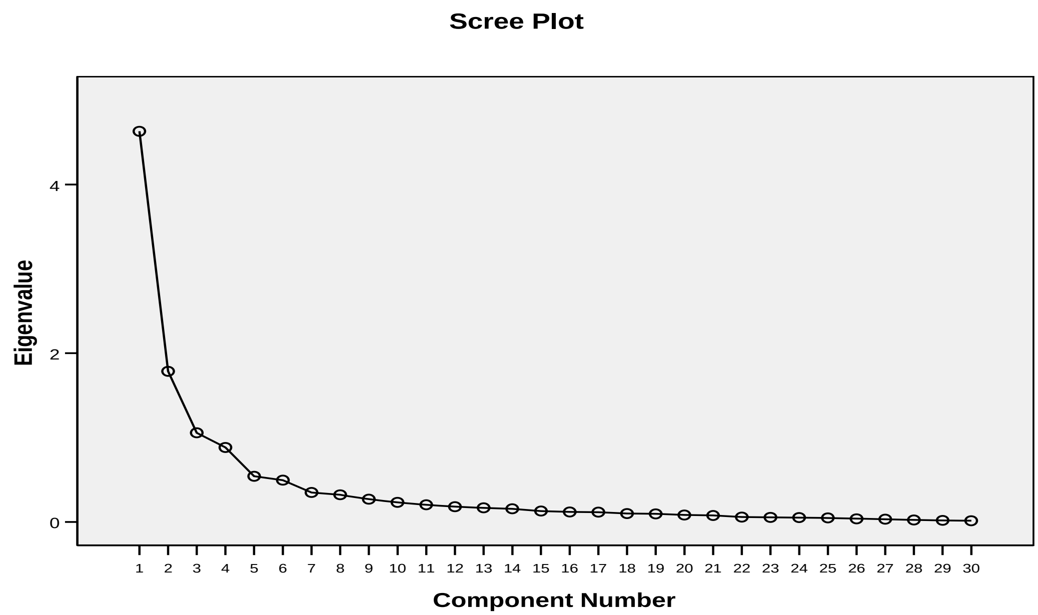


Figure 4.11 Scree Plot of Principal Component AnalysisA Distribution of Eigenvalue of Socio-Technical Components

Source: Structural Survey of Emergency Personnel of National-Provincial-Local Levels of Jurisdiction, Thailand July – August 2005

The first component accounted for 37.54% of the variance and the second for 14.47%. Component one includes variables in the group of "Technical Infrastructure" and component two includes variables in the group of "Organizational Flexibility". Taking into account the significant loadings on the fifth and sixth components, the fifth component contains two variables of "Technical Infrastructure", by theoretical framework, which are building codes and structural inspection, whereas the sixth component that contains a variable of integrated response plan which should belong to "Organizational Flexibility."

From interviews and document analysis, building codes and structural inspection are responsibilities that are performed by other government agencies. Emergency personnel do not have sufficient knowledge of those two procedures and the information regarding them. As discussed earlier regarding the low degree of coordination among emergency personnel of different jurisdictional levels, it is reasonable to state that emergency personnel do not have enough information on their integrated response plan. It is not a surprise to see emergency personnel shift such action plans out of their concept of Organizational Flexibility.

The third component, which is by a theoretical framework grouped as Cultural Openness, is close to the fourth component that obtains 0.88 Eigenvalue. The eigenvalues of the third and fourth components vary slightly and the scree plot shows a slightly different shift of line as well. The fourth component includes six other variables, regarding theoretical framework, that belong to Cultural Openness as well. I combined the third and fourth component under a group of variables indicating Cultural Openness, as there are two subgroups. The first group contains openness to new methods, willingness to review actions, to correct mistakes, and to accept responsibility, which are considered individual values. The second group contains organizational values that reflect humanitarian perspectives, shared goal of saving lives, willingness to share and accept new information as needed, public service orientation, and commitment to the continuing search for accurate information.

Based on insights gained from responses to the semi-structured interviews, I retained 3 components, Cultural Openness, Technical Infrastructure and Organizational Flexibility. This result basically confirms the theoretical framework proposed in Chapter 2. Undoubtedly, the principal component analysis shows the significant effect of Technical Infrastructure as the first component. This finding documents the frustration of the Thai government and emergency agencies of not having sufficient knowledge, information, training, gap identification, solutions and technological expertise to be able to relocate personnel and resource to help people and to cope with the unexpected disaster. The surveys and interviews were conducted in two sessions, one month and six months after the attack. Only after six months had the technical infrastructure been gradually installed and was functioning. The National Disaster Warning Center was established to pool information and knowledge of expertise into a country. Resource, manpower, and training are increasingly provided.

The second component of Organizational Flexibility is evidently leading to a long discussion. Changing organizations to be more flexible and effective in dealing with complexity and chaos is a long process. If knowledge and information are not yet provided or effectively accessible, agencies are unlikely to be willing to make decisions or adapt to changing situations based on limited experience and training. Personnel will rely on the top level of management to make decisions which then moves the organization back to a command-and-control pattern that is not flexible in emergency management.

The third component of Cultural Openness is divided into individual and organizational levels. Willingness of emergency personnel to change and improve performance is no longer questionable because it means saving not only other lives, but also their own. However, behavioral change is time consuming especially when such change also concerns inter-organizational values such as shared goal of serving public and saving lives or exchanging and accepting new information needed.

Figure 4.12 below shows the mean scores of socio-technical components extracted from the emergency response personnel questionnaires, 184 respondents, from the Department of Disaster Prevention and Mitigation (DDPM).

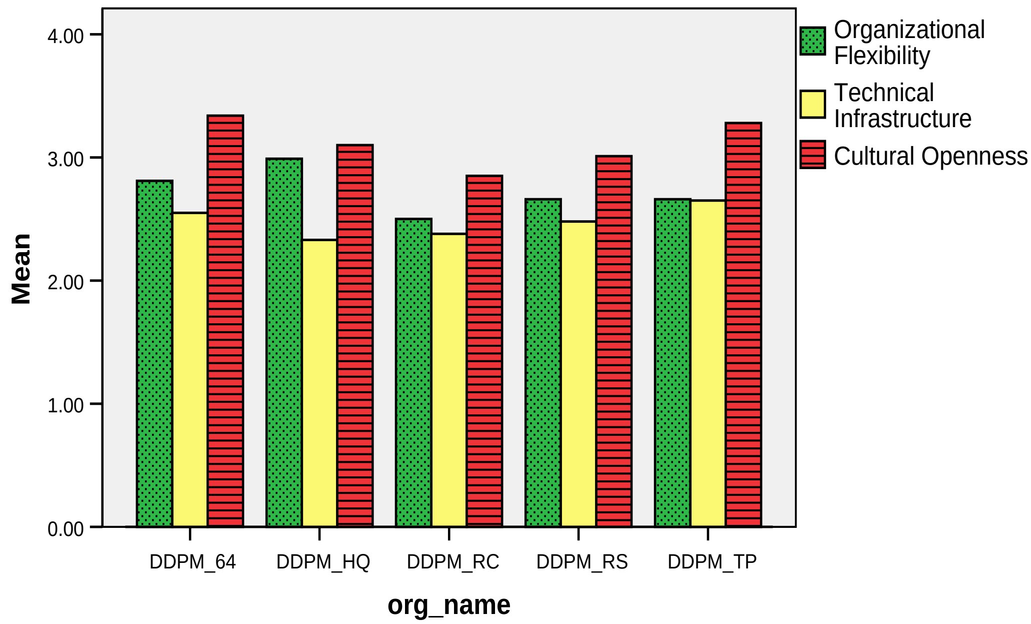


Figure 4.12 Mean scores of socio-technical component in each unit of The Department of Disaster Prevention and Mitigation, Thailand

Source: Structural Survey of Emergency Personnel of National-Provincial-Local Levels of Jurisdiction, Thailand July – August 2005

NOTE: Organization Name [org_name], DDPM representatives from 64 provinces [DPM_64], DDPM at Headquarter, Bangkok [DPM_HQ], DDPM at Central Regional Center [DPM_RC], DDPM at Southern Regional Center [DPM_RS], DDPM at tsunami affected provinces [DPM_TP]

The investigation was conducted with emergency operational personnel, supervisors, and top level operational managers to identify the degree of perceived recognition of the three socio-technical components in the national emergency response system. The interviews were also conducted to strengthen the interpretation and explanation of these results from surveys. The frequency distribution from the questionnaires corresponding to each socio-technical component is presented in Appendix H.

From the graph, across the board, all units of DDPM indicate the lowest measures for technical infrastructure in comparison to the degree of organizational flexibility and cultural openness. This finding can be explained by the fact that Thailand was considered to be in the low-risk zone for the large scale natural disaster before the 2004 tsunami. The readiness and preparation of technical equipment and infrastructure are lower. Also as previously discussed, the willingness of people to accept knowledge, information and training to enhance their adaptive capability to disaster management is relatively high compared to the realization of how long it takes an organization to change in order to adapt to new settings of complexity and emergency management.

DDPM Headquarters reports the lowest score of technical infrastructure and highest degree of organizational flexibility. The headquarters unit functions as the head of the emergency response system. DDPM Headquarters is mainly responsible for policy making, planning, budgeting, coordinating and training. It is unlikely for DDPM Headquarters in Bangkok to engage in the frontline emergency response operations. Bangkok Metropolis has its own agencies, Civil Emergency Relief Department and District office with the Civil Defense Volunteer Units, to function in the emergency response system (discussed in chapter 5). DDPM Headquarter has the highest degree of flexibility since the unit has full authority over its own functions and responsibilities. DDPM Headquarters has to coordinate with several units around the country within the DDPM network as well as with multiple agencies across sectors and level of jurisdictions.

The data show that the cultural openness component for the DDPM provincial personnel is higher than for those in the central area. After the devastation of tsunami, the provincial personnel realized the limitations of their knowledge and capabilities to deal with such a large scale of damage and unexpected consequences. The personnel are more willing to learn from their mistakes and bring in more information to change and enhance their adaptive capacity. Among the provinces, technical infrastructure in the southern area, especially those provinces affected by tsunami, has been installed and activated to ensure the safety of public and help save lives and properties. The Thai government realizes that emergency management needs not only response and mitigation infrastructure, but also warning dissemination infrastructure and technology. People need to be prepared for emergency situations that may confront them.

I calculated the sums of each socio-technical component to use as a socio-technical indicator to compare roughly the working environment of the different units of DDPM in order to identify the strengths and weaknesses of each unit. The mean scores of the socio-technical indicator are 3.36 for DPM_RC, 3.72 for DPM_RS, 3.74 for DPM_TP, 3.66 for DPM_ 64, and 3.33 for DPM_HQ. This result confirms a high degree of dynamic movement among emergency response personnel in the southern part of Thailand, especially for those in affected areas to change and improve their performance.

4.4.2 Interaction and Coordination Analysis

This analysis provides a general picture of how DDPM personnel interact among themselves as well as with other agencies across jurisdictions and sectors. I included questions in the survey to obtain the information regarding how each unit of DDPM coordinated and interacted with the others in the same and different levels of jurisdictions and sectors. The results are summarized as in the table 4.18.

The summary indicates how personnel in each unit of DDPM view their frequent interactions with multiple agencies in emergency response operations. Surprisingly, national agencies are ranked the least frequent in interactions with DDPM at regional centers as well as those under the provincial level. DDPM personnel in the tsunami-affected provinces also reported their interaction with the national agencies less frequently than with provincial agencies and private rescue teams. Provincial and local agencies are evidently favored over other organizations interacting in disaster response. Interestingly, the volunteers' interaction with DDPM ranges from the most frequent to less frequent. I examined the importance of volunteers in their role as community representatives.

Table 4.18 A Summary of Degree of Agencies Coordination between Department of Disaster Prevention and Mitigation and Participating Response Agencies

LEVELS OF COORDINATION / DEPARTMENT OF DISASTER PREVENTION AND MITIGATION UNIT	MOST FREQUENT	SECOND MOST FREQUENT	MODERATE FREQUENT	LESS FREQUENT	LEAST FREQUENT
HEADQUARTER	PROVINCIAL AGENCIES	NATIONAL LOCAL AGENCIES	VOLUNTEERS LOCALS	NGOS	PRIVATE
CENTRAL REGION	LOCAL AGENCIES	PROVINCIAL AGENCIES	NGOS LOCALS	VOLUNTEERS PRIVATE	NATIONAL
SOUTHERN REGION	VOLUNTEER	LOCAL AGENCIES	LOCALS PROVINCIAL	PRIVATE NGOS	NATIONAL
TSUNAMI AFFECTED	PROVINCIAL AGENCIES	PRIVATE	LOCAL AND NATIONAL	NGOS VOLUNTEERS	LOCALS
64 PROVINCES REPRESENTATIVES	PROVINCIAL AGENCIES	LOCAL AGENCIES	LOCALS VOLUNTEER	NGOS	NATIONAL

Source: Structural Survey of Emergency Personnel of National-Provincial-Local Levels of Jurisdiction, Thailand July – August 2005

This finding on coordination is problematic as it relates to the analysis of the interaction network. The Thai domestic response network relies very much on the interconnection from the national agencies such as ministries and departments. Even though provincial governments several times played crucial roles as focal points, they still functioned less effectively due to lack of information and confidence in making decisions. Provincial governments tended to work in their sub-networks as identified in the analysis of cliques and group centrality. In the entire network, provincial organizations constituted 19.4% of the actors involved in response operations. This proportion was less compared to the number of national organizations, 39.9%, and it indicated fewer interactions or ties from provincial organizations to other organizations.

Figure 4.13 shows how each unit of DDPM personnel views its degree of coordination with other government agencies. This mean score shows the degree of interagency initiation during their operations in routine work and emergency situation. Even though the results exceed the moderate degree (at 3.0), I need to investigate further the kind and patterns of coordination, because not every interaction is a basis of capacity building of interagency coordination in emergency response. The types of interaction patterns presented in table 4.19 allow a clearer interpretation of those degrees in coordination. Some of the activities done among agencies may strictly be routine businesses regardless emergency response involvement.

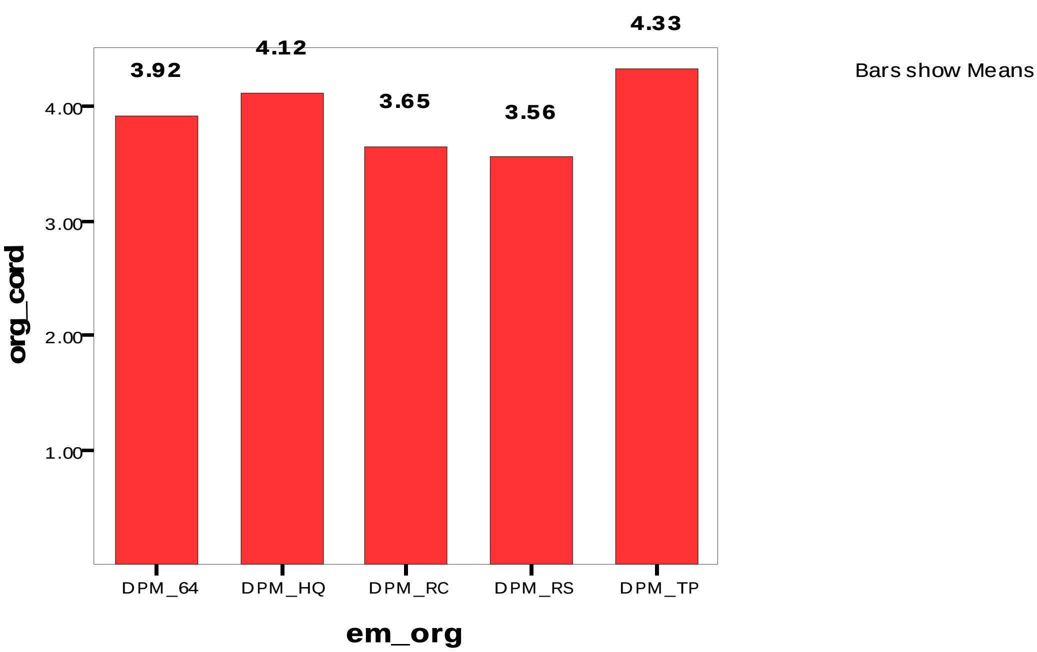


Figure 4.13 Mean score of organizational coordination by Department of Disaster Prevention and Mitigation emergency personnel

Source: Structural Survey of Emergency Personnel of National-Provincial-Local Levels of Jurisdiction, Thailand July – August 2005

NOTE: org_cord = Organization Coordination; em_org = Emergency Organizations; DPM_64 = Disaster Prevention and Mitigation 64 Provincial Representatives; DPM_HQ = DPM Headquarter; DPM_RC = DPM Central Regional Center; DPM_RD = DPM Southern Regional Center; DPM_TP = DPM as Tsunami Affected Provinces

Table 4.19 A Summary of Degree of Interaction Patterns by Department of Disaster Prevention and Mitigation emergency personnel

LEVELS OF COORDINATION / DDPM UNIT	THE MOST FREQUENT	THE SECOND MOST FREQUENT	LESS FREQUENT	LEAST FREQUENT
DDPM HEADQUARTER	ROUTINE WORK, ASSISTANCE	COMMAND	PERSUASION	NEGOTIATION
DDPM CENTRAL REGION	ROUTINE WORK	COMMAND	ASSISTANCE	NEGOTIATION, PERSUASION
DDPM SOUTHERN REGION	ROUTINE	PERSUASION	ASSISTANCE COMMAND	NEGOTIATION
DDPM TSUNAMI AFFECTED	ASSISTANCE	ROUTINE WORK, COMMAND, PERSUASION	ROUTINE WORK, COMMAND, PERSUASION	NEGOTIATION
DDPM 64 PROVINCES REPT	ROUTINE WORK	COMMAND	ASSISTANCE, PERSUASION	NEGOTIATION

Source: Structural Survey of Emergency Personnel of National-Provincial-Local Levels of Jurisdiction, Thailand July – August 2005

Most coordination and interaction between DDPM units with others is through their routine work. The second most frequent is the interaction through command and authority. This pattern tells the story of a long traditional management of bureaucracy that still has roots in the agency, although decentralization has been introduced into the system. It will take a long process to move them to interact through assistance, negotiation and persuasion for co-activities and practices. Such actions are still considered a high-profile decision making process which is reserved only for top management. It is also understandable, under emergency constraints, that less powerful and unauthorized personnel are not able to facilitate actions, reallocate resources, or request assistance across their jurisdiction.

Figure 4.14 cites how frequently technical support and assistance were asked among the reported interactions between DDPM and other response agencies. There is a moderate level of technical support and assistance among organizations. The mobilization of resources and rotation of well-trained personnel is expected among these organizations as one of the main interactions. It appears to be less frequent than routine works and command through authority lines.

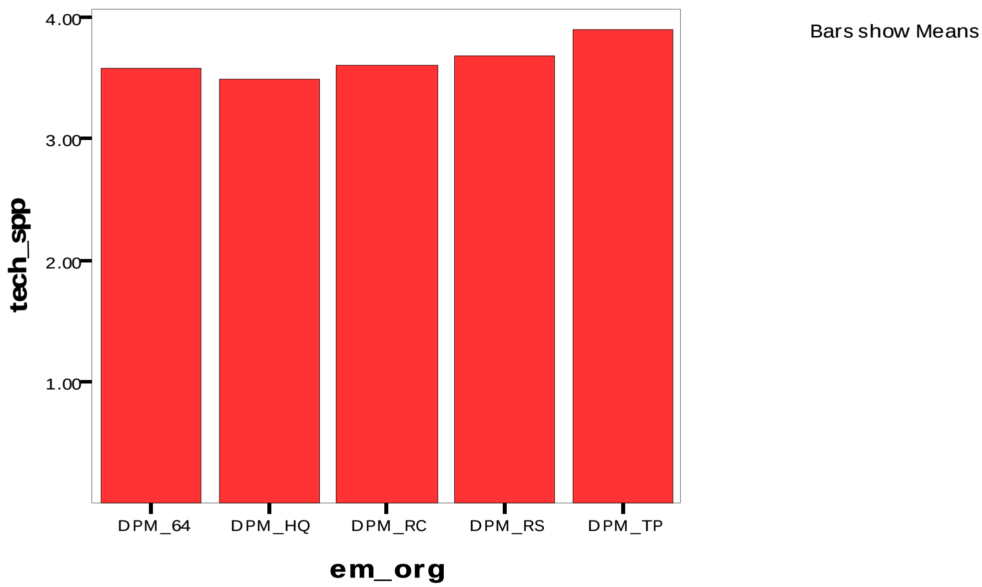


Figure 4.14 Degrees of frequency of technical support provided by other organizations by Department of Disaster Prevention and Mitigation emergency personnel

Source: Structural Survey of Emergency Personnel of National-Provincial-Local Levels of Jurisdiction, Thailand July – August 2005

NOTE: tech_spp = Technical Support, em_org = Emergency Organizations; DPM_64 = Disaster Prevention and Mitigation 64 Provincial Representatives; DPM_HQ = DPM Headquarter; DPM_RC = DPM Central Regional Center; DPM_RD = DPM Southern Regional Center; DPM_TP = DPM as Tsunami Affected Provinces

The lack of exchange in emergency response skills is also confirmed by the information regarding training programs reported by organizations in the surveys as shown in Figure 4.15. DDPM personnel receive training within their organization and are trained individually more frequently than any of the co-training programs provided by their agency or other organizations.

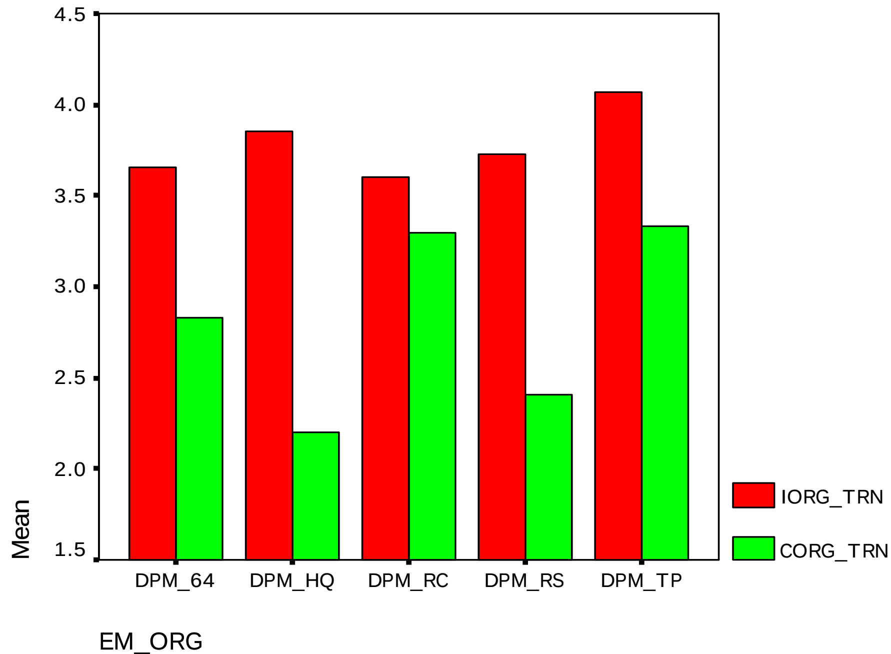


Figure 4.15 Graph shows the degrees of frequency of training programs provided by the organizations by Department of Disaster Prevention and Mitigation emergency personnel

Source: Structural Survey of Emergency Personnel of National-Provincial-Local Levels of Jurisdiction, Thailand July – August 2005
NOTE: IORG_TRN = Organizational Training; CORG_TRN = Co-Training; em_org = Emergency Organizations; DPM_64 = Disaster Prevention and Mitigation 64 Provincial Representatives; DPM_HQ = DPM Headquarter; DPM_RC = DPM Central Regional Center; DPM_RD = DPM Southern Regional Center; DPM_TP = DPM as Tsunami Affected Provinces

This lack of training creates another problem in the lack of understanding of work processes in other response organizations and adaptive skills to compensate or substitute actions for problems that may be caused by those who failed. The purpose of co-training and skills transfer through interaction among the emergency response agencies is to facilitate knowledge and information sharing within the network. When information is shared sufficiently, emergency personnel at every level of operations and management can react faster and more accurately especially under urgent time constraints.

4.4.3 Information and Communication Management Analysis

This section analyzes how information is managed and how it is transmitted to emergency personnel through the available communications infrastructure. Previous discussion has emphasized the importance of the processes by which information is received and used to make timely informed decisions. The characteristics of information flow and information and communication management are reported below, based on the following questions from the survey.

4.4.3.1 Information Management and Decision Making Characteristics

1. How would you describe the direction of information flow in your agency?
2. To what extent do you get the information you need within your agency?
3. How often do you use the information provided to your agency to make decisions related to your work operations?
4. How often do you estimate that you and/or your colleagues make contingent decisions under states of emergency?
5. At what level in your agency or unit are decisions formally made?
6. To what extent do you think the regulations and procedures in which you have been trained help to accomplish the goals of emergency operations?
7. To what extent do the participation and support from other organizations help to make more accurate decision related to your work?

Tables 4.20-4.24 show the characteristics of information flow and the use of information in the decision making processes for emergency operations at the management levels of each DDPM unit. It is interesting that the attitudes toward information use in decision making are at moderate to high levels across all DDPM personnel.

Table 4.20 Summary of Characteristics of Information Management, DDPM Headquarter

DDPM HQ		Information Flows directions	Information received within organization	Information used for decision making	Decision making made in organization	Rules and regulations used in practice	Decision making participation	Decision making accuracy from coordination
N	Valid	41	41	41	41	41	41	41
	Missing	0	0	0	0	0	0	0
Mean		**4.24**	**3.54**	**3.98**	**2.95**	**3.61**	**3.29**	**3.22**
Mode		All ways	4	4	Top Mgt	4	4	4

Source: Structural Survey of Emergency Personnel of National-Provincial-Local Levels of Jurisdiction, Thailand July – August 2005

Table 4.21 Summary of Characteristics of Information Management, DDPM Central Regional Center

DDPM RC		Information Flows directions	Information received within organization	Information used for decision making	Decision making made in organization	Rules and regulations used in practice	Decision making participation	Decision making accuracy from coordination
N	Valid	20	20	20	20	20	20	20
	Missing	0	0	0	0	0	0	0
Mean		**4.05**	**3.50**	**3.60**	**3.05**	**3.60**	**3.45**	**4.00**
Mode		Bottom up and Top Down	3	4	Chief of Operations under Supervision	4	4	4

Source: Structural Survey of Emergency Personnel of National-Provincial-Local Levels of Jurisdiction, Thailand July – August 2005

Table 4.22 Summary of Characteristics of Information Management, DDPM Southern Regional Center

DPM RS		Information Flows directions	Information received within organization	Information used for decision making	Decision making made in organization	Rules and regulations used in practice	Decision making participation	Decision making accuracy from coordination
N	Valid	41	41	41	41	41	41	41
	Missing	0	0	0	0	0	0	0
Mean		**2.95**	**3.37**	**3.51**	**3.49**	**4.02**	**3.56**	**3.68**
Mode		Bottom up and Top Down	3	3	Chief of Operations under Supervision	4	3	3

Source: Structural Survey of Emergency Personnel of National-Provincial-Local Levels of Jurisdiction, Thailand July – August 2005

Table 4.23 Summary of Characteristics of Information Management, DDPM tsunami affected provinces

DDPM TP		Information Flows directions	Information received within organization	Information used for decision making	Decision making made in organization	Rules and regulations used in practice	Decision making participation	Decision making accuracy from coordination
N	Valid	30	30	30	30	30	30	30
	Missing	0	0	0	0	0	0	0
Mean		**4.70**	**4.13**	**4.47**	**2.13**	**4.07**	**4.03**	**3.93**
Mode		Bottom up and Top Down	4	4	Throughout organization or unit	4	4	4

Source: Structural Survey of Emergency Personnel of National-Provincial-Local Levels of Jurisdiction, Thailand July – August 2005

Table 4.24 Summary of Characteristics of Information Management, DDPM 64 provinces representatives

DDPM 64		Information Flows directions	Information received within organization	Information used for decision making	Decision making made in organization	Rules and regulations used in practice	Decision making participation	Decision making accuracy from coordination
N	Valid	64	64	64	64	64	64	64
	Missing	0	0	0	0	0	0	0
Mean		**4.53**	**3.83**	**4.08**	**3.16**	**4.06**	**3.80**	**3.84**
Mode		All Ways	4	4	Chief of Operations under Supervision	4	4	4

Source: Structural Survey of Emergency Personnel of National-Provincial-Local Levels of Jurisdiction, Thailand July – August 2005

The flow of information consistently identified more than one direction, all ways, and top-down with bottom-up. This indicates the possible existence of feedback from within the organization that can help to evaluate performance and insert new knowledge or solutions for previous problems. Information flow facilitates the dissemination of knowledge and information needed to understand tasks or problems that have not yet been experienced. The variety of directions of information flow assists in effective dissemination. One may argue that the redundancy of information from various source and directions creates confusion. Based on data from this survey as well from interviews regarding what types of decisions were made where and by whom in the organization, it is clear that decisions will still be made primarily by top or middle management personnel.

It is more likely to be middle management personnel at the provincial level who confirm the assumption that the tsunami response system relied very much on decisions made by mid-level managers of provincial agencies. However, lack of timely, accurate information weakened the validity and confidence of their decisions, especially under urgent time constraints that in turn delayed delivery of needed assistance. Although the organization tends to have a decentralized pattern of information flow and its personnel are willing to receive such information, it is critical to provide information that corresponds to the needs of emergency operations and problem solving. Rules and regulations still play a crucial role as guidelines and direction for emergency personnel to follow. From the interviews, most personnel view the use of law, rules, and regulations as directing their actions. In states of emergency for which personnel have less knowledge and experience, it is more difficult for them to make informed and accurate judgments and decisions. The flow of sufficient information and relevant knowledge requires effective database management as well as efficient communication systems to support secure delivery of the information to operations personnel.

4.4.3.2 Communication Management Characteristics

1. How often does your unit communicate with others?
2. In which circumstance does your unit or agency communicate most frequently with other units or agencies?
3. In states of emergency, what kinds of communication mechanisms are available? Please rank in terms of frequency of use?

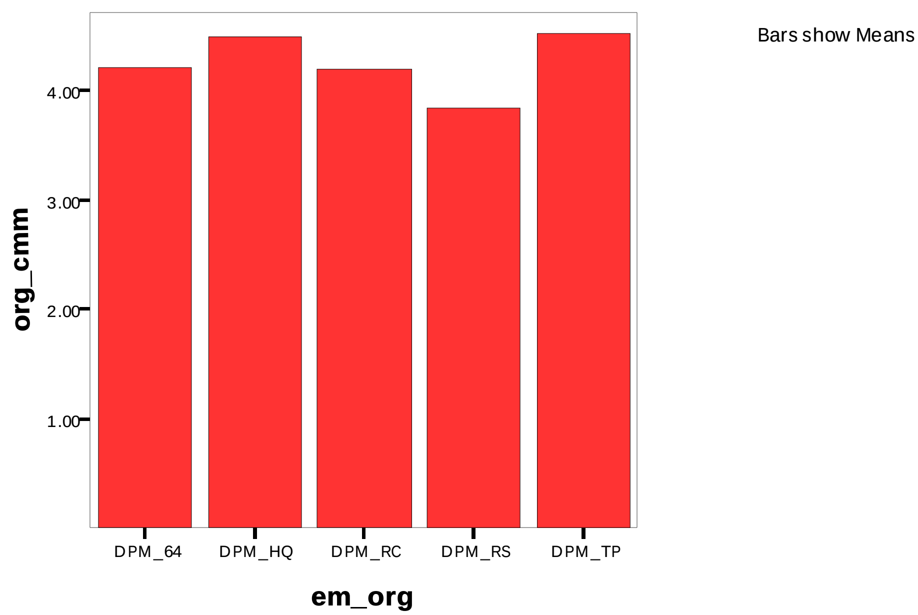


Figure 4.16 Degrees of frequency of communication by DDPM emergency personnel

Source: Structural Survey of Emergency Personnel of National-Provincial-Local Levels of Jurisdiction, Thailand July – August 2005

NOTE: org_cmm = Organization Communication; em_org = Emergency Organizations; DPM_64 = Disaster Prevention and Mitigation 64 Provincial Representatives; DPM_HQ = DPM Headquarter; DPM_RC = DPM Central Regional Center; DPM_RD = DPM Southern Regional Center; DPM_TP = DPM as Tsunami Affected Provinces

Although Figure 4.16 shows a high frequency of communication among the units of DDPM, Table 4.25 reports that those communications are largely made through official documents and regular meetings. These communication channels contribute less to knowledge sharing than those initiated through field operations and resource and information transfers.

Table 4.25 Summary of Characteristics of Communication Pattern, DDPM emergency personnel

DDPM		Communication through field operation	Communication through resource & info transfer	Communication through regular meeting	Communication through personal pleasure	Communication through official document	Communication through training
N	Valid	196	196	196	196	196	196
	Missing	0	0	0	0	0	0
Mean		3.36	2.38	3.44	2.11	3.70	3.29
Mode		6	2	6	1	6	5

Source: Structural Survey of Emergency Personnel of National-Provincial-Local Levels of Jurisdiction, Thailand July – August 2005

A second important use of communication channels cites how emergency personnel communicate among each other all information at hand as well as update information regarding the situations they confront. A black-out of electricity and basic communications raises the question of back-up plans and possible alternate networks for power and communication.

Table 4.26 Summary of Characteristics of Communication Channels, DDPM emergency personnel

		Low frequency radio	High frequency radio	Cell phone	GPS and GIS applications and equipment	Satellite communication	Other equipment
N	Valid	196	196	196	196	196	196
	Missing	0	0	0	0	0	0
Mean		3.14	2.53	4.76	1.82	.70	.97
Mode		0	0	6	0	0	0

Source: Structural Survey of Emergency Personnel of National-Provincial-Local Levels of Jurisdiction, Thailand July – August 2005

Cell phone networks, although very convenient, become congested and unavailable in large scale emergencies. Emergency personnel are unlikely to operate facilities and equipment through satellites and those applications such as Global Positioning System (GPS) and Geographical Information System (GIS). It leaves two alternatives for low radio frequency through local small networks and high frequency radio through HAM or amateur network. In the tsunami response network, I obtained evidence that the local residents preferred to use their mega-phone-network to communicate in their communities, villages and beach areas while the emergency front line personnel who mostly were local prefer the use of their amateur radio networks. Military and DDPM private radio networks are also activated under emergency conditions. Private organizations also communicated their operations and mobilization through their own radio networks. Interestingly, the information obtained about other equipment used in emergency reported the use of communities' radio network that usually broadcasts communities' news. This radio network can be used as a redundant communication in an emergency especially if the power is down since it uses power supply from the generators.

Based on the findings from the survey and interviews, I propose to develop a strategic plan for linking these private and special networks of communication together in states of emergency. The most important obstacle that emergency personnel in both public and private organizations, provincial governments, and military confront was how to bring the focal points of contact together. It is not possible to have multiple agencies and multiple teams working in the field without communication among them, even if a command center has representatives of every agency sitting in a war-room, trying to keep one another connected. Each unit operated and communicated within its network to send updates to their personnel. In states of emergency, one single unit cannot work alone. Implementing and coordinating multiple tasks with multiple units and agencies on a large scale area requires an effective communication system. The activation of special frequencies for radio networks in emergency may be one alternative. Telephone networks of “emergency bridging” through satellite maybe another. These alternatives will be discussed again in the recommendations.

4.5 SUMMARY

Findings from the exploratory study of tsunami emergency management document how the Thai emergency agencies operate during states of emergency. Multiple comprehensive analyses of emergency networks, participant observation, interviews and statistical variables of factors increase the validity and reliability in response to the research questions proposed in Chapter Three. This chapter presents the findings on how the Department of Disaster Prevention and Mitigation works throughout the national level of jurisdiction in coordination with other jurisdictions, and indicates the problems and obstacles of emergency response and management. The analyses also enable this study to identify the importance of information sharing used for making informed decisions and using efficient communication management to keep multiple agencies working together simultaneously.

The analyses also show how much emergency response operations and management need effective inter-organizational management as well as efficient information and communication networks. Despite a low level of technical infrastructure available to manage crises, the tsunami response reflected a lack of knowledge, skills, and adaptive capacities toward disaster and emergency consequences. This finding characterizes the national level response in the tsunami emergency as non-adaptive.

5.0 FLOOD CRISIS AND MASSIVE ACCIDENTS IN BANGKOK METROPOLIS

The nested set of cases that reflects the Thai emergency management system includes two cases of emergency operations within the capital city of Bangkok. As previously discussed, the Bangkok metropolis has its emergency response agencies that are managed under its command and across levels of jurisdiction. The Thai government has passed a law that considers Bangkok a provincial government that operates as a special area of governance. This inquiry into the emergency management operations of Thailand examines the role of the special unit of emergency personnel operating under Bangkok's authority. As shown in the map of domestic tsunami response network, Figure 4.5, Chapter 4, the Bangkok Metropolitan Authority functioned as an independent emergency unit outside the boundary of the tsunami response network. The analyses of Bangkok emergency management illustrates the link that l enables coordination among national, provincial, and local emergency agencies, as well as those across sectors in the entire emergency network.

5.1 EMERGENCY STRUCTURE AND ORGANIZATIONS

Bangkok and the 75 other Thai provinces operate under the Civil Defense Act 1979, which establishes the emergency processes and procedures for Thailand. As stated in the law, the Bangkok governor has the authority to appoint and assign emergency personnel as well as establish a department to undertake civil emergency management responsibilities. These emergency units and personnel are also responsible for disaster prevention and help to coordinate emergency response with the other units operating under the control of the Bangkok Metropolitan Authority.

5.1.1 Bangkok Metropolitan Authority

This study refers to the Bangkok Metropolitan Authority as the Bangkok Metropolitan Administration (BMA), which is co-chaired by the Governor and the Deputy Governor (elected body of administration) of Bangkok. The Permanent Secretary of the BMA is known as the Secretary of the Administration, who also serves as the head of civil services. Figure 5.1 shows the structure of the emergency response organizations operating by law under the Bangkok Metropolitan Administration.

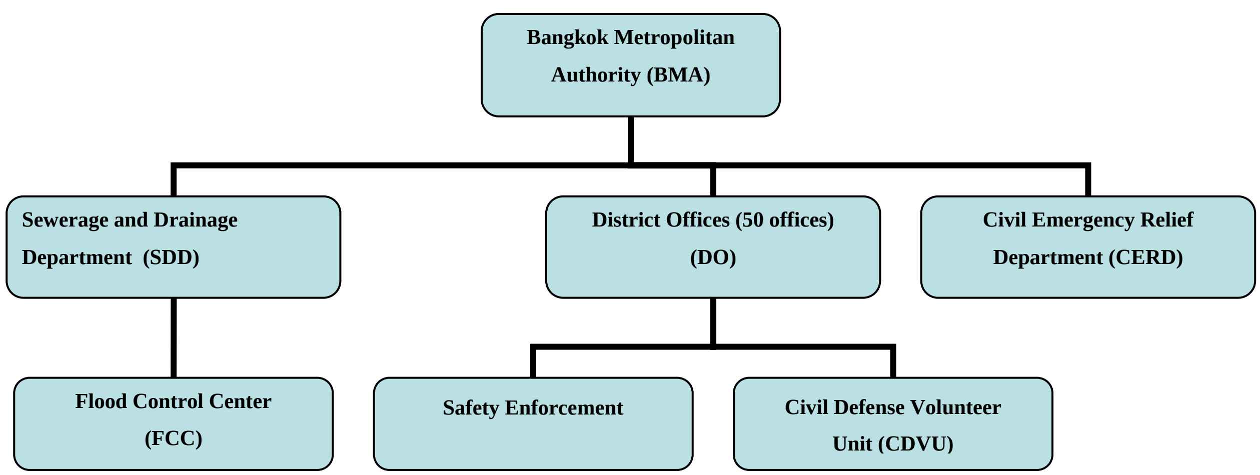


Figure 5.1 Structure of Emergency Response Organizations in Bangkok Metropolis

Source: Extracted from Bangkok Metropolitan Administration Annual Report of 2004

5.1.2 Flood Control Center

The Flood Control Center (FCC) under the Sewerage and Drainage Department (SDD) operates as an information and coordination center that utilizes computer technology to achieve systematic and efficient management of flood protection facilities. The system comprises a master control center located in the SDD Building, with fifty-two (52) remote sites scattered around Bangkok. The system covers approximately 1,000 square kilometers within the Bangkok Metropolis. At these fifty-two sites, data reflecting water levels in canals, water levels in the Chao Phraya River, rainfall levels, pump status, and water quality for flood protection is automatically collected and transmitted in cyclic mode to the master control center via telemeter system over UHF radios.

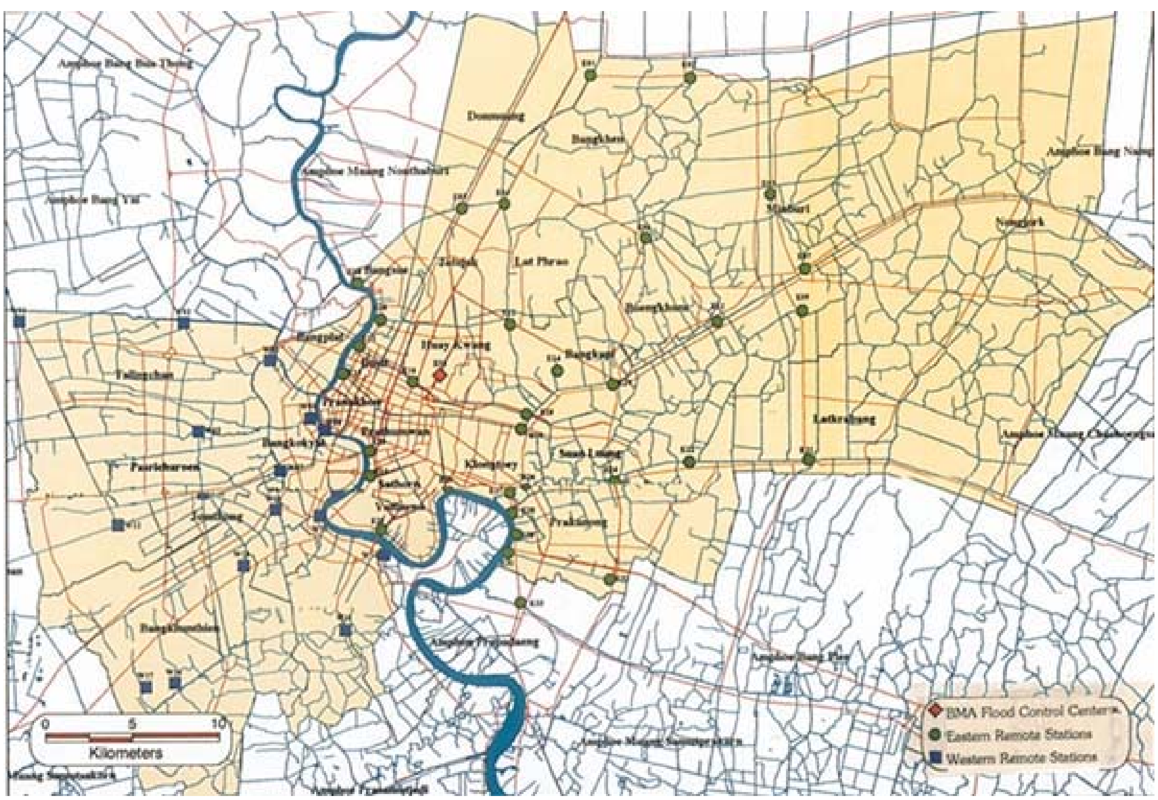


Figure 5.2 Map of Flood Control Remote Sites around Bangkok

Source: Flood Control Center, Sewerage and Drainage Department, Bangkok Metropolitan Authority

The Control system is based on Supervisory Control And Data Acquisition software (SCADA). Using TCP/IP and Ethernet links, SCADA provides an interface for data exchange between the main computer system and the remote data collection sites. Real time data can be represented graphically so that it can be monitored on computer screens, video projectors, or mimic boards for instantaneous decision making. Alarms and flooding events are also displayed and printed. Historical data are stored for later analysis and simulation. Figure 5.2 and 5.3 below show the SCADA computer network and the location of the remote data collection sites around Bangkok.

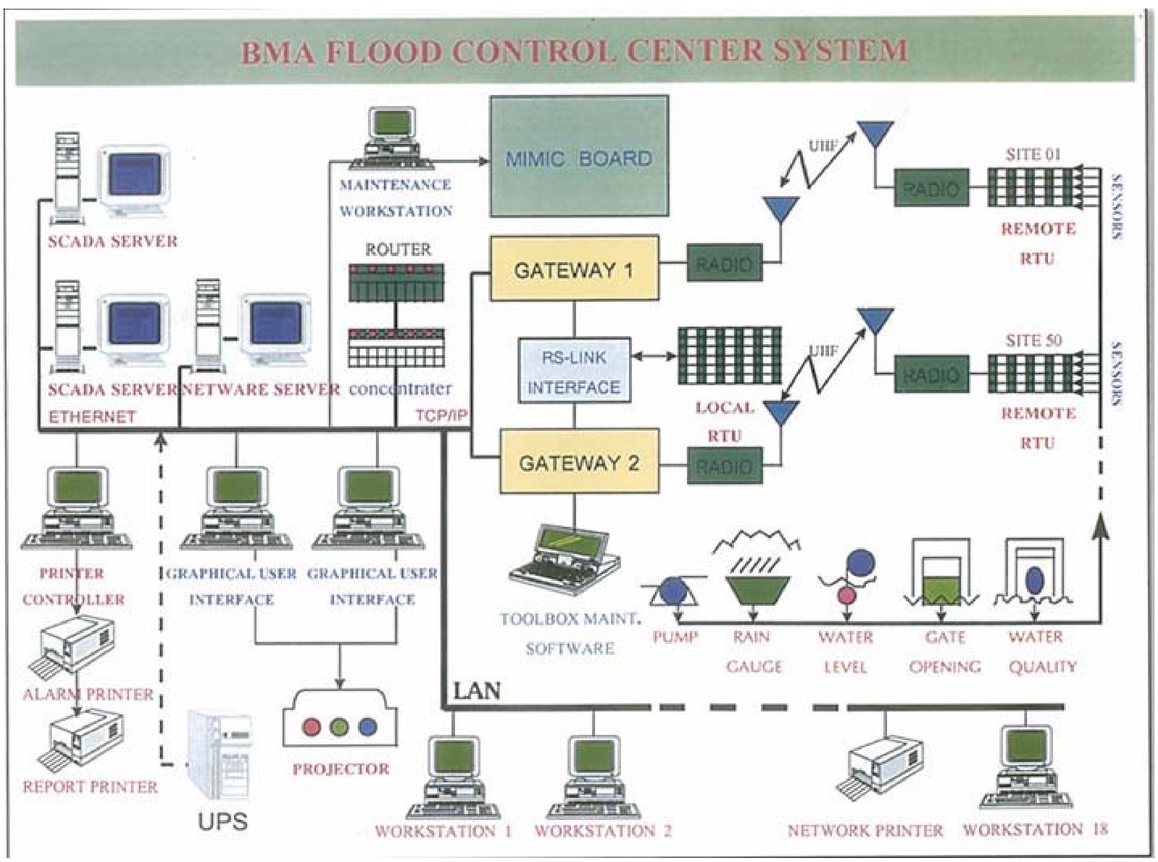


Figure 5.3 SCADA Computer Network of Bangkok Flood Control Center (FCC)

Source: Flood Control Center, Sewerage and Drainage Department, Bangkok Metropolitan Authority

5.1.3 District Offices

Bangkok is separated into 50 districts, which are grouped into 12 zones. These groups are organized to reflect the different types of communities, structures, and activities that occur within their boundaries. The 12 groups are categorized as:

1) Center Zone
2) Business Center Zone
3) New Economic Zone
4) New Economic River Zone
5) Preservation Zone
6) West New Economic Zone
7) Northeast Resident Zone
8) Transition Zone
9) Agricultural and Resident Zone
10) New Airport Zone
11) Agricultural Zone
12) Agricultural-Industrial Zone

Following a recommendation made by a BMA official, who pointed out that each district is comprised of distinct communities with different types of emergency response activities, five districts were selected for this study: Bang Plad, Bangkok Noi, Paya Tai, Din Deang, and Laksi.. Bang Plad and Bangkok Noi share a border and are located in a Preservation Zone because the communities are old with many historical places and government buildings. Paya Tai and Dindeang share a border and are located in the New Economic Zone where governmental, business, industrial activities are dominant, but there are a number of residents. Laksi, in contrast, is located in a Residential zone to which some governmental offices have recently moved. These land use and population characteristics create patterns of emergency response that differ from one zone to another. These different patterns inhibit a coordinated, unified response to natural disaster.

Recently, BMA assigned a task to the district offices to set up a special mobile unit to respond to emergency calls from the public. The Unit is called BEST, Bangkok Emergency Service Team, responsible for the maintenance of public properties and flood related problems.

5.1.4 Civil Defense Volunteer Unit

Supervised by district offices are Civil Defense Volunteer Units (CDVU), which work as front line emergency response units. As in every province, Bangkok Metropolitan Administration also encourages district offices to promote a significant role for CDVU in order to encourage citizens in the district to volunteer for the district unit. Basically, these units are composed of community members who live in each of the Bangkok districts. CDVU is also trained by the Department of Disaster Prevention and Mitigation periodically. On a routine basis, CDVU teams with district officers to conduct field inspections and risk assessments of the area. This collaboration results in greater familiarity of CDVU with the geography and communities.

5.1.5 Civil Emergency Relief Department

The Civil Emergency Relief Department (CERD) was established in 2005 by moving the Fire Fighter Section from the National Police Department (NPD) and merging it with BMA officials to be the major unit responsible for managing emergencies. Starting out as experts in fire prevention and response, BMA has provided training to CERD to build its capacity to serve as trained emergency personnel that had the knowledge and experience to confront multiple hazards. CERD operates through four command centers that direct emergency response activities within four separate zones.

The Bangkok Metropolitan Authority implements its emergency response by managing the Civil Defense Volunteer Units that operate under the 50 District Offices (DO) discussed above in Section 5.1.3. Disaster experts and emergency personnel from the Fire Fighter Unit of the National Police Department, the Department of Royal Irrigation, the Department of Meteorology and private rescue units, also participate with DO officers. After the devastation from the 2004 tsunami, the BMA established the committee for Bangkok Disaster Prevention and Mitigation Strategy and Action Plan to design and deliver policies, plans, regulations and an organizational structure for emergency operations for BMA district offices.

All of the organizations mentioned above operate within the Bangkok jurisdiction under BMA supervision. The FCC functions as an auxiliary unit to support information dissemination and coordination among all agencies through communication processes. The CERD functions as the major emergency unit with full resources and manpower, and the district officers (DO) and CDVU function as front line emergency personnel who have experience and familiarity with the people and geography within their operational regions. This study explores how these agencies work together and identifies patterns of coordination among the FCC, CERD, DO, and CDVU in their interactions with BMA and its agencies.

5.2 INTER-ORGANIZATIONAL EMERGENCY RESPONSE

In order to operate effectively during a state of emergency, the BMA enforces the 2005 Civil Defense Interagency Action Policy (CDIAP) by requiring the responsible parties to implement their specific action plans. The CDIAL also determines level of severity of state of emergency into three scales, 1) low to medium, 2) high, and 3) very high. This classification allows the BMA to activate different levels of emergency response according to the nature of the threat, and to assign authority to field personnel according to the requirements for collaboration across jurisdictions and sectors.

5.2.1 Levels of response agencies

BMA's emergency regulation in Civil Emergency Relief Department's operations' manual, 2005, identifies levels of emergency response agencies as follow.

1. Provincial Personnel: Bangkok Metropolis
    - 1.1 Bangkok Incident Command Center (BICC), chaired by the governor and located in CERD headquarters
    - 1.2 Civil Emergency Relief Department (CERD)
    - 1.3 Representatives from public, non-profit and private sectors who serve as administrative committees
2. District Personnel: district area
    - 2.1 District Incident Command Center (DICC), chaired by the district deputy
    - 2.2 District emergency response personnel
    - 2.3 Civil Defense Volunteer Unit
3. Supporting personnel
    - 3.1 Other agencies under BMA that support emergency response operations with manpower, facilities, equipment and necessities.
    - 3.2 Other governmental agencies and private organizations that provide support and function as expert teams or coordinators.

5.2.2 Scales of emergency and severity

1. Level 1: Low to medium degree of severity

   District Incident Command Center is authorized to conduct emergency response operations alone.

2. Level 2: High degree of severity

   If DICC cannot control the situation, assistance from neighboring districts or other agencies under BMA such as CERD is requested. . In case CERD cannot control an extreme event, Bangkok governor is in charge.

3. Level 3: Very high degree of severity

   If an emergency is very severe, Bangkok governor requests assistance from other governmental agencies to provide experts or equipment as well as transfers command of the incident to the Director of National Civil Defense, the Minister of Interior,

5.2.3 Action Plans for District Emergency Response

1. General public or CDVU in the area notify the district office (DO) of emergency incidents in the area through phone calls or the district radio network. In case of high potential of flood, FCC coordinates with the Department of Meteorology to confirm the information and activates the flood communication network through BMA and district office.
2. District emergency response unit and CDVU on duty at the district office mobilize personnel, resources and equipments to the affected area.

3. Communications personnel of CERD communicate through hot-line 199 to dispatch the CERD emergency response team to the area. The CERD communications unit is also responsible for reporting an incident to BMA management through BMA command-radio-network (Ammarint).
4. Activating Incident Command for Single Incidents: District Deputy is a commander in chief of the Incident Command Center.
5. District Deputy and Director of CERD team establish a Command Post and Supporting Zone for other governmental agencies, private rescue teams, medical care units, and foundations that will assist upon request.
6. District polices are in charge of safety, accessibility and traffic in the affected area. CDVU and district personnel are supporting personnel.
7. CVDU in the area is automatically authorized to respond to an emergency until the District Deputy arrives and assumes command.
8. Emergency personnel from other districts and CVDU are available upon request to assist in the affected areas if needed.
9. Monitoring and maintaining good span of control
10. Demobilizing organizational personnel when they are no longer needed.

5.2.4 Action Plans for Bangkok Emergency Response

In case of overload for the District Command Center, the following policies and procedures are in effect.

1. Bangkok governor is a commander in chief with coordination from Bangkok Permanent Secretary, Supreme Commander of Metropolitan Police Department and Director of CERD upon specific request. The Incident Unified Command may be activated if there are many participating organizations with diversity of operations that require many areas of expertise or multiple tasks simultaneously under a wider span of control.
2. Bangkok command-radio-network (Ammarint) notifies neighboring districts to activate their emergency operations centers and mobilize their resources. Command-radio-network notifies the other repeater-networks. . BMA has four repeater radio networks with other governmental agencies. Ministry of Interior and Military (radio and trunk radio) and non-governmental networks, Natrainthorn Medical Care Unit – Amateur Radio – Emergency Volunteers, share the same emergency communication frequency. . Information regarding the details of the radio network is discussed below in the analysis of information and communication management.
3. CERD mobilizes information and equipment of base-data and dynamic data for the Director of Incident Command Center, who makes decisions on emergency response support from military units, Port of Authority, Pollution Control Department, National Police Department and other organizations.
4. Other emergency response assistance from other governmental agencies, private rescue teams, foundations, medical care teams and others are directed by District Deputy, Director of CERD, and Permanent Secretary of BMA or Bangkok governor, depending upon the scale of the emergency.

5.3 POLICY TRANSLATION TO PRACTICE: ACTION PLANS

The Bangkok Metropolitan Authority has the advantage of operating within a capital city that has significant governmental and business activity. The BMA reinforces the national government by supporting emergency operations to secure public safety. In the years following the tsunami disaster, the BMA has been able to mobilize political support for emergency response organization and operations. The message is clear: Thailand needs to maintain an effective emergency response system.

This study employs document analysis and interviews to identify emergency policies, organizational structures and inter-organizational cooperation within Bangkok's emergency response system. The study seeks to identify whether emergency response organizations are willing to accept various levels of organizational flexibility when responding to disasters. The BMA appoints four sub-committees to design and deliver specific policies and action plans on Command and Management, Disaster Management Preparedness, Resource Management and Communication and Information Management.

While these initiations suggest that the BMA recognizes that there are three critical socio-technical components to an effective emergency response and management system, the system is not currently without shortcomings. For example, there are questions about the skills and knowledge of emergency personnel operation under CERD. Many of these personnel transferred from Fire Division of National Police Department whether or not they were able to manage disaster and emergency situations. In addition, new personnel recruited from academic institutions may not be able to translate their knowledge into practice. The BMA has anticipated these shortcomings and has initiated numerous training programs and expertise teams to enhance and increase capabilities of CERD team and emergency personnel of district offices.

The BMA must also solve problems of command and control, as well as figure out how to ensure that multiple organizations participate cooperatively in the event of a disaster. Often times, the BMA and district commanders have difficulty issuing commands and directing activities when high level government officials arrive at the disaster scene. Even though written policy identifies the BMA as the manager of emergency response activities, when government ministers or political party executives arrive at the scene, the BMA's directives are often repeated or contradicted by the visitors. The BMA responds to this issue by designing a "transfer of incident command" procedure for the Incident Commander. This procedure can be used in two different situations. First, if a high ranking government official arrives at the command center, the BMA can transfer the Incident Commander's authority to that official, but only if the transfer is necessary to guarantee effective emergency response operations. Second, the BMA can transfer the Incident Commander's authority to a subordinate official when the incident that gave rise to the state of emergency has been brought under control.

Another important problem that the BMA must confront is how to coordinate and cooperate with the community under stress, as well as the numerous private emergency response organizations and personnel. These parties need to understand clearly the nature and scope of the emergency, as well as how they can effectively cooperate within the BMA response plan. It is likely that private rescuers will want their own units to work as the main response actors during an emergency. Yet, sometimes private rescuers initiate operations without informing district officers or CERD personnel. Such an occurrence often leads to mismatched operations that can generate accidents and other negative consequences. Just as important are the citizens and organizations within the affected communities. These actors must be educated and trained so that they understand emergency response laws and regulations and can prepare for, and effectively respond to, an emergency. The systematic and effective coordination of multiple parties is a significant element of emergency response, especially when response operations must occur within the complex environments presented by crowds, construction activities and traffic congestion. Effective coordination between the BMA and local communities and private actors reduces the uncertainty that exists during a state of emergency, and helps to ensure improved emergency response.

I collected data on emergency response operations conducted under the management of Bangkok Metropolitan Authority from the operation reports and emergency regulation manual documenting how different agencies interact under state of emergency. Additional data from the interviews and field observations enable me to assess the patterns of interactions among agencies and their effectiveness in performance.

Figure 5.4 shows a map of the organizational coordination network for emergency response and management within the Bangkok Metropolitan region. The map shows, first, that 8 distinctive nodes serve as hubs for linking other organizations. The BMA Board, CERD and FCC are the main actors within the network. As the majority of information within the system is reported to these actors, they are more likely to be the actors who can coordinate response activities according to the laws, regulations, and action plans. District offices (DO) function as centers of emergency operations and coordination in the area while Private Rescue Unit and Narainthorn Medical Care enter into this coordination network as frontline personnel who have absolute expertise in specific areas.

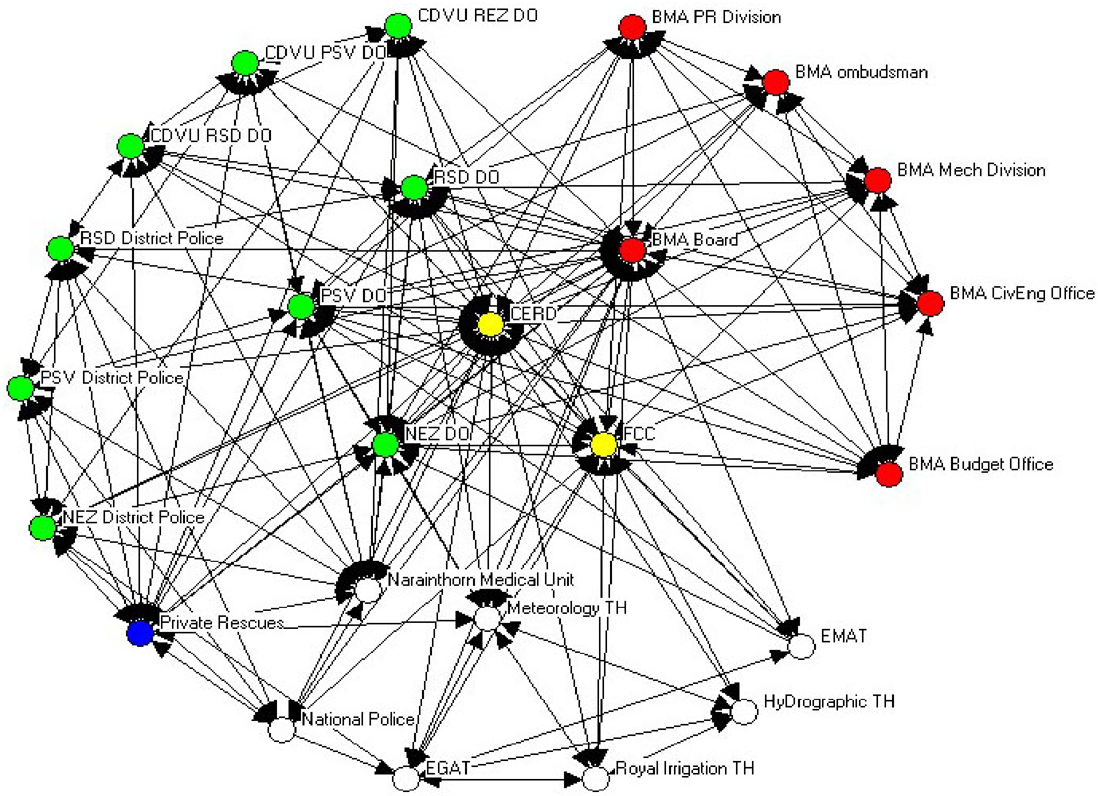


Figure 5.4 Map of Organizational Coordination in Bangkok Emergency Response and Management

Source: Extracted from Civil Defense Action Plan of Bangkok Metropolitan Authority, 2005

Table 5.1 Acronyms List

BMA (CENTRAL)	**OTHER GOVERNMENTAL AGENCIES**
BMA BOARD: BMA ADMINISTRATIVE BOARD	METEOROLOGY TH: DEPARTMENT OF METEOROLOGY
BMA PR DIVISION: BMA PUBLIC RELATION DIVISION	EGAT: ELECTRICITY GENERATION AUTHORITY OF THAILAND
BMA CIVENG OFFICE: OFFICE OF CIVIL ENGINEERING	EMAT: ELECTRICITY METROPOLITAN AUTHORITY OF THAILAND
BMA MECH DIVISIO: BMA MECHANICAL CONTROL DIVISION	NEZ DISTRICT POLICE: NEW ECONOMIC ZONE POLICE
FCC: FLOOD CONTROL CENTER	PSV DISTRICT POLICE: PRESERVATION ZONE POLICE
CERD: CIVIL EMERGENCY RELIEF DEPARTMENT	RSD DISTRICT POLICE: RESIDENT ZONE POLICE
BMA (LOCAL/DISTRICT)	ROYAL IRRIGATION TH
NEZ_DO: NEW ECONOMIC ZONE DISTRICT OFFICES	HYDROGRAPHIC TH: HYDROGRAPHIC DEPARTMENT, NAVY
PSV_DO: PRESERVATION ZONE DISTRICT OFFICES	NATIONAL POLICE
RSD_DO: RESIDENT ZONE DISTRICT OFFICES	PRIVATE RESCUE UNIT
CDVU NEZ DO: NEW ECONOMIC ZONE CIVIL DEFENSE VOLUNTEER UNIT	NARAINTHORN MEDICAL UNIT
CDVU PSV DO: PRESERVATION ZONE CIVIL DEFENSE VOLUNTEER UNIT	
CDVU RSD DO: RESIDENT ZONE CIVIL DEFENSE VOLUNTEER UNIT	

Source: Extracted from Civil Defense Action Plan of Bangkok Metropolitan Authority, 2005

Table 5.2 Degree of Centrality of Bangkok Emergency Response Netwrok

	1 DEGREE	2 NRMDEGREE	3 SHARE
CERD	24.000	100.000	0.083
BMA BOARD	23.000	95.833	0.079
FCC	18.000	75.000	0.062
PSV DO	16.000	66.667	0.055
NEZ DO	16.000	66.667	0.055
RSD DO	16.000	66.667	0.055
PRIVATE RESCUES	14.000	58.333	0.048
NARAINTHORN MEDICAL UNIT	13.000	54.167	0.045

Source: Extracted from Civil Defense Action Plan of Bangkok Metropolitan Authority, 2005
NOTE: SSQ = sum of square; MSCCQ = mean-centered sum of square; Euc Norm = Euclidean norm; NrmDegree = Normed Degree

Table 5.3 Centrality Descriptive Statistic of Bangkok Emergency Response Network

	1 DEGREE	2 NRMDEGREE	3 SHARE
1 MEAN	11.600	48.333	0.040
2 STD DEV	4.716	19.650	0.016
3 SUM	290.000	1208.333	1.000
4 VARIANCE	22.240	386.111	0.000
5 SSQ	3920.000	68055.555	0.047
6 MCSSQ	556.000	9652.777	0.007
7 EUC NORM	62.610	260.875	0.216
8 MINIMUM	5.000	20.833	0.017
9 MAXIMUM	24.000	100.000	0.083

NETWORK CENTRALIZATION = 56.16%
HETEROGENEITY = 4.66%. NORMALIZED = 0.69%
Source: Extracted from Civil Defense Action Plan of Bangkok Metropolitan Authority, 2005

Centrality measures identify the most prominent actors; those who are extensively involved in relationships with other network members. Degree of centrality indicates the “importance” of actors within a network. In lay terms, these are the “key” players, while degree of centrality is the sum of all other actors who are directly connected to ego. It signifies activity or popularity. Lots of ties coming in and lots of ties coming out of an actor would increase degree centrality. Interestingly, as an overall response system, the BMA emergency response coordination network appears to be strongly interconnected The statistics from Freeman’s degree centrality index show the centralization within the whole network to be 56.16%, which indicates that BMA emergency network appears to be well connected.

Distance is another way to measure the strength of a network. The distance from one node to another is the length of a shortest path between them. The larger the number the more difficult it is to pass information from one side to the other. This is the notion of "degree of separation" made familiar to many by a popular play. The Average Distance (among reachable pairs) is 1.53 and the Distance-based cohesion of 0.753 (range 0 to 1; larger values indicate greater cohesiveness). The Distance-weighted Fragmentation is 0.265. The density of the network shows a low average of 0.47 that indicates a state of medium density. Dense networks are particularly good for coordination of activity among actors.

Betweenness, as indicated by tables 5.4 and 5.5, measures whether a node can operate as a gatekeeper in controlling the flow of resources and information between the other nodes within the network. The amount of betweenness variation for this network ranges from 0 to 100.376. This finding suggests that only a few connections can be made within this network without the aid of any intermediary. The centralization index for the BMA emergency response network is 16.54%, which indicates the importance of CERD as the main network actor. The statistics identify another main actor, the BMA Board, whose actions are closely tied to the main actor. Clearly, this network differs from the tsunami response network. Here the CERD staff are less likely to view themselves as gatekeepers. In this sense, there is a high betweenness power in the system that is confirmed by group formation analysis reported below in table 5.6. Interestingly, the BMA emergency response network revealed a group of organizations that had the best fit in terms of the interacting with one another in reference to disaster-related issues.

Table 5.4 Betweenness Centrality of Bangkok Emergency Response Network

DESCRIPTIVE STATISTIC	1	2
NETWORK CENTRALIZATION INDEX = 16.54%	BETWEENNESS	NBETWEENNESS
1 MEAN	12.720	2.304
2 STD DEV	24.188	4.382
3 SUM	318.000	57.609
4 VARIANCE	585.045	19.200
5 SSQ	18671.078	612.761
6 MCSSQ	14626.119	480.011
7 EUC NORM	136.642	24.754
8 MINIMUM	0.000	0.000
9 MAXIMUM	100.376	18.184

Source: Extracted from Civil Defense Action Plan of Bangkok Metropolitan Authority, 2005

Table 5.5 Betweenness of Bangkok Emergency Response Network

	1	2
	BETWEENNESS	NBETWEENNESS
CIVIL EMERGENCY RELIEF DEPARTMENT	100.376	18.184
BANGKOK METROPOLITAN AUTHORITY BOARD	77.476	14.036
FLOOD CONTROL CENTER	35.933	6.510
PRESERVATION ZONE DISTRICT OFFICES	18.155	3.289
RESIDENTIAL ZONE DISTRICT OFFICES	18.155	3.289
NEW ECONOMIC ZONE DISTRICT OFFICES	17.988	3.259
PRIVATE RESCUES	11.540	2.091

Source: Extracted from Civil Defense Action Plan of Bangkok Metropolitan Authority, 2005
NOTE: SSQ = sum of square; MSCCQ = mean-centered sum of square; Euc Norm = Euclidean norm; NrmDegree = Normed Degree

While the CERD may not be an extreme gatekeeper, it still functions as a coordinator of emergency response activities and personnel. This gives CERD a new status as both implementer and linker. The BMA also functions as the command center and linking pin. Regarding the action plan, both CERD and BMA are likely to activate their operations and retrieve information for the same emergency incidents. District units are the frontline personnel who are usually in the area and can access the affected location faster and more accurately.

The other actors within the network, the FCC, the Hydrographic Department of Navy and the Mechanical Control Division basically function as to provide information and personnel support. The first two agencies are responsible for relaying information to those who have to prepare and implement emergency operations, while the latter agency works to provide personnel, equipment and resources when they are needed. Last, in a state of emergency, all of these agencies need a reliable source of power. This explains why the Electricity Metropolitan Authority of Thailand (EMAT) is identified within this network. Nonetheless, group formation in the same pattern of coordination can be found with the different combinations of organizations and agencies. Closeness centrality analysis is identified below which supports this argument with measures of network-in and network-out centralization indices that are very high at almost 71%, shown in table 5.6 and 5.7.

Table 5.6 Group Centrality of Bangkok Emergency Response Network

STARTING FITNESS: 25.000, ROUND 0, 1, ITERATIONS FIT = 0.000,
OBSERVED NO. REACHED = 25.000 (100.0%)
GROUP MEMBERS:
1 BANGKOK METROPOLITAN AUTHORITY BOARD
6 FLOOD CONTROL CENTER
7 CIVIL EMERGENCY RELIEF DEPARTMENT
10 BANGKOK METROPOLITAN AUTHORITY MECHANICAL DIVISION
13 HYDROGRAPHIC DEPARTMENT OF THAI ROYAL NAVY
15 ELECTRICITY METROPOLITAN AUTHORITY OF THAILAND
17 OFFICE OF NATIONAL POLICE
19 RESIDENTIAL ZONE DISTRICT POLICE
23 CIVIL DEFENSE VOLUNTEER UNIT OF RESIDENTIAL ZONE DISTRICT OFFICES
25 CIVIL DEFENSE VOLUNTEER UNIT OF PRESERVATION ZONE DISTRICT OFFICES

Source: Extracted from Civil Defense Action Plan of Bangkok Metropolitan Authority, 2005

Table 5.7 Descriptive Statistics of Closeness of Bangkok Emergency Response Network

	1 INFARNESS	2 OUTFARNESS	3 INCLOSENESS	4 OUTCLOSENESS
1 MEAN	36.720	36.720	66.743	66.733
2 STD DEV	4.788	4.729	10.792	10.814
3 SUM	918.000	918.000	1668.567	1668.317
4 VARIANCE	22.922	22.362	116.458	116.953
5 SSQ	34282.000	34268.000	114276.117	114255.055
6 MCSSQ	573.040	559.040	2911.439	2923.834
7 EUC NORM	185.154	185.116	338.048	338.016
8 MINIMUM	24.000	24.000	54.545	55.814
9 MAXIMUM	44.000	43.000	100.000	100.000

NETWORK IN-CENTRALIZATION = 70.79%, NETWORK OUT-CENTRALIZATION = 70.81%

Source: Extracted from Civil Defense Action Plan of Bangkok Metropolitan Authority, 2005

NOTE: SSQ = sum of square; MSCCQ = mean-centered sum of square; Euc Norm = Euclidean norm; NrmDegree = Normed Degree

The analysis of subgroups in the network further confirms the observation of interaction within subgroups. Clique analysis, shown in Table 5.8, proposes that information spreads rapidly through densely knit subgroups because actors are strongly connected to one another and they directly share the information. The degrees of closeness are fairly high and not The clique analysis in UCINET identified 20 subgroups within the network. These subgroups are identified within Table 5.9.

Table 5.8 Closeness Centrality Measures of Bangkok Emergency Response Network

	IN FARNESS	OUT FARNESS	IN CLOSENESS	OUT CLOSENESS
CIVIL EMERGENCY RELIEF DEPARTMENT	24.000	24.000	100.000	100.000
BANGKOK METROPOLITAN AUTHORITY BOARD	25.000	25.000	96.000	96.000
PRESERVATION ZONE DISTRICT OFFICES	32.000	33.000	75.000	72.727
NEW ECONOMIC ZONE DISTRICT OFFICES	32.000	33.000	75.000	72.727
RESIDENTIAL ZONE DISTRICT OFFICES	32.000	33.000	75.000	72.727
FLOOD CONTROL CENTER	33.000	30.000	72.727	80.000
PRIVATE RESCUES	34.000	34.000	70.588	70.588
NARAINTHORN MEDICAL UNIT	35.000	35.000	68.571	68.571
BANGKOK METROPOLITAN AUTHORITY CIVIL ENGINEER OFFICE	38.000	38.000	63.158	63.158
BANGKOK METROPOLITAN AUTHORITY PUBLIC RELATION DIVISION	38.000	38.000	63.158	63.158
METEOROLOGY DEPARTMENT	38.000	38.000	63.158	63.158
BANGKOK METROPOLITAN AUTHORITY MECHANICAL DIVISION	38.000	38.000	63.158	63.158
BANGKOK METROPOLITAN AUTHORITY BUDGET OFFICE	38.000	38.000	63.158	63.158
NEW ECONOMIC ZONE DISTRICT POLICE	38.000	39.000	63.158	61.538
BANGKOK METROPOLITAN AUTHORITY OMBUDSMAN OFFICE	39.000	39.000	61.538	61.538
PRESERVATION ZONE DISTRICT POLICE	39.000	39.000	61.538	61.538
CIVIL DEFENSE VOLUNTEER UNIT OF PRESERVATION ZONE	39.000	40.000	61.538	60.000
CDVU REZ DO	39.000	40.000	61.538	60.000
RSD DISTRICT POLICE	39.000	39.000	61.538	61.538
CDVU RSD DO	39.000	40.000	61.538	60.000
ELECTRICITY GENERATING AUTHORITY	40.000	40.000	60.000	60.000
NATIONAL POLICE	40.000	39.000	60.000	61.538
ROYAL IRRIGATION DEPARTMENT	42.000	42.000	57.143	57.143
HYDROGRAPHIC DEPARTMENT OF ROYAL NAVY	43.000	43.000	55.814	55.814
ELECTRICITY METROPOLITAN AUTHORITY	44.000	41.000	54.545	58.537

Source: Extracted from Civil Defense Action Plan of Bangkok Metropolitan Authority, 2005

Interestingly, the cliques show overlapping memberships among the organizations, but the sheer number of cliques indicates that the response system was functioning essentially as a set of separate groups formed around a specific geographical area. The set functioned as a coherent system in addressing this extreme event with a common strategy.

Table 5.9 Cliques Analysis of Bangkok Metropolitan Emergency Response Network

CLIQUES ANALYSIS: 20 CLIQUES FOUND (ACRONYMS IN BOLD ARE SPELT OUT AND REPEATED)
1: BANGKOK METROPOLITAN AUTHORITY (BMA) BOARD, NEW RESIDENTIAL ZONE DISTRICT OFFICES (RSD_DO), NEW ECONOMIC ZONE DISTRICT OFFICES (NEZ_DO), FLOOD CONTROL CENTER (FCC), CIVIL EMERGENCY RELIEF DEPARTMENT (CERD), BMA CIVIL ENGINEER OFFICE, BMA BUDGET OFFICE, BMA MECHANICAL DIVISION, BMA PUBLIC RELATION DIVISION
2: BMA BOARD, NEZ_DO, RSD_DO, PSV_DO, FCC, CERD, METEOROLOGY DEPARTMENT
3: BMA BOARD, NEZ_DO, RSD_DO, PSV_DO, FCC, CERD, ELECTRICITY METROPOLITAN AUTHORITY (EMAT)
4: BMA BOARD, RSD_DO, FCC, CERD, CIVIL DEFENSE VOLUNTEER UNIT (CDVU), RSD_DO
5: BMA BOARD, FCC, CERD, METEOROLOGY DEPARTMENT, ELECTRICITY GENERATING AUTHORITY (EGAT), ROYAL IRRIGATION DEPARTMENT
6: BMA BOARD, FCC, CERD, EGAT, EMAT
7: BMA BOARD, FCC, CERD, EGAT, OFFICE OF NATIONAL POLICE
8: BMA BOARD, FCC, CERD, CDVU, REZ_DO, CDVU, RSD_DO, CIVIL DEFENSE VOLUNTEER UNIT OF PRESERVATION ZONE DISTRICT OFFICES (CDVU_PSV_DO)
9: BMA BOARD, NEZ_ DO, FCC, CERD, CIVIL DEFENSE VOLUNTEER UNIT OF RESIDENTIAL ZONE DISTRICT OFFICES (CDVU_REZ_DO)
10: BMA BOARD, PSV_DO, FCC, CERD, CDVU_PSV_DO
11: BMA BOARD, BMA OMBUDSMAN OFFICE, NEZ_DO, RSD_DO, PSV_DO, CERD, BMA CIVIL ENGINEER OFFICE, BMA BUDGET OFFICE, BMA MECHANICAL DIVISION, BMA PUBLIC RELATION DIVISION (BMA_PR_DIVISION)
12: BMA BOARD, CERD, OFFICE NATIONAL POLICE, NEW ECONOMIC ZONE DISTRICT POLICE, RESIDENTIAL ZONE DISTRICT POLICE, PRESERVATION ZONE DISTRICT POLICE, NARAINTHORN MEDICAL UNIT, PRIVATE RESCUES
13: BMA BOARD, NEZ_DO, CERD, NEW ECONOMY ZONE DISTRICT POLICE, NARAINTHORN MEDICAL UNIT, PRIVATE RESCUES, CDVU_REZ_DO
14: BMA BOARD, CERD, EGAT, OFFICE OF NATIONAL POLICE, NEW ECONOMIC ZONE DISTRICT POLICE
15: BMA BOARD, RSD_DO, CERD, RESIDENTIAL ZONE DISTRICT POLICE, NARAINTHORN MEDICAL UNIT, PRIVATE RESCUES, CDVU_RSD_DO
16: BMA BOARD, PSV_DO, CERD, PRESERVATION ZONE DISTRICT POLICE, NARAINTHORN MEDICAL UNIT, PRIVATE RESCUES, CDVU_PSV_DO
17: BMA BOARD, NEZ_DO, RSD_DO, PSV_DO, CERD, NARAINTHORN MEDICAL UNIT, PRIVATE RESCUES
18: BMA BOARD, CERD, NARAINTHORN MEDICAL UNIT, PRIVATE RESCUES, CDVU_REZ_DO, CDVU_RSD_DO, CDVU_PSV_DO
19: BMA BOARD, NEZ DO, RSD DO, PSV DO, CERD, METEOROLOGY DEPARTMENT, PRIVATE RESCUES
20: FCC, CERD, METEOROLOGY DEPARTMENT, HYDROGRAPHIC DEPARTMENT OF THAI ROYAL NAVY, EGAT, ROYAL IRRIGATION DEPARTMENT

Source: Extracted from Civil Defense Action Plan of Bangkok Metropolitan Authority, 2005

BMA assigns responsibility for emergency operations according to coverage area and indicates which function of CERD, FCC as regular unit is activated. Significant in a review of this list is the participation of the BMA board and CERD. The BMA board is almost always the first named actor, and is clearly a primary actor in coordinating response organizations and conducting emergency operations. Also noteworthy is the finding that interactions among the cliques are very similar with the roles of BMA board, CERD, FCC, Private Rescue, Medical Unit and District Officers operating as emergency response units in the area affected.

The response system appears to be strongly connected, with a fair number of organizations presented and necessarily interacting efficiently with one another. The measures of group centrality, closeness, betweenness and identification of cliques reflect the operations by geographical area with the same set of actors. The findings reflect strong connection and effective coordination among all levels of agencies. In practicing action plans and managing response operation, emergency response will be effective if coordination, information and communication can be mobilized through all organizational ties,.

5.4 BMA RADIO NETWORK IN EMERGENCY RESPONSE

I also collected data on communication patterns through the use of a very high frequency radio network. As this study discussed in reference to the tsunami response, the VHF radio network was identified by emergency personnel and citizens as a very effective means of communication during emergencies, especially if the infrastructures of communication are not available, if the telephone poles were destroyed by the tsunami or the cell phone network was overloaded.

Figure 5.5 below shows how specific radio networks are linked under emergency response operations. This, in turn, can provide an interpretation of how effectively information can be shared and how efficiently communication channels can be provided.

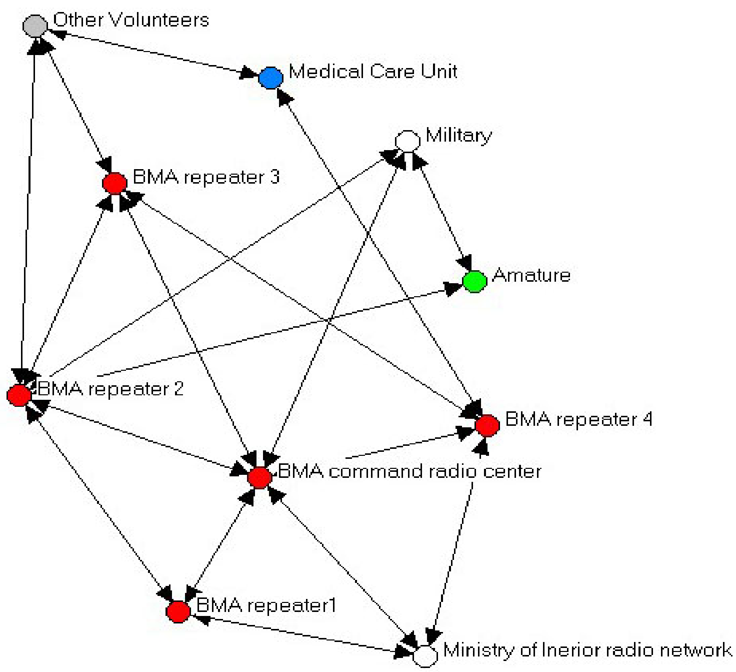


Figure 5.5 Map of VHF Radio Network during Emergency Response Initiated by BMA
Source: Extracted from Civil Defense Action Plan of Bangkok Metropolitan Authority, 2005

It is clear from the map that the BMA command radio center functions as a communication center for all BMA repeaters and personnel. Repeaters are critical to link with personnel outside the BMA network, especially with medical care and amateur radio networks. The first responders can disseminate the needs of paramedics, while the latter can broadcast news and update information to restrict population from entering the affected area.

Table 5.10 presents the UCINET analyses of the BMA Radio Network. The signal for this radio network is initiated by the BMA command radio center and sent to the BMA repeaters and other agencies.

Table 5.10 Information Centralities of Bangkok Emergency Radio Network

ACTOR INFORMATION CENTRALITIES		**STATISTIC**	
	INFORM		INFORM
1 BMA COMMAND RADIO CENTER	2.068	1 MEAN	1.590
2 BMA REPEATER1	1.519	2 STD DEV	0.305
3 BMA REPEATER 2	2.062	3 SUM	15.903
4 BMA REPEATER 3	1.781	4 VARIANCE	0.093
5 BMA REPEATER 4	1.725	5 SSQ	26.217
6 MEDICAL CARE UNIT	1.161	6 MCSSQ	0.928
7 MINISTRY OF INERIOR RADIO NETWORK	1.488	7 EUC NORM	5.120
8 OTHER VOLUNTEERS	1.493	8 MINIMUM	1.147
9 MILITARY	1.459	9 MAXIMUM	2.068
10 AMATURE	1.147		

Source: Extracted from Civil Defense Action Plan of Bangkok Metropolitan Authority, 2005
NOTE: This version of centrality focuses on the information contained in all paths originating with a specific actor. The information of an actor averages the information in these paths, which, in turn, is inversely related to the variance in the transmission of a signal from one actor to another.

The BMA command radio network creates a small, reliable network of communications that works to coordinate BMA emergency personnel and other critical agencies acting as response operations units. This network is purposely designed to facilitate and disseminate information related to the needs and activities of BMA emergency personnel. As shown in Table 5.11, the network centrality index at 33.33% has a high level of heterogeneity at 11. 42%, and has a clique structure that shows how the BMA command radio center and repeaters deliver information through the available channels of communication.

Table 5.11 Degree of Centrality of Bangkok Emergency Radio Network

	1	2	3
	DEGREE	NRMDEGREE	SHARE
1 MEAN	3.600	40.000	0.100
2 STD DEV	1.356	15.072	0.038
3 SUM	36.000	400.000	1.000
4 VARIANCE	1.840	227.160	0.001
5 SSQ	148.000	18271.604	0.114
6 MCSSQ	18.400	2271.605	0.014
7 EUC NORM	12.166	135.173	0.338
8 MINIMUM	2.000	22.222	0.056
9 MAXIMUM	6.000	66.667	0.167
NETWORK CENTRALIZATION = 33.33%			
HETEROGENEITY = 11.42%. NORMALIZED = 1.58%			

Source: Extracted from Civil Defense Action Plan of Bangkok Metropolitan Authority, 2005
NOTE: SSQ = sum of square; MSCCQ = mean-centered sum of square;
Euc Norm = Euclidean norm; NrmDegree = Normed Degree

Table 5.12 Betweenness of Bangkok Emergency Radio Network

	1	2
	BETWEENNESS	NBETWEENNESS
BMA COMMAND RADIO CENTER	23.467	32.593
BMA REPEATER 2	15.467	21.481
BMA REPEATER 4	10.133	14.074
MILITARY	9.167	12.731
OTHER VOLUNTEERS	6.167	8.565
BMA REPEATER 3	3.967	5.509
BMA REPEATER1	1.733	2.407
MINISTRY OF INERIOR RADIO NETWORK	1.667	2.315
MEDICAL CARE UNIT	1.400	1.944
AMATURE	0.833	1.157
NETWORK CENTRALIZATION INDEX = 24.79%		

Source: Extracted from Civil Defense Action Plan of Bangkok Metropolitan Authority, 2005

Geodesic Distance and Density Analyses

Average distance = 1.822

Distance-based cohesion = 0.653

Distance-weighted Fragmentation = 0.347

Density (matrix average) = 0.3667

Standard deviation = 0.4819

The BMA emergency radio network appears to be moderately well connected. The radio network has a density of 0.3667, and a distance-based cohesion of 0.653. Although this network relies on the BMA command radio center, its centralization index is fairly low at 24.79%. This measure indicates that the BMA radio command center is less likely to play the role of gatekeeper. Since the BMA utilizes four other repeaters to ensure redundancy, interconnection and communication throughout emergency radio network, the information can be disseminated throughout the network without having to pass through the command center.

Table 5.13 Cliques Analysis of Bangkok Emergency Radio Network

8 CLIQUES FOUND.
1: BMA COMMAND RADIO CENTER, BMA REPEATER1, BMA REPEATER 2
2: BMA COMMAND RADIO CENTER, BMA REPEATER 2, BMA REPEATER 3
3: BMA COMMAND RADIO CENTER, BMA REPEATER 2, MILITARY
4: BMA COMMAND RADIO CENTER, BMA REPEATER 3, BMA REPEATER 4
5: BMA COMMAND RADIO CENTER, BMA REPEATER 4, MINISTRY OF INTERIOR RADIO NETWORK
6: BMA COMMAND RADIO CENTER, BMA REPEATER 1, MINISTRY OF INTERIOR RADIO NETWORK
7: BMA REPEATER 2, BMA REPEATER 3, OTHER VOLUNTEERS
8: BMA REPEATER 2, MILITARY AMATEUR

Source: Extracted from Civil Defense Action Plan of Bangkok Metropolitan Authority, 2005

In context of a communications relationship, an actor is central if it can quickly interact with all others (Wasserman, 1994) If actors in the set of actors are engaged in problem solving and the focus is on communication links, efficient solutions occur when one actor has very short communication paths to the other actors. This concept underlies the measure of closeness centrality (Wasserman, 1994).

The BMA radio network has degrees of network-in centrality at 44.47% and network-out centrality at 43.25%, values that are considered medium to high. When the centrality results are considered in conjunction with the clique analysis, the BMA command radio center is identified as the central network actor. Of particular interest is the BMA repeater 2. Although it is not always identified as the first actor in each clique, its degree of closeness centrality is relatively close to the BMA command radio. This suggests that if the BMA radio command center wants to reach particular agencies located on the periphery of the network, it needs to rely on its repeater network.

Table 5.14Closeness Centrality Measures of Bangkok Emergency Radio Network

	1 INFARNESS	2 OUTFARNESS	3 INCLOSENESS	4 OUTCLOSENESS
BMA COAND RADIO CENTER	12.000	12.000	75.000	75.000
BMA REPEATER 2	13.000	14.000	69.231	64.286
BMA REPEATER 4	15.000	15.000	60.000	60.000
BMA REPEATER 3	16.000	14.000	56.250	64.286
BMA REPEATER1	17.000	16.000	52.941	56.250
OTHER VOLUNTEERS	17.000	17.000	52.941	52.941
MINISTRY OF INERIOR	17.000	17.000	52.941	52.941
MILITARY	18.000	16.000	50.000	56.250
AMATURE	19.000	24.000	47.368	37.500
MEDICAL CARE UNIT	20.000	19.000	45.000	47.368

Source: Extracted from Civil Defense Action Plan of Bangkok Metropolitan Authority, 2005

Table 5.15Closeness Statistics of Bangkok Emergency Radio Network

	1 INFARNESS	2 OUTFARNESS	3 INCLOSENESS	4 OUTCLOSENESS
1 MEAN	16.400	16.400	56.167	56.682
2 STD DEV	2.375	3.137	9.008	9.722
3 SUM	164.000	164.000	561.673	566.822
4 VARIANCE	5.640	9.840	81.141	94.524
5 SSQ	2746.000	2788.000	32359.033	33073.984
6 MCSSQ	56.400	98.400	811.409	945.244)
7 EUC NORM	52.402	52.802	179.886	181.863
8 MINIMUM	12.000	12.000	45.000	37.500
9 MAXIMUM	20.000	24.000	75.000	75.000

NETWORK IN-CENTRALIZATION = 44.47%, NETWORK OUT-CENTRALIZATION = 43.25%

Source: Extracted from Civil Defense Action Plan of Bangkok Metropolitan Authority, 2005

NOTE: SSQ = sum of square; MSCCQ = mean-centered sum of square; Euc Norm = Euclidean norm; NrmDegree = Normed Degree

Based upon the interviews of governmental and non-governmental agencies such as the military and amateur radio personnel, I found that each network has its own technical infrastructure. This technical infrastructure is used to support communications throughout the country. In part, this is because there is a large number of communication repeaters located in locations in various parts of the country. This technical infrastructure helps to overcome a weakness of the BMA emergency network that is highly dependent on the BMA command center. With active communications supported by non-BMA technical infrastructure, the BMA has a back-up communications network that can function in the event that a failure occurs. These non-BMA communications networks increase the span of coverage so that information can be distributed more efficiently in the event of an emergency

The first section of this chapter examined the coordination and communication networks of the BMA emergency response system in terms of how networks function in emergency response. Such an examination is useful for the discussion in chapter 6, which explores how emergency management can be designed to operate effectively and efficiently, and what factors affect interactions, coordination, information sharing, communication and personnel performance. The next section of this chapter focuses on socio-technical components, interaction patterns, information and communication management and other factors that affect emergency response operations and management.

5.5 THE ANALYSIS OF EMERGENCY RESPONSE AND MANAGEMENT

The findings from network analysis and the personnel interviews documented how response operations were conducted in Bangkok during states of emergency. The cases of flooding and massive accidents within the Bangkok Metropolis demonstrate that the BMA manages emergency operations with the knowledge and skills acquired from the Fire Division and the district field officers. The content analyses revealed that the BMA emergency response network is well connected and operates with the same connection pattern, but differs by geographical area of coverage and size of the emergency.

The next phase of analysis focuses on qualitative data and addresses the research questions posed in chapter 3. These research questions ask how the emergency response agencies of BMA and CERD function during emergency operations and what elements affect their performance. An additional agency, the FCC completed surveys and was subjected to interviews to understand how modern information technology is used to share and disseminate information that is needed for emergency preparedness and mitigation. Data related to the FCC's coordination role within emergency response operation is also collected. In a previous chapter, a Factor Analysis confirmed that three components are critical for effective emergency management. In the remainder of this chapter, quantitative analysis will show the relationships among these three factors and how they interact during an emergency. Data derived from interviews with emergency response personnel is used to identify details of interaction patterns in the processes of information collection, management, and distribution.

5.5.1 Socio-Technical Component Analysis

Factor analysis of the data collected from the survey revealed three primary socio-technical components within Thailand's national emergency response system: organizational flexibility; technical infrastructure and cultural openness. To collect data related to these socio-technical indicators, questionnaires were distributed to emergency personnel working at the

Bangkok Metropolitan Authority (BMA). Additional questionnaires were distributed to other emergency response agencies, including: 1) the Civil Emergency Relief Department, CERD: including representative personnel at all 4 command centers emergency personnel; 2) Flood Control Center, FCC; 3) New Economic Zone District Office, Newz_DO; 4) Preservation Zone District Office, Prsv_DO; 5) Resident Zone District Office, Rsdc_DO and 6) Civil Defense Volunteer Unit (CDVU) within each of these districts.

The surveys were conducted with emergency operations personnel, as well as the supervisor and senior operations manager, to identify the extent to which these three socio-technical components exist within the provincial emergency response system. Responses to the survey were ranked on an ordinal scale of 1 to 5, where 5 is the highest score. The mean scores of the socio-technical components for the emergency response personnel and managers are identified in Figure 5.6 below. The interviews were also conducted with all levels of management and emergency operations to collect data regarding the perceptions and and knowledge of their organizations and operations. Data collected from the interviews is used to strengthen the interpretation of these results from the survey.

The findings shown for all units of the BMA indicate that, compared to organizational flexibility and cultural openness, the lowest component is technical infrastructure. This is especially true of agencies operating at the local district level, whose technical infrastructure is even lower than the agencies that operate at the provincial level. This is explained by the fact that, even though Bangkok is a capital city, Thailand has traditionally been considered at low risk for large-scale natural disasters. Accordingly, policy makers have not considered technical infrastructure for emergency response as important an issue as reducing traffic congestion. Thus, readiness and preparation of technical equipment and infrastructure within Thailand are not yet fully developed. The damage and trauma wrought by the tsunami disaster, however, triggered awareness among policy-makers of the need to be prepared for complex emergencies. In turn, the public has expressed an increased degree of willingness to have its emergency personnel engage in training to enhance their adaptive capability.

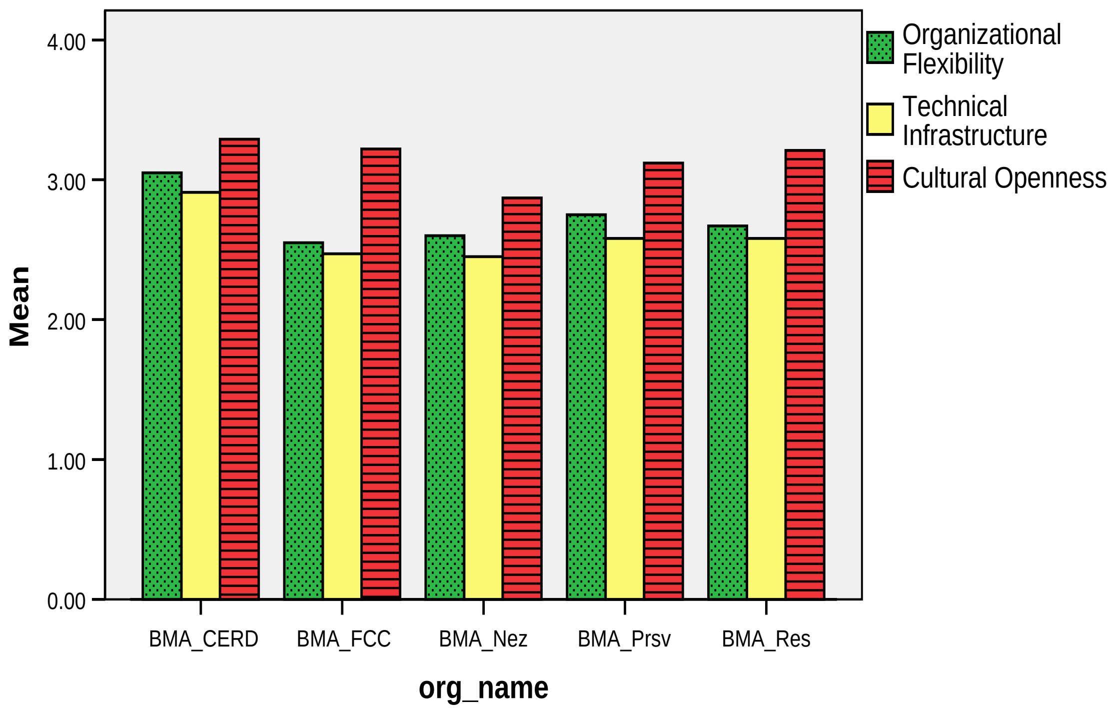


Figure 5.6 Mean scores of socio-technical component of emergency unit of Bangkok Metropolitan Authority

Source: Extracted from questionnaires distributed to Bangkok Metropolitan Authority (BMA) emergency personnel; dated July - August 2005

NOTE: BMA_CERD is Civil Emergency Relief Department, BMA_FCC is Flood Control Center, BMA_Nez is New Economic Zone District Offices, BMA_Prsv is Preservation Zone District Offices, BMA_Res is Residential Zone District Offices

Interestingly, the graphs show that the three socio-technical components are lower for the BMA district offices than for CERD, even though district officers are frontline emergency personnel. The BMA has traditionally focused less attention on emergency operations than on the various other issues that the agency confronted. During this time, the public accepted floods and massive accidents as a normal part of everyday life. Only after the tsunami event made the public aware that emergency preparation could mitigate the effects of disaster, did the BMA begin to consider the need to improve emergency operations. Rather than focusing on emergency units and local level operations, the BMA emphasized the development of the CERD to spearhead this role.

CERD was established to be the single emergency response organization that would function at the provincial level. However, the BMA cannot simply rely upon the CERD to ensure that emergency operations are effectively implemented. Twelve district zones present a unique set of characteristics and challenges. It is necessary for the BMA and CERD to coordinate their emergency operations with local authorities who have knowledge about local communities as well as the geography of these communities. Emergency personnel assigned to the district level remain a critical component of emergency response operations

Of those working within the different zones, the emergency response personnel within the New Economic Zone have the lowest degree all socio-technical scores In large part, this finding reflects the first priority of the District Office in the New Economic Zone, the development of business and economic activities. Consequently, emergency response personnel within this zone have received less attention focused on improving their operational performance. This zone also covers a wide geographic area and is over-populated. This means that, in a time of emergency, it is extremely difficult for emergency personnel within this zone to manage operations without guidance from central agencies or a superior official operating from a district office. Compared to those within to New Economic Zone, emergency response personnel in the Preservation and Resident Zones have a higher degree of all socio-technical scores.

Emergency personnel operating within these two zones are better equipped and prepared to respond to an emergency. The Preservation Zone receives attention from the BMA because of the numerous historical sites and government buildings located there. The Residential Zone merits attention from the BMA because it is over-populated with citizens whose homes, stores, hospitals and schools require a high degree of protection, especially at night.

As the emergency caretakers for the local level, the district officers rely on Civil Defense Volunteer Units to operate as frontline emergency response personnel and to relay timely information needed to conduct effective operations. Unfortunately, some volunteers within the CDVU have low literacy levels, and do not have the time to participate in training. These shortcomings make it difficult for the CDVU to accept new information and learn how to improve their overall performance. While willingness exists on the part of CDVU personnel to change and build capabilities, their members often work without compensation. To encourage change, the District Office must set an annual budget to fund CDVU training activities and maintenance. This is a problem that exists throughout the Bangkok Metropolitan Region. An effective solution requires the BMA to increase the funding it provides to support the training, technology, and personnel needed to maintain effective emergency response operations.

The results of this study suggest that trust enables emergency response agencies and personnel to quickly adapt to the changing environment posed by a natural disaster. For example, the BMA needs to believe that district officers know their people, have good relationships with all personnel and volunteers, and can manage them successfully. In turn, the BMA must listen to the needs of emergency personnel and respond quickly and positively. Likewise, because its volunteers have moderate levels of experience, skills and a familiarity of the area, the District Offices must trust that its volunteers will work effectively. Finally, the

CDVU must realize that when decisions are made about emergency operations, these decisions are authorized and fully supported by their superiors. All of these agencies must accept feedback and evaluation as a natural part of the emergency response process. Without trust, emergency response personnel and organizations cannot operate effectively on their own. Rather, they put-off emergency operations until they receive directions from superiors or BMA officials. District officers, district volunteers and the communities at risk must be capable of coping with an emergency until additional assistance arrives at the scene.

This study also calculates the sum of the socio-technical components, and uses this result as an indicator to compare the working environments within the agencies under observation. This indicator can also be used to identify the strengths and weaknesses within these agencies. There were a number of interesting results. For example, the highest mean score of the socio-technical indicator for CERD is 3.08, while the New Economic Zone DO is lowest at 2.69. These results confirm that there exists a high degree of dynamic movement among the emergency response personnel within CERD, which is relatively new to emergency operations and retains a high degree of political support and a budget that can support the requisite technical infrastructure, personnel and expertise and training courses. There is substantially less movement, however, of the district emergency personnel that operate within the New Economic Zone. Lastly, FCC which has a significant role in flood management retains a score of 2.75. It is explained by its function as coordinator and information provider in flood crisis operation. FCC only owns flood forecast information technology and warning dissemination facilities and does not run an emergency response operation.

5.5.2 Interaction and Coordination Analysis

This analysis provides a picture of how BMA emergency personnel interact among themselves, as well as with other agencies across multiple jurisdictions and sectors. Survey questions were designed to collect data about how each BMA unit coordinates its actions and interacts with the others when responding to an emergency. The results, interpreted and summarized in table 5.16, show that BMA emergency personnel prefer to interact with local response agencies. This finding is confirmed by BMA network analysis, which shows that local district personnel function as frontline emergency personnel. Additional findings suggest that agencies such as FCC and CERD serve as information providers and coordinate and support major emergency response activities of the frontline emergency personnel operating in affected areas. This finding corresponds to the emergency response procedures specifying that BMA manages its emergency through local authorities with help and support from CERD, and from FCC in flood crisis.

Table 5.16Summary of Degree of Coordination from BMA Emergency Personnel

LEVELS OF COORDINATIOI / BMA UNITS	THE MOST FREQUENT	THE SECOND MOST FREQUENT	MODERATE FREQUENT	LESS FREQUENT	LEAST FREQUENT
FLOOD CONTROL CENTER	LOCAL AG PROVINCIAL	PRIVATE	VOLUNTEERS	NGOS	NATIONAL
CIVIL EMERGENCY RELIEF DEP'	LOCAL AG PROVINCIAL	NATIONAL	NGOS	VOLUNTEERS PRIVATE	LOCALS
NEW ECONOMIC ZONE DISTRICT OFFICE	LOCAL AG	PROVINCIAL	VOLUNTEERS LOCALS	PRIVATE	NATIONAL NGOS
RESIDENCE ZONE DISTRICT OFFICE	LOCAL AG	LOCALS VOLUNTEERS PROVINCIAL	PRIVATE	NGOS	NATIONAL
PRESERVATION ZONE DISTRICT OFFICE	LOCAL AG	VOLUNTEERS LOCALS	NGOS PROVINCIAL	PRIVATE	NATIONAL

Source: Extracted from questionnaires distributed to Bangkok Metropolitan Authority (BMA) emergency personnel; dated July - August 2005

The data collected from the survey reveal another interesting result; a network pattern that corresponds to the BMA network displayed in figure 5.4. For example, CERD interacts frequently with local and national agencies, but less so with local agencies and district volunteers. This is understandable since CERD functions at the provincial level as a BMA central agency. District or local authorities are, in fact, the designated coordinators for local residents and volunteers. Likewise, the FCC works closely with local and provincial agencies to transfer information, but works less frequently with national agencies since they are under the BMA Sewerage and Drainage Department. When the FCC interacts with national agencies, such as the Department of Meteorology, the Hydrographic Department of the Navy, or the Royal Irrigation Department, it does so through the BMA Board. Private organizations become involved because their activities can be interrupted seriously if an emergency unexpectedly occurs. Lastly, the district offices interact with the local level through various agencies, but also maintain well-connected networks of coordination that run through central and national emergency response agencies.

The survey also collected data about the frequency with which emergency response agencies coordinate their activities. Figure 5.7 shows how BMA personnel reported the frequency of their coordination activities. It shows that, when their coverage areas are connected, district personnel interact more with provincial agencies. This is because residential areas in Bangkok are more likely to spread out at the periphery and come into contact with other provinces. When emergency response personnel begin to operate in such an environment, they are likely to ask for assistance from emergency personnel within a nearby province. In a similar fashion, the New Economy Zone, which has numerous developments, construction sites, business activities and an extremely crowded residential area, serves as gateway for the international airport. Driven in large part by the desire to maintain airport operations, provincial agencies will provide the New Economy Zone with significant attention during an emergency.

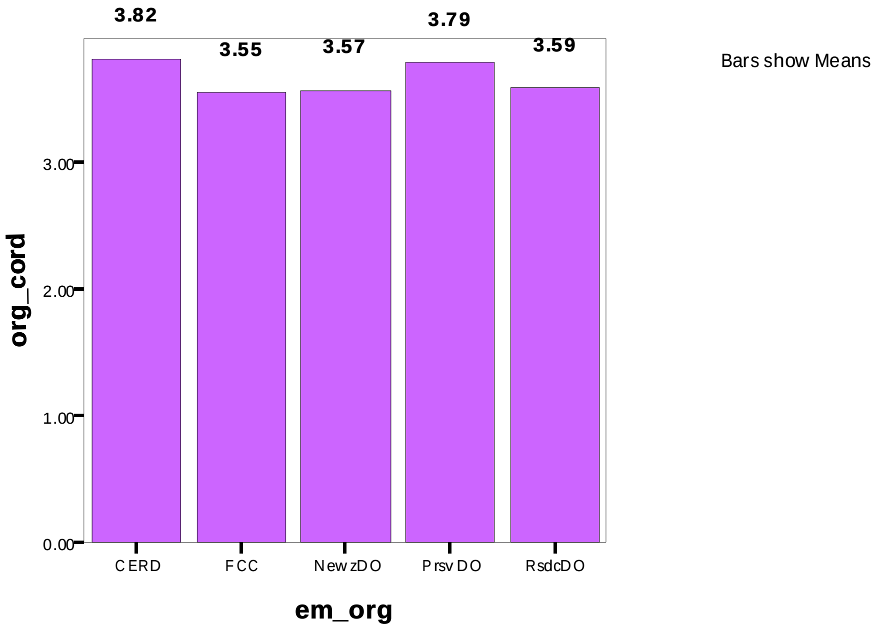


Figure 5.7 Graph shows a mean score of organizational coordination by BMA emergency personnel

Source: Extracted from questionnaires distributed to Bangkok Metropolitan Authority (BMA) emergency personnel; dated July - August 2005

NOTE: em_org is Emergency Organization, org_cord is organizational coordination, CERD is Civil Emergency Relief Department, FCC is Flood Control Center, NewzDO is New Economic Zone District Offices, PrsvDo is Preservation Zone District Offices, RsdcDO is Residential Zone District Offices

Even though the results report a fairly high degree (above 3.5) of coordination, I need to investigate further whether there exist patterns of coordination and interaction between emergency response agencies. The patterns of coordination and interaction are identified in table 5.17. This Table provides a clear picture of how Thailand's emergency response agencies coordinate their activities. Some of the activities coordinated amongst agencies, however, may simply be routine activities that would occur whether an emergency existed or not.

Table 5.17Summary of Degree of Interaction Patterns of BMA emergency personnel

LEVELS OF COORDINATION / BMA UNITS	THE MOST FREQUENT	THE SECOND MOST FREQUENT	LESS FREQUENT	LEAST FREQUENT
FLOOD CONTROL CENTER	NEGOTIATION	ROUTINE WORK	PERSUASION ASSISTANCE	COMMAND
CIVIL EMERGENCY RELIEF DEPARTMENT	ASSISTANCE	ROUTINE WORK	COMMAND PERSUASION	NEGOTIATION
NEW ECONOMIC ZONE DISTRICT OFFICE	ROUTINE WORK	COMMAND	ASSISTANCE PERSUASION	NEGOTIATION
RESIDENCE ZONE DISTRICT OFFICE	ASSISTANCE	ROUTINE WORK	COMMAND	NEGOTIATION PERSUASION
PRESERVATION ZONE DISTRICT OFFICE	ROUTINE WORK	ASSISTANCE	COMMAND PERSUASION	NEGOTIATION

Source: Extracted from questionnaires distributed to Bangkok Metropolitan Authority (BMA) emergency personnel; dated July - August 2005

The data collected from the survey reveal that the majority of interactions between the BMA units and other agencies take the form of routine work activities. This reflects the transition of the BMA system from a traditional command and control bureaucracy to a system that supports complex and dynamic operations, especially in terms of emergency management. While the BMA has moved towards becoming a more adaptive organization, it has yet to embrace interactions and activities that support assistance, negotiation and persuasion.

The FCC, however, identified negotiation as the most frequent interaction pattern that they are involved in. This is explained by the data obtained from the content analysis and interviews, which reports that the FCC has to provide information about flood risk, and how to best reduce or prevent flood damage. Water management in Thailand is extremely complicated, and the FCC must balance the needs of the Royal Irrigation Department, whose mission is to prevent drought, and the needs of the BMA, whose mission is to prevent flood emergencies. While these goals at times conflict with each other, the FCC operates as the primary negotiator, balancing the diverse needs and concerns of the parties at interest.

The survey data also revealed how frequently emergency response organization requested technical support and assistance. This type of interaction is reported in Figure 5.8. With the exception of the CERD, there are a moderate number of interactions that reflect requests for technical support and assistance among organizations. The CERD has a relatively high score because the agency is in a relatively early stage of development, and still needs to seek expertise and technical support to strengthen its capability to respond to multi-hazards.

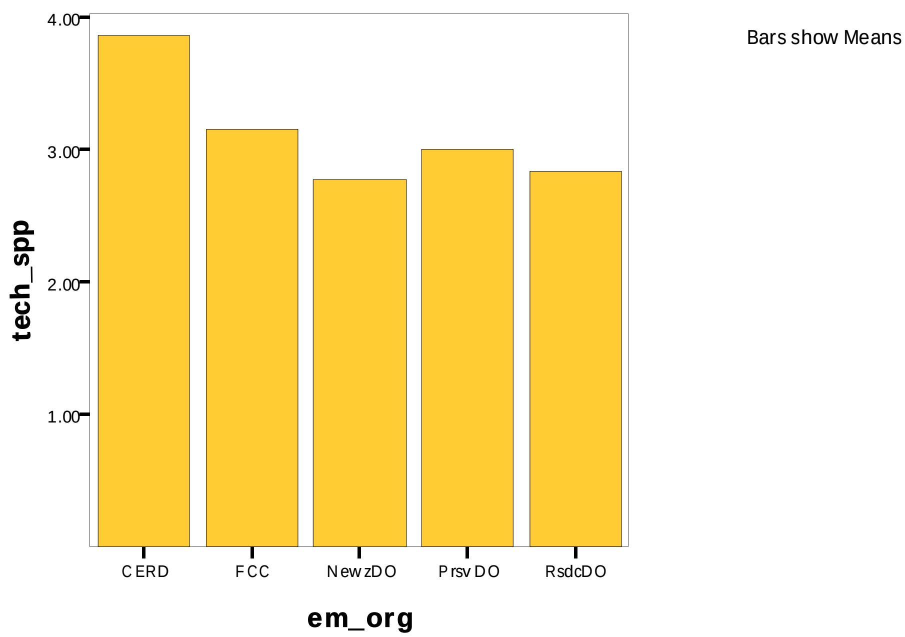


Figure 5.8 The degrees of frequency of technical support provided to BMA emergency personnel by other organizations

Source: Extracted from questionnaires distributed to Bangkok Metropolitan Authority (BMA) emergency personnel; dated July - August 2005

NOTE: em_org is Emergency Organization, org_cord is organizational coordination, CERD is Civil Emergency Relief Department, FCC is Flood Control Center, NewzDO is New Economic Zone District Offices, PrsvDo is Preservation Zone District Offices, RsdcDO is Residential Zone District Offices

While the mobilization of resources and the rotation of well-trained personnel are expected among these types of coordination, knowledge and skills can also be transferred among these agencies through training. The interviews revealed that emergency personnel prefer to attend multiple training programs during the year. They believe that by participating in training programs, they can acquire and hone the skills they need to operate effectively in a time of crisis. As shown in figure 5.9, BMA emergency personnel receive training within the organization and are trained individually significantly more frequent than their colleagues in other agencies and organizations.

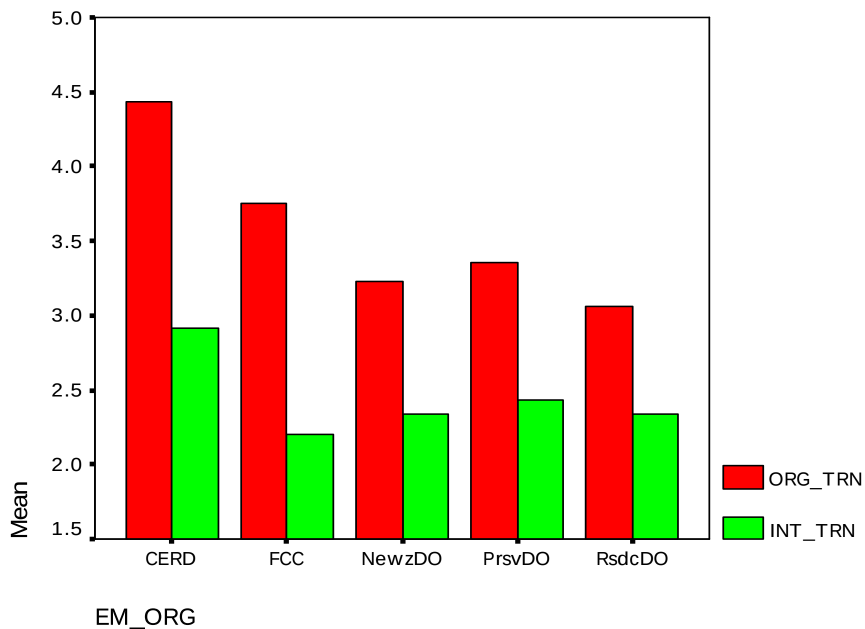


Figure 5.9Graph shows the degrees of frequency of training programs provided by the BMA

Source: Extracted from questionnaires distributed to Bangkok Metropolitan Authority (BMA) emergency personnel; dated July - August 2005

NOTE: EM_ORG is Emergency Organization, ORG_TRN is Organizational Training, INT_TRN is Inter-organizational Training, CERD is Civil Emergency Relief Department, FCC is Flood Control Center, NewzDO is New Economic Zone District Offices, PrsvDo is Preservation Zone District Offices, RsdcDO is Residential Zone District Offices

This data also reveals that the emergency response system under analysis fails to provide adequate inter-organizational training. The goal of inter-organizational training is to share information and knowledge throughout the network. When information is shared sufficiently, emergency personnel operating at jurisdictional levels can quickly adapt to unforeseen problems as they arise. The emergency response failures that occurred during the tsunami response were in large part caused by the lack of inter-organizational training, which prevented emergency response agencies and personnel from working together to adapt to the hazard.

This study confirms that information sharing and efficient communication channels can expand the cognitive capacity of individuals and their organizations in learning to adapt to complex situations and to make effective decisions under pressure. Emergency response personnel need information that is reliable and actionable in order to maintain command of their operations. The events that occur during a state of emergency are often complex and unforeseen, and emergency personnel must be able to react to change and effectively adapt their response activities. Unfortunately, there are situations where emergency response personnel are unable to communicate the information that is needed to trigger adaptation. While training programs can help to reduce the occurrence of such situations, it is crucial that all emergency response personnel and organizations learn how to effectively manage the communication of information within and among organizations.

5.5.3 Information and Communication Management Analysis

The study analyzes how information is managed and transferred to emergency response personnel and organizations in Thailand. The findings answer the question how emergency organizations facilitate the sharing of information through the communication channels made available to them. These findings presented in this section show how to integrate information sharing and communication systems into intergovernmental networks. The characteristics of information flow, and how information is used to support the decision making processes of emergency personnel operating all levels of operation for the BMA are shown in Tables 5.18 through 5.22. An attitude toward information used in decision making is at a moderate to high level for all BMA personnel. The flow of information is identified as a vertical line pattern of top-down and bottom-up. This pattern reflects the existence of semi-decentralized information flows and decision making patterns. While superiors are in charge of the operations, they are provided with opportunities to receive crucial information from subordinates.

This existence of feedback loops within organizations helps decision makers to evaluate performance and take alternative courses of action upon the arrival when new knowledge enters the system. These information flows also help policy makers identify and respond to not-yet-identified problems. However, the system is not without weaknesses. The BMA must create lateral channels of communication so that it can ensure that information is effectively disseminated to all participating parties. This is a critical element of an effective emergency response system because information that is shared across multiple directions is less likely to be controlled. While the BMA system is moving towards becoming an adaptive organization that shares information, decision makers still need to learn that the organization must develop effective relationships, not just between superiors and their subordinates, but also among all emergency response agencies.

Table 5.18Summary of Characteristics of Information Management, Flood Control Center

FCC		Information Flows directions	Information received within organization	Information used for decision making	Decision making made in organization	Rules and regulations used in practice	Decision making participation	Decision making accuracy from coordination
N	Valid	20	20	20	20	20	20	20
	Missing	0	0	0	0	0	0	0
Mean		**3.75**	**3.45**	**3.8**	**3.15**	**3.75**	**3.60**	**3.50**
		Bottom up and Top Down	3	4	Chief of Operations under Supervision	4	4	4

Source: Extracted from questionnaires distributed to Bangkok Metropolitan Authority (BMA) emergency personnel; dated July - August 2005

Table 5.19 Summary of Characteristics of Information Management, Civil Emergency Relief Department

CERD		Information Flows directions	Information received within organization	Information used for decision making	Decision making made in organization	Rules and regulations used in practice	Decision making participation	Decision making accuracy from coordination
N	Valid	44	44	44	44	44	44	44
	Missing	0	0	0	0	0	0	0
Mean		**4.2**	**3.86**	**4.14**	**2.8**	**4.3**	**4.05**	**3.8**
Mode		Bottom up and Top Down	4	5	Chief of Operations under Supervision	5	4	4

Source: Extracted from questionnaires distributed to Bangkok Metropolitan Authority (BMA) emergency personnel; dated July - August 2005

Table 5.20 Summary of Characteristics of Information Management, New Economy Zone District Office

Newz_Do		Information Flows directions	Information received within organization	Information used for decision making	Decision making made in organization	Rules and regulations used in practice	Decision making participation	Decision making accuracy from coordination
N	Valid	35	35	35	35	35	35	35
	Missing	0	0	0	0	0	0	0
Mean		**3.69**	**3.57**	**3.66**	**2.6**	**3.54**	**3.6**	**3.31**
Mode		Bottom up and Top Down	4	4	Chief of Operations under Supervision	4	4	4

Source: Extracted from questionnaires distributed to Bangkok Metropolitan Authority (BMA) emergency personnel; dated July - August 2005

Table 5.21 Summary of Characteristics of Information Management, Preservation Zone District Office

Prsv_Do		Information Flows directions	Information received within organization	Information used for decision making	Decision making made in organization	Rules and regulations used in practice	Decision making participation	Decision making accuracy from coordination
N	Valid	28	28	28	28	28	28	28
	Missing	0	0	0	0	0	0	0
Mean		**3.71**	**3.64**	**4.11**	**2.11**	**3.50**	**3.75**	**3.61**
Mode		Bottom up and Top Down	4	4	Throughout Organization	4	4	4

Source: Extracted from questionnaires distributed to Bangkok Metropolitan Authority (BMA) emergency personnel; dated July - August 2005

Table 5.22 Summary of Characteristics of Information Management, Residence Zone District Office

Rsdc_Do		Information Flows directions	Information received within organization	Information used for decision making	Decision making made in organization	Rules and regulations used in practice	Decision making participation	Decision making accuracy from coordination
N	Valid	64	64	64	64	64	64	64
	Missing	0	0	0	0	0	0	0
Mean		**4.53**	**3.83**	**4.08**	**3.16**	**4.06**	**3.80**	**3.84**
Mode		Bottom up and Top Down	3	4	Throughout Organization	4	4	4

Source: Extracted from questionnaires distributed to Bangkok Metropolitan Authority (BMA) emergency personnel; dated July - August 2005

Although the BMA tends to have a decentralized pattern of information flow and its personnel are willing to give and receive critical information, it is important that the information being shared corresponds to the needs of emergency personnel confronting the problems of a disaster. Sometimes, action must be taken without sufficient knowledge. This is where rules and regulations play a crucial role in shaping the responsibilities and activities of emergency personnel. In a state of emergency, personnel who have less knowledge and experience cannot make informed and accurate judgments or decisions. As the interviews revealed, when such a situation arises, emergency personnel turn to laws, rules and regulation as guidelines for action.

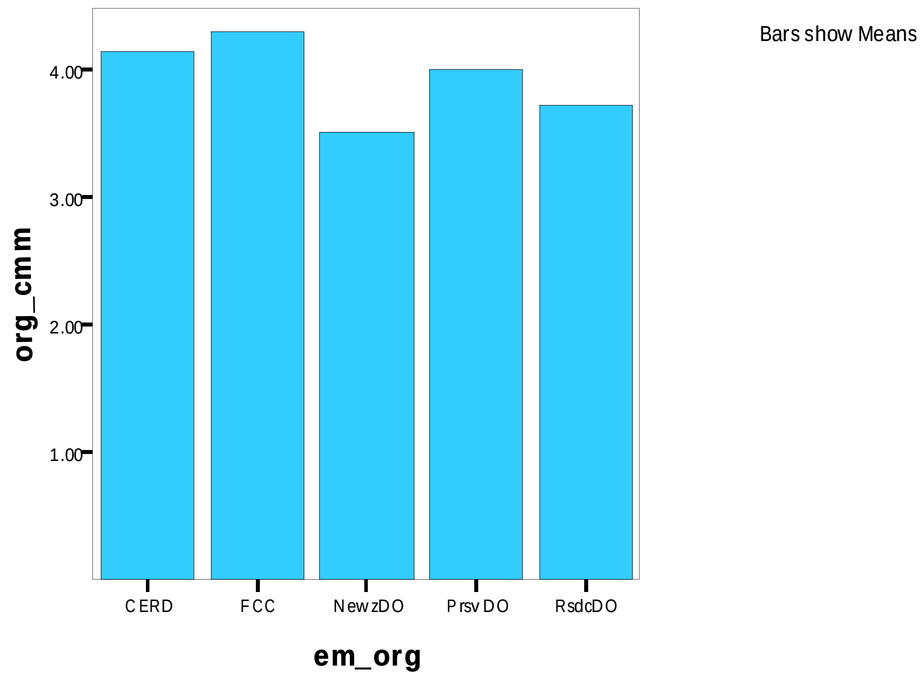


Figure 5.10 Graph shows the degrees of frequency of communication by BMA emergency personnel

Source: Extracted from questionnaires distributed to Bangkok Metropolitan Authority (BMA) emergency personnel; dated July - August 2005

NOTE: em_org is Emergency Organization, org_cmm is Organizational Communication, CERD is Civil Emergency Relief Department, FCC is Flood Control Center, NewzDO is New Economic Zone District Offices, PrsvDo is Preservation Zone District Offices, RsdcDO is Residential Zone District Offices

Table 5.23Summary of Characteristics of Communication Pattern, BMA emergency personnel

BMA		Communication through field operation	Communication through resource & info transfer	Communication through regular meeting	Communication through personal pleasure	Communication through official document	Communication through training
N	Valid	159	159	159	159	159	159
	Missing	0	0	0	0	0	0
Mean		3.90	2.54	2.79	1.81	3.12	2.42
Median		5	2	3	1	4	3

Source: Extracted from questionnaires distributed to Bangkok Metropolitan Authority (BMA) emergency personnel; dated July - August 2005

As indicated by Figure 5.10 and Table 5.23, BMA emergency personnel frequently communicate with other organization through field operations and official documents. These communication channels correspond to the previous finding: that the BMA is transitioning towards becoming a more decentralized, adaptive organization. While it retains strong characteristics of a traditional bureaucracy that implements policies through plans, formal structures and official activities, BMA understands the need to develop a robust, adaptive capacity to respond to emergencies. This transition is reflected in how the BMA communicates information during emergency response activities; emphasizes cooperation, and accepts the need to understand the knowledge, responsibilities and activities of other response agencies. If the BMA continues this pattern of transformation, it will be in a better position to respond to future disasters, whether they come in the form of tsunami, flood or massive accident.

Apart from patterns of communication paths, an important question centers on the equipment that emergency personnel use to communicate the critical information. In the accident that generated a fire and a subsequent building collapse, emergency personnel chose to make contact each other via cell phones rather than through the emergency radio network. Interviews conducted with personnel involved in this scenario revealed that, when an unexpected accident or consequence occurs, the human-cognitive decision making process often directs the actor to utilize tools that are most familiar, in this case a cell phone. However, there are other practical reasons why emergency personnel may not elect to use tools such as the emergency radio network. In chaotic situations, people tend to seek assistance from individuals or organizations that they believe will actually respond. Cell phones help to reassure people that when they place a call for assistance, information about their location and needs will be quickly passed along to the appropriate emergency response personnel.

Table 5.24 demonstrates that a wide range of communication technology and equipment is used to coordinate the activities of BMA personnel. Each of these technologies, however, comes with certain limitations that can reduce communication. For example, as discussed earlier, the DDPM emergency personnel surveys revealed that, while cell phones are convenient and handy in large-scale states of emergency, cellular networks often become congested and unavailable. The Civil Defense Volunteer Units report that low frequency radios such as walky-talkies are effective, but can create problems when their personnel operate outside the transmission range of the devices. Alternatively, each District Office possesses special VHF radios, which communicate throughout the BMA radio network without having to rely upon repeaters. In the event of an emergency, this radio can shorten communication paths between decision-makers and front-line responders. However, this radio can only be used when authorized by the District Deputy. Given these limitations, it is important that emergency response personnel do not rely on any single form of technology or equipment to ensure communication.

Table 5.24Summary of Characteristics of Communication Channels, BMA emergency personnel

		Low frequency radio	High frequency radio	Cellphone	GPS and GIS applications and equipments	Sattelite communication	Other equipments
N	Valid	159	158	159	159	159	158
	Missing	0	1	0	0	0	1
Mean		3.59	2.58	4.34	.97	.49	.39
Median		5.00	3.00	5.00	.00	.00	.00

Source: Extracted from questionnaires distributed to Bangkok Metropolitan Authority (BMA) emergency personnel; dated July - August 2005

This study suggests that steps must be taken to ensure the more effective use of communications technology and equipment. The solution may not depend upon the adoption of expensive and sophisticated technology. While these tools provide amazing capabilities, emergency personnel are unlikely to operate facilities and equipment through satellite phones and applications such as Global Positioning System (GPS) and Geographical Information System (GIS). This leaves three low cost alternatives: low frequency radio used by small local networks; high frequency radio used by HAM or amateur networks; and VHF radio networks used by public and private organizations. It is therefore critical for the BMA to develop a plan that will integrate these low cost and readily available methods of communication into a unified communication network that can facilitate the spread of information during a state of emergency.

5.6 CONCLUSION

Data collected through participant observation, interviews, and surveys, offer informed insight into how Bangkok's government manages emergency response operations. Data contained in this chapter revealed how the BMA works to coordinate and interact with other emergency response agencies, as well as other governmental and non-governmental organizations. The analyses of the BMA radio network in particular, identified the important roles that information sharing and communication channels play in the decision making process. In order for the BMA to design an effective emergency response plan, it must learn to organize emergency personnel and organizations according to function, geography, and areas of expertise. Despite only moderate levels of technical infrastructure available to support the management of a crisis, Bangkok's emergency response organizations are starting to develop self-adaptive capabilities. This is demonstrated by the fact that emergency personnel in Bangkok pay close attention to developing inter-organizational coordination, communication networks, and processes of information sharing.

Bangkok's emergency response organization is beginning to develop auto-adaptive characteristics. Before moving forward, we must take a moment to examine the past. Chapter Four[??] identified the lessons that were learned during the emergency response activities in the wake of the December 26, 2004 tsunami, and Chapter Five identified lessons from the flood crisis and massive accidents managed by BMA emergency agencies. These events allow a comparison of their advantages and disadvantages as a basis for strategies to improve emergency management in Thailand. Such a comparison under nested analysis reveals the gaps that exist within Thailand's national emergency response system and documents the need to design a scalable coordinating operation. Chapter 6 will analyze the emergency operations managed by national, provincial, and local personnel, and will make specific recommendations as to how Thailand's government can move its emergency response system towards an auto-adaptive future.

6.0 NESTED ANALYSIS OF THAILAND EMERGENCY MANAGEMENT

Emergency management in Thailand is reflected in this study through an exploratory study of three cases: 1) the 2004 tsunami, 2) flooding in the Bangkok Metropolitan Area, and 3) a massive accident within a district of the Bangkok Metropolitan Authority. Case study research examines a set of actors bounded in time or place and the contextual material about the setting of the case. Creswell (1998) emphasized the use of within-case and cross-case analysis to identify the lessons learned. This study takes into account not only these two dimensions of analysis, but also the relationships among cases. The tie or relationship among the two core actors, the Department of Disaster Prevention and Mitigation (DDPM) and Bangkok Metropolitan Authority (BMA) in three cases illustrates the concept of a “nested-set case study”. The “nested analysis” focuses on the levels of analysis among the units under study. . Nested design exploits cross-unit variation and analysis to elucidate the features of an individual unit rather than examining an individual unit to explain a more general phenomenon (Coppedge, Lieberman 2002). Inquiry into each case in the nested design seeks to identify the positive and negative factors in implementing the emergency plan of each core agency, and to examine the effectiveness of intergovernmental coordination which ties all cases and analyses together in a coherent emergency operation.

As discussed earlier, this study examines performance for single-unit and multiple-unit emergency operations. Nested analysis allows the exploration of not only a comparison of performance between core emergency units, but also strategies by which core units can work together more effectively. Advantages and disadvantages revealed in all three cases contribute to methods of improving emergency response and enhancing the capabilities of emergency response agencies. Emergency response agencies at all three jurisdictional levels operate under the same Civil Defense Act 1979 and are supervised by the Minister of Interior for each scale of emergency. Provincial DPM and Bangkok district offices team their emergency personnel with Civil Defense Volunteer Units (CDVU) to work at the frontline in emergency situations. These collaborative actions reflect levels of shared goals and direction in coordinating emergency responses. Nested analysis allows comparison among the three cases of emergency response and relates the analysis to the criteria for scalable emergency management, critical to intergovernmental coordination under states of emergency. As a result, the analyses will contribute to identifying the factors needed to improve Thailand's emergency management.

As discussed in chapter 2, this study focuses on socio-technical components as crucial factors of effectiveness in managing emergency response. This study shows how the interaction of socio-technical components differ among the three cases of emergency response and how these differences explain gaps in performance among the three levels of emergency operations. These gaps identify the states of effectiveness at each level of emergency response operations and illustrate how lessons learned from the analyses of each level may be used to improve performance for the entire emergency response system in Thailand.

6.1 SOCIO-TECHNICAL COMPONENTS IN EMERGENCY RESPONSE SYSTEMS

This study uses Comfort's model in her book, *Shared Risk*, (1999), to explain the existing emergency model in Thailand. This study applies three sets of indicators, technical structure, organizational flexibility, and cultural openness, to identify the type of emergency management in three cases of emergency response operations. The set of cases includes: 1) December 26, 2006 tsunami in the southern Thailand; 2) Bangkok Metropolitan Authority's response to flood crisis; and 3) district response to massive accidents. The three components are critical to the effectiveness of emergency response because under a state of emergency, every participating agency needs its full capabilities to adapt to unexpected events as well as to make timely, informed decisions. In doing so, emergency personnel need sufficient technical infrastructure to conduct emergency operations, extensive organizational support, flexibility in implementing their operations, and cooperative cultural openness among multiple emergency agencies to perform multiple tasks. The combination of characteristics for the three components is later used to identify the state of the emergency response system as non-adaptive, emergent-adaptive, operative-adaptive, or auto-adaptive. In this study, Comfort's three sets of indicators have been modified and quantified into variables recoded as "socio-technical components," as discussed in factor analysis in chapter 4.

In a comparative aspect, at the national level, emergency response agencies confronted the devastation of the tsunami with low levels of technical structure, organizational flexibility, and cultural openness, classified as a non-adaptive system. Bangkok Metropolitan Authority's emergency response agencies perform their emergency operations with higher levels of the three components, which illustrate an emergent adaptive system. Interestingly, the district level operations, with volunteer units and minimal training are characterized as somewhat both a non-adaptive and an emergent adaptive system. Although the degree of socio-technical components of district emergency operations is not significantly different from the national system, experience in confronting with emergencies and familiarity with the area for a long time helps to build a fundamental knowledge base needed to improve its emergency response. This study examined the significant factors needed to improve the existing emergency management systems of both national and local levels from states of non-adaptive and emergent-adaptive to auto-adaptive. Such adaptive capacity and system performance will be analyzed from the perspective of individual as well as cooperative performance in emergency operations. The socio-technical components are shown as follows.

Table 6.1 Socio-Technical Matrices

I. Organizational Flexibility Component	II. Technical Infrastructure Component	III. Cultural Openness Component
National emergency laws	**Providing risk assessment**	**Shared value of humanitarian assistance**
Special emergency regulations	**Designing and assigning building codes**	**Commitment to goal of protecting life**
Emergency integrated response plans	**Structural inspection**	**Willingness to share information needed**
Emergency commands and coordination	**Alternative communication**	**Acceptance of new information**
Emergency inter-organization for communities	**Alternative electrical facilities**	**Openness to new methods**
Emergency inter-organization for agencies	**Special emergency operation and equipment**	**Willingness to review actions taken**
Multi-ways of information exchange between agencies	**Identification of major facilities**	**Willingness to correct mistakes, solve conflicts**
Multi-ways of information exchange across sectors	**Alternative rescue or emergency response**	**Willingness to accept responsibility**
Trained professional managers on duty	**Self technical manual procedure**	**Willingness to service public**
Trained reserved personnel on recall	**Other technical support**	**Continual search for relevant, accurate info**
Average point of organization flexibility	**Average point of technical infrastructure**	**Average point of cultural openness**

Source: Group of questions in a survey given to emergency personnel in Thailand, July – August 2005

I will later discuss how to develop an approach for an auto-adaptive emergency response system, using the concept of intergovernmental management supporting collaboration among emergency units at national, metropolitan, and district levels. The goal is to develop scalable emergency management for the entire country.

Socio-technical components shown in Table 6.1 are categorized and quantified using an ordinal scale from 1 to 5 in the structured questionnaires distributed to all emergency personnel, as described in Chapter 3. The mean value of the indicators for each component is calculated to extract a single score to represent the level of organizational complexity, technical infrastructure and cultural openness for each respondent. I computed the average mean scores for all three components by summing the three sets of indicators, and generated an average mean score of perceived performance on the socio-technical indicators. This single measure of a socio-technical mean score is used to compare the existing level of perceived performance among groups of emergency personnel. I identified four groups of emergency personnel as Civil Emergency Defense Department (CERD), Department of Disaster Prevention and Mitigation (DDPM), field personnel of district offices, and field personnel of the DDPM. As shown in Chapter Five, emergency personnel at headquarters or central command have different characteristics in performance than field personnel. The perspectives regarding the focal point of emergency response operations also differ. The Bangkok administration is more likely to have control over its agencies and CERD personnel, unlike the DPM field personnel who serve under the provincial government and are supported by headquarters and regional centers.

Figure 6.1 presents the summary of mean scores for the three socio-technical components and the sum of mean scores for the set of socio-technical components to show the comparison among different levels of operation of emergency personnel. As shown in the graph of mean scores for each socio-technical component, DPM at headquarters is perceived to have a lower level of technical infrastructure than CERD. This finding is explained by DPM's function as a policy maker, planner, and coordinator in emergency management, rather than providing technical support and field assistance as CERD does. Under states of emergency in Bangkok, where DPM headquarters is based, CERD and district officers (DO) are emergency personnel in charge and on duty. Headquarters and central agencies are perceived to have a higher degree of organizational flexibility, since they function as coordinators of assistance. Field emergency personnel in Thailand are still directed through command and control and decisions regarding performance are mostly made by superiors at the central command center or local command posts.

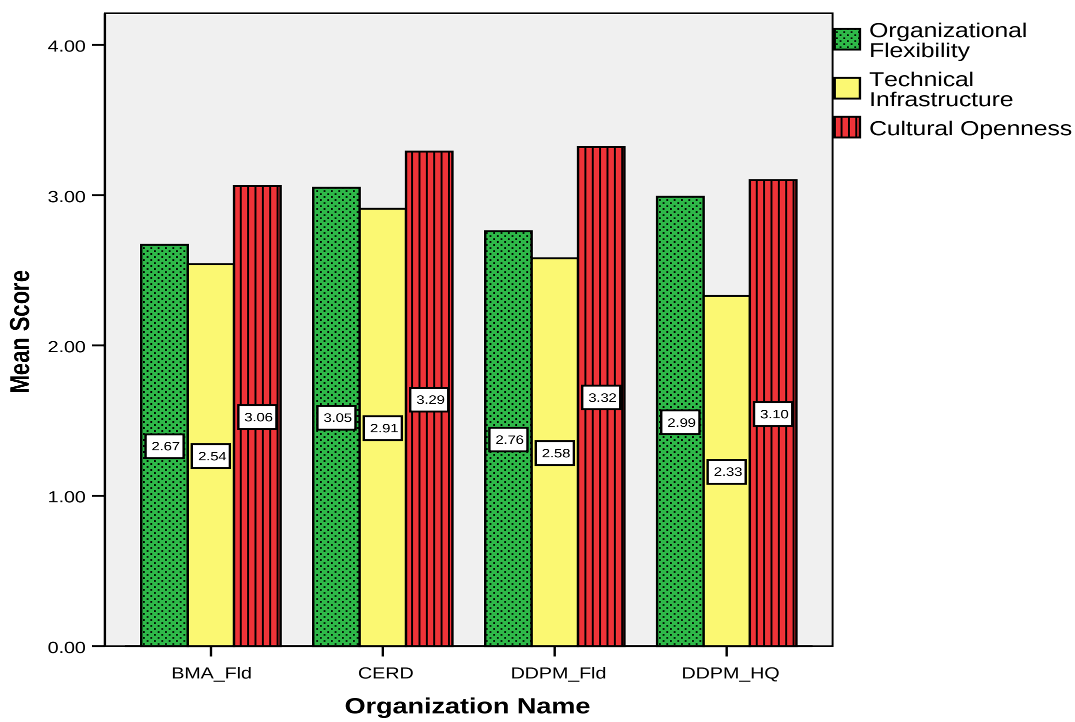


Figure 6.1 Graph shows a summary of socio-technical components of emergency personnel

Source: Extracted from questionnaires distributed to Thailand emergency personnel; dated July - August 2005

NOTE: CERD is Civil Emergency Relief Department, DPM_HQ is Disaster Prevention and Mitigation at Headquarter, BMA_Fld is Field District Officer, DDPM_Fld is Field Disaster Prevention and Mitigation.

Cultural openness becomes more interesting since it gains the highest score and differs significantly from other socio-technical components. Emergency personnel become aware of the risk they confront because of the frequent occurrence of natural and manmade hazards, and acquire skillful knowledge needed to cope with emergency operations. They become more open to new information and lessons learned from the past. CERD, in turn, is different because these personnel function in two roles in emergency operations, as coordinators and field support personnel. More importantly, CERD is relatively new to multi-hazards operations and members realize they need to be trained for these operations by experts in different fields as well as their colleagues who have more experience in such operations.

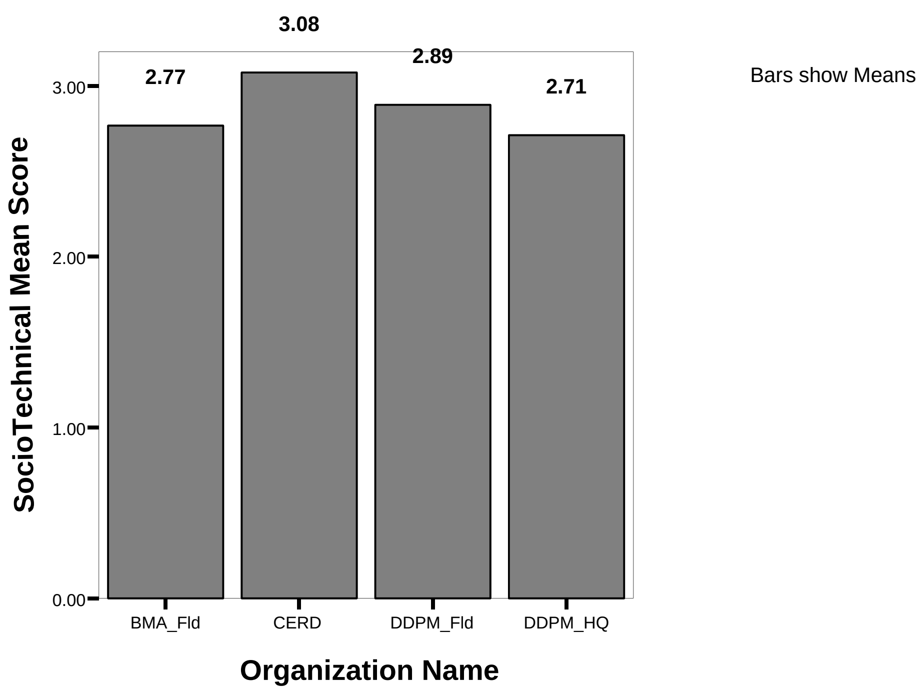


Figure 6.2 Graph shows mean scores of a sum of socio-technical components ofThailand emergency response systems by units of operations

Source: Extracted from questionnaires distributed to Thailand emergency personnel; dated July - August 2005
NOTE: CERD is Civil Emergency Relief Department, DPM_HQ is Disaster Prevention and Mitigation at Headquarter, BMA_Fld is Field District Officer, DDPM_Fld is Field Disaster Prevention and Mitigation.

The mean scores of socio-technical component, reported in Figure 6.2, show that all field personnel recognize the need for change in emergency response operations. This need concerns not only the safety of the public, but also the lives of emergency personnel. Lessons learned from losses sustained in the tsunami response and building collapse in Bangkok reflect the need for more skills, knowledge, information and equipment for emergency personnel to be able to function on individual tasks as well as coordinated ones. As also shown, mean scores on socio-technical characteristics for field emergency personnel are low.

In contrast, there is a significant difference in mean scores between CERD and DDPM. This difference can be explained by different functions in practice for the two central agencies. CERD functions as a coordinator and provider of information and technical support, and in a large scale event, CERD is a field supervisor or one of the unified commanders. CERD also has its own emergency response personnel who can assist in field operations. DDPM, on the other hand, functions as a strategic body for emergency response which designs policies, assigns action plans, and coordinates training programs. DDPM at headquarters participates less in emergency operations. With this difference, CERD has a higher mean score not only in perceived overall socio-technical performance, but also among each element of the emergency response system.

Interestingly, DDPM Headquarters' authority and responsibility are similar to Bangkok Metropolitan Administration in policy making and resources distribution rather than being central emergency personnel like CERD. DDPM field personnel who work under provincial governors have the same function as CERD. They both coordinate actions of the provincial government and local authorities. A significant difference is the authority structure. CERD is under the structure of BMA as an agency with line authority, while provincial DPM operate under provincial governors as an auxiliary unit. This difference in authority makes it difficult for provincial DPM to coordinate city, district, and sub-district personnel in emergency operations without strong support from the governors.

A comparative approach distinguishes between emergency agencies at headquarters or central office and field personnel, and also focuses on the integration of central and field agencies in an emergency response system. DDPM emergency response has a lower degree of perceived socio-technical performance. This finding was also confirmed by the content analysis that shows a more densely connected network of emergency response for BMA than DDPM, discussed in previous chapters. In the tsunami response, regional and provincial DPM functioned under the provincial governors facing an unknown situation and unfamiliar consequences. Lack of information to support action combined with diminished trust by the Command Center in their skills and experience resulted in less flexibility for frontline personnel to make decisions and mobilize their resources. A large scale of devastation increases difficulty in operations because regional and provincial DPM personnel have not trained together for coordination and operation across jurisdictions, especially without an effective communication channel.

With stronger interconnections, CERD functions more effectively with a higher degree of flexibility. CERD also covers less area and has fewer local units. BMA has field officers who have worked in emergency field operations for a decade longer than DDPM personnel. The emergency structure of BMA, operating through the CERD and district offices, increases the degree of organizational flexibility by having BMA serve as the top decision maker and direct emergency operations as needed or when the degree of severity increases. CERD functions as a linking pin of the operation as well as assisting when requested under the pre-planned procedures in the action plans. This structure allows the district offices to direct their frontline emergency personnel and volunteers to work under states of emergency more effectively and systematically.

To assess the effects of the socio-technical components on emergency response, I collected data on the readiness of emergency response agencies to cope with unexpected events. I sought their perceptions regarding the sufficiency of resources, manpower, training, and knowledge that they have received and whether the availability of resources and training affected their performance. I used the data collected from field personnel to conduct a regression analysis of the perceived socio-technical components and the performance of emergency agencies.

The degree of public awareness of an emergency agency's performance is considered a factor driving cultural openness. Public awareness and recognition of emergency personnel increased after the tsunami devastation and massive accidents in Bangkok. Public awareness pushed the national and provincial governments to commit to improving emergency management. This recognition reinforced the efforts of emergency personnel to maintain a higher standard of performance for the public and their own safety. Support for enhancing emergency response performance comes from both top-down and bottom-up directions that can be effectively implemented by all parties.

Figure 6.3 shows the degree of emergency response performance, readiness to confront unexpected events, and public recognition of the performance of the emergency organizations. Data are reported from surveys and interviews at every level of management for the four groups of emergency personnel. The degree of public recognition of emergency response performance in Bangkok is higher than that for DDPM, because the national government is drawing attention to the establishment of the National Disaster Warning Center of Thailand and the international fund for the establishment of a Regional Disaster Warning Center or Indian Ocean Tsunami

Warning Center. The indirect impact of the tsunami devastation has been to increase the level of awareness regarding how little Thai people know about disaster risk reduction and realization of the need to increase their capacity to adapt and confront such disaster risk.

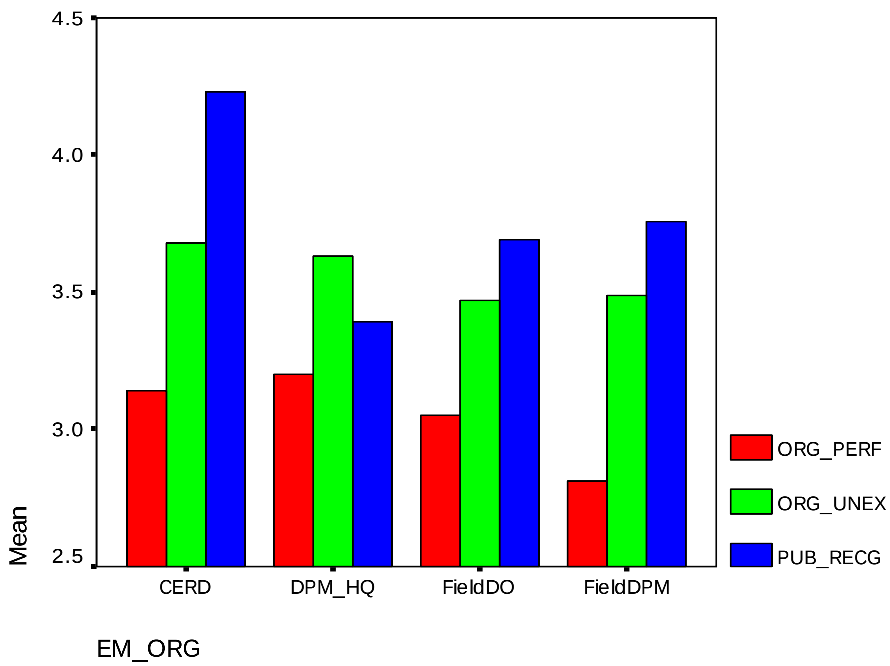


Figure 6.3 Summary of mean scores of emergency personnel's organizational performance, organizational readiness to unexpected event and public recognition of Thailand emergency personnel

Source: Extracted from questionnaires distributed to Thailand emergency personnel; dated July - August 2005
NOTE: EM_ORG is Emergency Organization, ORG_PERF is Organizational Performance, ORG_UNEX is Organizational Readiness to Confront with Unexpected Events, PUB_RECG is Public Recognition, CERD is Civil Emergency Relief Department, DPM_HQ is Disaster Prevention and Mitigation at Headquarter, FieldDO is Field District Officer, FiledDPM is Field Disaster Prevention and Mitigation.

A direct impact of the tsunami disaster was to focus attention on disaster warning, rather than improving disaster management and emergency response system as the first priority. Once a warning system is activated, disaster still occurs and states of emergency are still activated for personnel to respond. This is a weakness of the situation of Thailand. The moment that DDPM activates a warning system for disaster anywhere in the country, the agency has less support to develop its capabilities to manage disaster and states of emergency. DDPM is functioning as coordinator when their members are supposed to work as front line emergency personnel

This study suggests that co-training programs can pool expertise from other emergency agencies and outside expert organizations by engaging in related activities. Bangkok emergency personnel are trained by DDPM academy which brings in experts from various emergency institutions such as Pacific Disaster Center (PDC) and Asian Disaster Preparedness Center (ADPC). There is still a wide gap in the integration of emergency operations between the two systems. It is recorded by documentary analysis that BMA sent two emergency response teams of CERD into the affected area around Phuket and PhangNga to help search and rescue operations, yet none of the records indicated coordination or interaction between CERD units and DDPM local agencies. Until December 31, 2004 the operations report of the CERD deputy verify that CERD units were operating at one of the local shelters at BanNumKem Municipality in PhangNga province.

There is a high possibility that BMA has to request assistance from DDPM if a large scale of disaster occurs. The other example is the possibility that a disaster may occur in the area of two provinces. Both BMA and DDPM are authorized to manage emergency response in such an affected area together. Lessons learned from the tsunami response and building collapse incidents are that multiple agencies work at their highest potential when they understand the others' operations and have experience in coordinating and interacting with each other in practice.

I analyzed the effects of socio-technical components on organizational performance and organizational readiness to unexpected events using factor analysis and multivariate regression. SPSS statistics in the tables below show the regression results. Data have been tested for normal distribution and linearity. Data screening, recoding, and mean replacement, are done prior to factor analysis and linear regression analysis to meet the assumptions of normality and validity.

I present the regression analysis in two dimensions. First, the analysis examines the relationship between socio-technical components and dependent variables. The variables of organizational performance and organizational readiness to unexpected event are examined without categorizing them as indicators of organizational flexibility, technical infrastructure, and cultural openness. The analysis computed a mean score, single value, of all components and uses it as socio-technical component value. The second aspect of the analysis identifies each group of socio-technical components to estimate the degrees of their relationships with the dependent variables. Tables 6.2, 6.3, and 6.4 present regression analyses of socio-technical components and organizational performance in the order discussed above.

6.1.1 Organizational Performance and Socio-Technical Component

6.1.1.1 Socio-Technical Component (Overall)

From the statistical analysis of survey data, the regression model of organizational performance on the socio-technical components is significant at level of 0.01, which is considered very high. Emergency personnel consider their performance to have a significant correlation with socio-technical components. From the interviews, emergency personnel are well aware of the needs of socio and technical components to help them perform their tasks to accomplish their goals and enable them to learn new methods and improve their performance. They realize that they have less knowledge, skill, and tools to help them do their operations effectively. They expressed their need for technical support as well as organizational and cultural assistance.

Table 6.2 Regression Analysis of Socio-technical Component and Organizational Performance of Thailand emergency personnel

Descriptive Statistics

	Mean	Std. Deviation	N
Organization performance	2.94	.793	331
MnSocTch	2.9017	.38734	331

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.395(a)	.156	.154	.730

a Predictors: (Constant), MnSocTch

ANOVA(b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	32.454	1	32.454	60.939	.000(a)
	Residual	175.214	329	.533		
	Total	207.668	330			

a Predictors: (Constant), MnSocTch
b Dependent Variable: Organization performance

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.587	.304		1.934	.054
	MnSocTch	.810	.104	.395	7.806	.000

a Dependent Variable: Organization performance

Source: Data collected from survey distributed to Thailand emergency personnel; dated July - August 2005
NOTE: MnSocTch is Socio-Technical Component (mean score of a sum of Organizational Flexibility, Technical Infrastructure, and Cultural Openness)

Regression model (shown in Table 6.2)
Organizational Performance = 0.587 + 0.810Socio-Tehcial Component

As discussed earlier, this study also seeks to explain the relationships between organizational performance and the three socio-technical components. The analysis shows a positive relationship between organizational performance and socio-technical component. As the level of socio-technical capability increases, so to does the level of the organizational performance. The analysis also shows the real needs of Thailand emergency personnel when they report which factors affect their performance. Table 6.3 below presents a regression analysis of organizational performance and organizational flexibility, technical infrastructure, and cultural openness.

6.1.1.2 Socio-Technical Component (By category)

Regression model (shown in Table 6.3)
Organizational Performance = 0.576 + 0.339 Organizational Flexibility + 0.214 Technical Infrastructure + 0.259 Cultural Openness

From the statistical analysis of the survey data, the regression model of organizational performance and the socio-technical components is significant at level of 0.01, which is considered high. Emergency personnel view their performance as having a significant correlation with all three socio-technical components at different degrees. From the regression analysis, organizational flexibility has the highest degree of positive relationship with organizational performance, cultural openness is second, and technical infrastructure has the lowest degree of relationship. From the interviews, emergency personnel consider change and new knowledge as necessary tools for them to operate. The awareness of disaster and emergency has emerged the recognition of learning the unknown. However, they consider that their performance effectiveness can change if the organizations provide more flexibility for them to improve.

Emergency personnel in both DDPM and BMA are looking for incentives in terms of more access to useful training programs, resource availability, and reliable information sharing to make decisions with the support of their superiors. Such decisions, from their perspective, need to have sufficient information in order for them to make more appropriate decisions that may affect safety of lives. They view support from organizational top management as crucial to their overall performance. They indicate that superiors should also recognize the importance of changes and support their improvement with both financial and non-financial benefits.

Table 6.3 Regression Analysis of Organizational Performance and Organizational Flexibility, Technical Infrastructure, and Cultural Openness

Descriptive Statistics

	Mean	Std. Deviation	N
Organization performance	2.94	.793	331
OrgFlxSs	2.8192	.46004	331
TchStrSs	2.6725	.48838	331
CultOpSs	3.2134	.48006	331

Model Summary

Model	R	R Square	Adjusted Square	Std. Error of Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.397(a)	.158	.150	.731	.158	20.379	3	327	.000

a Predictors: (Constant), CultOpSs, TchStrSs, OrgFlxSs

ANOVA(b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	32.711	3	10.904	20.379	.000(a)
	Residual	174.957	327	.535		
	Total	207.668	330			

a Predictors: CultOpSs, TchStrSs, OrgFlxSs, b Dependent Variable: Organization performance

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.576	.309		1.863	.063
	OrgFlxSs	.339	.111	.196	3.041	.003
	TchStrSs	.214	.102	.132	2.108	.036
	CultOpSs	.259	.099	.157	2.623	.009

Source: Data collected from survey distributed to Thailand emergency personnel; dated July - August 2005

NOTE: OrgFlxSs is a sum of mean scores of Organizational Flexibility, TchStrSs is a sum of mean scores of Technical Infrastructure, and CultOpSs is a sum of mean score of Cultural Openness

The regression model shows that socio-technical components do, in fact, play a significant role in organizational performance. The R square value of the model is relatively low because the sample size of the survey is large with a lot of variance. The survey was conducted with all emergency personnel around the country under different jurisdictions. The nested case design is complex. Thailand emergency management has three levels of primary players which are DDPM, BMA and CERD, and the District emergency team. As discussed in chapters 4 and 5, DPM headquarters, regional centers, provincial personnel, BMA central agency CERD, and Field District Officers differ by their characteristics and structure of emergency operations. Thus, the R square value for the entire system is compounded by the errors at each level of performance.

To check the argument made above, I ran a regression analysis for specific groups of emergency personnel. Tables 6.4-6.7 present regression analyses of organizational performance and socio-technical component of emergency personnel. The results explain in which states of the emergency response system each emergency service worker operates and offer insights into how to improve its operation.

Table 6.4 Regression Model Summary of Organizational Performance and Socio-Technical Component of Civil Emergency Relief Department

N	R	R Square	Adjusted R Square	Significant
39	0.578	0.334	0.277	0.002

Source: Data collected from survey distributed to Thailand emergency personnel (all levels); dated July - August 2005

Regression model of the Civil Emergency Relief Department (CERD)
Socio-Technical Component (By category)

Organizational Performance = -1.3 + 0.68 Organizational Flexibility + 0.1 Technical Infrastructure + 0.65 Cultural Openness

Table 6.5 Regression Model Summary of Organizational Performance and Socio-Technical Component of District Emergency Personnel

N	R	R Square	Adjusted R Square	Significant
90	0.118	0.014	0.021	0.75 (not significant)

Source: Data collected from survey distributed to Thailand emergency personnel; dated July - August 2005

Regression model of the District Offices (DO), not statistically significant
Socio-Technical Component (By category)

Organizational Performance = 2.67 - 0.152 Organizational Flexibility + 0.24 Technical Infrastructure + 0.05 Cultural Openness

Table 6.6 Regression Model Summary of Organizational Performance and Socio-Technical Component of Department of Disaster Prevention and Mitigation Headquarters Emergency Personnel

N	R	R Square	Adjusted R Square	Significant
35	0.605	0.367	0.305	0.002

Source: Data collected from survey distributed to Thailand emergency personnel; dated July - August 2005

Regression model of the Department of Disaster Prevention and Mitigation Headquarters
Socio-Technical Component (By category)

Organizational Performance = -0.03 + 0.893 Organizational Flexibility + 0.02 Technical Infrastructure + 0.16 Cultural Openness

Table 6.7 Regression Model Summary of Organizational Performance and Socio-Technical Component of Provincial Department of Disaster Prevention and Mitigation (Field) Emergency Personnel

N	R	R Square	Adjusted R Square	Significant
88	0.434	0.188	0.159	0.001

Source: Extracted from questionnaires distributed to Thailand emergency personnel; dated July - August 2005

Regression model of the Department of Disaster Prevention and Mitigation (Provincial)
Socio-Technical Component (By category)

Organizational Performance = -0.005 + 0.595 Organizational Flexibility + 0.1 Technical Infrastructure + 0.261 Cultural Openness

From regression analysis of all emergency personnel on their perceived relationships between their organizational performance and socio-technical components, the results reported that CERD as a provincial authority under BMA expressed their need for organizational flexibility and cultural openness. CERD is well equipped since they transfer all resources with them when they moved from the Fire Department. Although the zone-integrated-regression model is not significant,, all regression models are statistically significant when the regression analysis was run separately for each zone.. District personnel in the New Economic Zone view technical infrastructure (Coefficient = 1.136) as the first priority which confirms earlier findings that this zone needs more attention on emergency operations, apart from other problems with which they are coping. District personnel in the Preservation Zone expressed their concern for cultural openness (Coefficient = 0.559) as the first priority. The area is the center for important organizations and BMA focuses attention on having District personnel sufficiently well-equipped and flexible to enable them to make immediate decisions. Lastly, District personnel in the Resident Zone reported their greatest concern to be organizational flexibility (Coefficient = 0.681). Many residential structures are located in the area with a large population that needs extremely effective emergency operations and timely informed decisions.

When the interviews were conducted, emergency personnel viewed their emergency response operations as one part of their performance. They consider other routine tasks they perform as part of how they evaluate their performance. I examined the readiness of the emergency response agencies to cope unexpected events to see whether the socio-technical components are significant for the level of readiness of emergency personnel.

6.1.2 Organizational Readiness to Confront with Unexpected Event and Socio-Technical Component

6.1.2.1 Socio-Technical Component (Overall)

Table 6.8 Regression Analysis of Socio-technical Component and Organizational Readiness for Unexpected Events of Thailand emergency personnel

Descriptive Statistics

	Mean	Std. Deviation	N
Organization unexpected event	2.74	.659	310
MnSocTch	2.9093	.37872	310

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.392(a)	.153	.151	.608

a Predictors: (Constant), MnSocTch

ANOVA

Model		Sum of Squares		Mean Square	F	Sig.
1	Regression	20.594	1	20.594	55.779	.000(a)
	Residual	113.716	308	.369		
	Total	134.310	309			

a Predictors: (Constant), MnSocTch, b Dependent Variable: Organization unexpected event

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.752	.268		2.810	.005
	MnSocTch	.682	.091	.392	7.469	.000

a Dependent Variable: Organization unexpected event

Source: Data collected from a survey distributed to Thailand emergency personnel; dated July - August 2005

NOTE: MnSocTch is Socio-Technical Component (mean score of a sum of Organizational Flexibility, Technical Infrastructure, and Cultural Openness)

Regression model (shown in Table 6.8)
Socio-Technical Components (Overall)

Organizational Readiness = 0.752 + 0.682Socio-Technical Component

From the statistical analysis of survey data, the regression model of organizational readiness and the socio-technical components is significant at the level of 0.01. Emergency personnel consider their readiness to be significantly correlated with socio-technical component. From the interviews, emergency personnel are well aware of their social and technical needs to help them react and respond more effectively to states of emergency and unexpected consequences. They realize that they have less knowledge, skill, and tools to help them adapt to rapid change effectively. Notably, a constant value of this model, 0.752, is higher than the one, 0.576, in organizational model. This reflects the realization of the emergency personnel that they need to be more alert when states of emergency occur, and better prepared for unexpected consequences.

Interestingly, the coefficient value of socio-technical component in this model, 0.682, is lower than the coefficient value, 0.810, in organizational performance model. This is explained by the discussion above that emergency personnel view their performance broader and cover a wider range of tasks than a readiness to confront with unexpected events, which require higher degree of support from policy makers and superior in the organizations. To support this argument, I also examined how each socio-technical component contributes to organizational readiness to confront unexpected events. Regression analysis tested the relationship between organizational readiness and the three socio-technical components: organizational flexibility, technical infrastructure, and cultural openness.

6.1.2.2 Socio-Technical Component (by category)

Table 6.9 Regression Analysis of Organizational Performance and Organizational Flexibility, Technical Infrastructure, and Cultural Openness

Descriptive Statistics

	Mean	Std. Deviation	N
Organization unexpected event	2.74	.659	310
OrgFlxSs	2.8311	.45245	310
TchStrSs	2.6756	.48799	310
CultOpSs	3.2211	.47157	310

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.426(a)	.182	.174	.599	.182	22.664	3	306	.000

a Predictors: (Constant), CultOpSs, TchStrSs, OrgFlxSs

ANOVA(b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	24.418	3	8.139	22.664	.000(a)
	Residual	109.892	306	.359		
	Total	134.310	309			

a Predictors: CultOpSs, TchStrSs, OrgFlxSs, b Dependent Variable: Organization unexpected event

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.900	.269		3.345	.001
	OrgFlxSs	.353	.094	.242	3.774	.000
	TchStrSs	.346	.085	.256	4.087	.000
	CultOpSs	-.028	.084	-.020	-.335	.738

Source: Data collected from survey distributed to Thailand emergency personnel; dated July - August 2005

NOTE: OrgFlxSs is a sum of mean scores of Organizational Flexibility, TchStrSs is a sum of mean scores of Technical Infrastructure, and CultOpSs is a sum of mean score of Cultural Openness

Regression model (Table 6.9)

Socio-Technical Component (By category), * coefficient is not statistically significant

Organizational Readiness = 0.9 + 0.353Organizational Flexibility + 0.346 Technical Infrastructure - 0.028 Cultural Openness*

Unexpected events and their consequences are characteristic of disaster and emergency management. Emergency personnel expect that their adaptive capabilities in unexpected events will increase if the organization provides more resources and flexibility to them. The degree of readiness of the personnel to adapt to unexpected events is explained by the model at 0.05 significant level. This model revealed the significance of organizational flexibility and technical infrastructure as the first two priorities in managing emergency response. Compared to organizational performance model, emergency personnel view there is a higher degree of need in technical infrastructure when they confront with unexpected event.

Nevertheless, question falls into why cultural openness, in this model, has less effect to organizational readiness to confront with unexpected event. A negative coefficient value of cultural openness, even though is relatively low and not statistically significant, is the factor that reduced the overall effects of socio-technical component on organizational readiness in a previous model. Cultural openness should be individually examined whether its effects has a significant result to an organizational readiness.

I ran the regression analysis of organizational readiness upon cultural openness. The relationship between the two variables is positive and statistically significant at 0.01 level of confidence with a coefficient of 0.28. I classified the levels of culture into two categories: "organizational culture" and "individual cultures". I regressed the variable of organizational readiness on the two levels of culture. The model is significant with a positive relationship between the dependent variable, organizational readiness, and two independent variables of culture. Interestingly, organizational culture has a higher degree of relationship (0.2) to organizational readiness than individual culture (0.08). This finding is supported by data obtained from interviews and professional observation as well as previous regression analysis reported for all socio-technical components. Organizational flexibility is likely to have a higher degree of relationship for personnel performance and readiness in emergencies. Personnel are more likely to consider their operations and response to have a strong tie with organizational structure, authority, flexibility, culture, shared goal, and underlying values. They believe that these factors are crucial to the accomplishment of their goals.

From the interviews, emergency personnel view their learning process as their preparation to deal with unexpected events. They consider the elements in cultural openness as crucial factors to have in their training programs. Willingness to change, to adapt, to learn new knowledge, to accept mistakes and to solve conflict are taken into account as fundamental value of personnel in order to change their performance more than applying them in unexpected events. They view new knowledge of the unknown as to build and enhance their capability to operate their emergency response.

In the regression of organizational readiness to cope with unexpected events, the R square value is also explained in the same manner as in the regression of organizational performance. That is, there is a wide range of types of emergency personnel under investigation in this study with a higher degree of variation. Tables 6.10-6.13 below show regression analysis of organizational readiness for unexpected events and socio-technical component of emergency personnel.

Statistic regressions analyses of each level of emergency personnel are presented below. R squares extracted from each regression reflect a stronger prediction power of the model. However, as discussed before, the regression model is analyzed in order to find statistical support for the argument of this study that socio-technical components play crucial roles in emergency operations and management. The regression analyses for each emergency personnel unit point in the same direction. The socio-technical components are statistically significant for organizational performance and readiness to confront unexpected events. Nonetheless, with the differences in organizational characteristics, emergency response structure, response action plans, organizational values, and nature of risks that emergency personnel confront, the effects of socio-technical components and the demand for such elements differ among the agencies.

Table 6.10 Regression Model Summary of Organizational Readiness to confront unexpected Event and Socio-Technical Component of Civil Emergency Relief Department Emergency Personnel

N	R	R Square	Adjusted R Square	Significant
39	0.433	0.187	0.108	0.089

Source: Data collected from survey distributed to Thailand emergency personnel; dated July - August 2005

Regression model of the Department of Civil Emergency Relief Department (CERD) Socio-Technical Component (By category)
Organizational Readiness = 0.93 + 0.39 Organizational Flexibility + 0.38 Technical Infrastructure + 0.063 Cultural Openness

Table 6.11 Regression Model Summary of Organizational Readiness to confront unexpected Event and Socio-Technical Component of District Office Emergency Personnel

N	R	R Square	Adjusted R Square	Significant
80	0.278	0.078	0.041	0.10

Source: Data collected from survey distributed to Thailand emergency personnel; dated July - August 2005

Regression model of the Department of District Offices (DO) Socio-Technical Component (By category)

Organizational Readiness = 1.94 + 0.18 Organizational Flexibility + 0.33 Technical Infrastructure + 0.177 Cultural Openness

Table 6.12 Regression Model Summary of Organizational Readiness to confront unexpected Event and Socio-Technical Component of Department of Prevention and Mitigation at Headquarters Emergency Personnel

N	R	R Square	Adjusted R Square	Significant
35	0.544	0.296	0.217	0.022

Source: Data collected from survey distributed to Thailand emergency personnel; dated July - August 2005

Regression model of the Department of Prevention and Mitigation at Headquarters Socio-Technical Component (By category)

Organizational Readiness = -0.05 + 0.457 Organizational Flexibility + 0.516 Technical Infrastructure + 0.042 Cultural Openness

Table 6.13 Regression Model Summary of Organizational Readiness to confront unexpected Event and Socio-Technical Component of Department of Prevention and Mitigation at Provincial Field Emergency Personnel

N	R	R Square	Adjusted R Square	Significant
88	0.479	0.23	0.201	0.000

Source: Data collected from survey distributed to Thailand emergency personnel; dated July - August 2005

Regression model of the Department of Prevention and Mitigation at Provincial (Field) Socio-Technical Component (By category)

Organizational Readiness = 0.695 + 0.322 Organizational Flexibility + 0.345 Technical Infrastructure + 0.022 Cultural Openness

Statistical regression models of how emergency personnel view their performance and adaptive capacities in unexpected events show the important effect of socio-technical components on their performance. From their perspective, technical infrastructure would certainly help their operations to become more efficient while they view themselves as being open-minded, willing to learn, and willing to improve their performance. All of the above will not effectively applied to their routine or special operation if the organization does not support their willingness to change. The structure of the organizations needs to be reorganized to clarify the line of authority, access to information, resource flows and coordination routes for personnel to follow easily. These changes will enable them to learn how to make changes or decisions for the situations they confront. They also realize that change in the organization takes a long time; yet it can be done. The improvement of organizational performance and readiness for unexpected events has to have both organizational culture and individual beliefs that support their readiness to learn and change. Without the critical role of socio and technical components, emergency personnel cannot perform their responsibility effectively and efficiently.

6.2 THE EVOLUTION OF EMERGENCY RESPONSE SYSTEMS

Based on the three-dimensional model, Comfort groups emergency response systems into four sub-sets reflecting the dominant characteristics of their state of transition toward self – organization during their emergency response operations. The four groups are: 1) non-adaptive response system with a low level of presence of socio-technical components, 2) emergent adaptive response system with a low to medium level on indications for the three components, 3) operative-adaptive response system with a medium to high degree of socio-technical elements, and 4) auto-adaptive response system that has a high level of performance on every element in the three-dimensional model. Based on findings from study, the tsunami response is classified as a non-adaptive response, and the Bangkok emergency response at provincial level is classified as an emergent-adaptive response while at district level is classified as a mixed state of non-adaptiveness and emergent-adaptiveness. I also explored how to improve the two related emergency management sub-systems to become an integrated auto-adaptive response system.

6.2.1 Tsunami response as a non-adaptive response system

Findings from this research identified the tsunami response as a non-adaptive response system due to the lack of knowledge, emergency plans, response procedures and resource reallocation. It took the response system three days to implement systematically organized emergency response operations and recovery processes. During those three days, assistance and resources were pouring into the affected areas without organized processes of coordination and distribution. That disorganization delayed the delivery of aid and supplies to the injured and needy survivors.

As discussed in chapter 4, network analysis shows that the response system appears to be loosely connected with many organizations participating, but not necessarily interacting efficiently with one another. In addition, there are several organizations that are involved in scattered interactions, or are engaged in interactions outside the network boundary. Those organizations represent public, private and non-profit sources of funding as well as national, provincial and local levels of jurisdiction. The network diagram reveals the poor connections and coordination among all levels of agencies. The loosely connected organizations entered the system by themselves, finished their operations, and then withdrew from the area. Search-and-rescue operations by these organizations were more likely to be repeated because of a lack of feedback of updated information and inefficient communication channels.

The lack of knowledge and information reduced confidence in the decision making process when it came to responding to unexpected events and consequences. Although the emergency personnel expressed a willingness to improve operations and collaborate, on-the job learning was not an effective choice given the time constraints during these emergencies. The knowledge and information needed to collaborate and to make informed decisions must be internalized in each unit’s personnel, as well as facilitated among units. As mentioned earlier, all emergency personnel recognize the need of training and co-training which can help them learn to operate more effectively and coordinate more efficiently. The lack of infrastructure and the failure of communication channels can prevent organizations from managing effective response operations. There remains significant room for improvement before the DDPM emergency response system evolves to a state that will enable it to function more effectively and efficiently. The subsequent discussion will focus on how collaboration among the three levels of authority: DDPM as a national authority, the BMA/CERD as a provincial authority, and district emergency units in Bangkok, can be improved.

6.2.2 Bangkok flood emergency response system as an emergent-adaptive system

The findings and previous analyses suggest that Bangkok's flood emergency response system is an emergent-adaptive system. The existence and functions of the FCC and BMA emergency radio networks reveal that their level of technical infrastructure is medium to high. The political commitment of the Bangkok governor, together with Bangkok being a center of government and business activities, increases the attention that the public gives towards emergency response issues. In addition, compared to the DDPM, which covers 75 provinces around the country, the BMA emergency response only covers a small area. This limited coverage area gives Bangkok a chance to improve and make constructive changes to its entire system. CERD, although a new organization, has a lot of potential because its personnel have been trained in the Fire Division under the National Police Department. This informal network of relationships indirectly creates a strong connection between the emergency personnel of CERD and police department, and provides an incentive for them to work together if needed. As prior members of the Fire Department, CERD personnel have an acceptable knowledge of how the Police Department operates. This shared knowledge supports the development of more effective coordination between the two departments.

As shown by the network analysis, the response system appears to be strongly connected, with a fair number of organizations represented and necessarily interacting efficiently with one another. The group centrality, closeness, betweenness and cliques reflect the operation by geographical area with the same set of actors. This reflects strong connections and effective coordination among all levels of agencies. If coordination, information and communication can be mobilized through all ties activated, emergency response will operate effectively. BMA and CERD need to maintain a degree of organizational flexibility because it enables the field district officers to feel more confident and empowered to make decisions under a state of emergency. A majority of district personnel still perceive their operations to be limited and centralized. This creates difficulty for rapid adaptation under the constraints of emergency.

6.2.3 Bangkok massive accident emergency response system as a mixed state of non-adaptiveness and emergent-adaptiveness

The combination of district officers and volunteers benefits emergency response in terms of having experienced personnel who know the area and the communities in which they operate. However, the lack of technical infrastructure and low degree of organizational flexibility makes effective emergency response operations difficult. Although the degrees of coordination and network interactions reported by the network analysis are relatively high when compared to the other agencies, district office emergency personnel are more likely to seek approval from their superiors before making decisions and reacting to situational difficulties.

The analyses reflect the need to implement training programs for the emergency personnel within the District Offices so that they can increase and sustain high skill levels. A co-training program should be adopted that involves all parties. The accident involving the building collapse and injured emergency personnel is evidence of poor coordination and a lack of experience. District officers have more accurate information regarding procedures and resources while district volunteers have more familiarity with the geography and communities. These types of information and specific experience need to be shared so that they complement each other. District level emergency personnel often work with private rescue teams who frequently arrive at the damaged location first. The other emergency units, provincial and district, subsequently arrived at the scene without being informed of current operations. They lack information about the status of the situation, and have difficulties updating reports on the state of emergency and coordinating actions. This gap in operational coordination was identified through a difficult lesson, but it garnered the attention needed to instigate improvement in emergency response collaboration.

6.2.4 Moving to an auto-adaptive response or self-organizing system

Systems operating at the edge of chaos have the potential for creative response to meet suddenly altered conditions of operations in effective ways. Yet, the margin for choice is narrow. Systems that do not move toward creative new actions will slide back toward chaos as their old patterns of performance fracture under the stress. Systems that move toward creative new actions are termed auto-adaptive or self-organizing (Comfort 1999). Such systems have a high degree of socio-technical components. This study provides its assessment how to move the two emergency response systems of Thailand to the state of auto-adaptive response system.

6.2.4.1 Technical Infrastructures

Before discussing how to more effectively position the emergency response infrastructure, I evaluate the new infrastructure already being implemented. The newly established National Disaster Warning Center, Thailand, ,installed 36 of 72 warning towers along the southern coastline. Those towers, activated from the national center in Bangkok, are linked to automatically warn people of upcoming threats to life and property. The towers are expected be linked to the alarm systems of every hotel and building so that a warning message will be disseminated. Signs, placed along the beaches, indicate evacuation routes and the nearest emergency facilities and shelters. The Department of Disaster Prevention and Mitigation (DDPM) has been working with the Department of Mineral Resources, provincial governments of the six coastal provinces and municipality administration to develop evacuation maps, plans and building codes. The Civil Emergency Relief Department (CERD) has purchased fire trucks, extinguishers, equipment and designed action plans that serve as a standardized operational manual. Budgetary allocations for the construction of additional fire stations have also been approved. In many places, the construction of these stations has already begun.

This movement toward training and mitigation is a sign that emergency response agencies are attempting to coordinate their infrastructure and their operations. Drills for tsunami evacuations should encourage the DDPM to activate and update their evacuation maps with provincial governments and municipalities. The DDPM information center should reorganize the information and knowledge needed for operations and make sure it is made available to emergency personnel. The DDPM academy should develop curriculum for co-training programs that encourage all personnel to learn about their equipment, procedures, facilities, risk assessments and action plans for responding to multi-hazards. The BMA should take this opportunity to integrate district officers and volunteers and teach them about the facilities and procedures of CERD and DDPM that are available within and around the area of Bangkok. Regional DPM at the center, located in Bangkok vicinity's area, which is structured as supporting unit for provincial DPM, can help Bangkok emergency personnel to reallocate more resources and personnel in a large scale emergency response. Knowing how to use alternate facilities, learning how the other emergency unit operates, and developing relationship through coordination help emergency personnel and organizations reach for assistance as needed.

6.2.4.2 Cultural Openness

It is unfortunate that it costs a huge number of deaths for people to recognize how important emergency response is. Willingness to learn is already rooted in the minds of all emergency personnel because they recognize that it is the unknown that caused people to suffer injury. This is evidenced by the significantly different mean scores between the three socio-technical components. As the study previously discussed, the cultural openness of emergency personnel is not driven by the enforcement of law or regulations. It is obviously pushed by the public that confront with an unknown disaster and experience an ineffectiveness of emergency response operations to ensure public safety. It is also emphasized by the emergency personnel's recognition of their lack of knowledge and skill to operate effective emergency responses which can also cost their lives during the operations.

High awareness of risk all parties creates the best opportunity for national and provincial governments to continue improving their emergency personnel and systems. In the practice of public management, culture and willingness to accept change are two of the most difficult factors to alter. Most of the time, policy makers confront difficulties translating policy into practice because of a resistance to change within the personnel who implement such policy and change.

International experts and assistance have been offered to the country to enhance the capabilities to understand and manage disaster and emergency response. The establishment of the National Disaster Warning Center represents a big step towards accepting change, new technology, coordination and solving conflicts and mistakes made in the past. The next time they confront a multi-hazard, the DPM, CERD and DO will be better equipped and prepared to learn new knowledge and skills.

6.2.4.3 Organizational Flexibility

Willingness to change and commitment to improvement can be worthless if the organizations do not provide flexibility in implementing the emergency response. BMA has a good start in designing two systems of single incident command and unified incident command. This will allow emergency response operations and personnel to move towards developing creative solutions if unexpected complications or consequences occur. The other pattern of transferring command to subordinates reflects the decentralized decision making process. This allows emergency personnel to make their own decisions about the situation at hand. These decision making capabilities are critical because emergency personnel need accurate, timely, and updated information to make informed decisions. DDPM has to focus on the changes within BMA and consider whether these changes can be applied to their system. Co-training programs will help connect their operation and share the information and knowledge needed in the operation into practice. An effective information sharing network needs effective database administration, organizational willingness to share knowledge and information, and efficient communication management to facilitate acquired information to emergency personnel at the time they need.

6.3 CONCLUSION

As the study moves toward the integration of intergovernmental and information-communication networks into emergency response in immediate crises or disasters, this chapter has laid out the elements needed to improve emergency systems of Thailand and how to move them to the next step of an auto-adaptive emergency response system. A single emergency response [unit – organization??] will not likely be able to manage a large scale disaster. Multiple agencies need to learn to work with one another. Such cooperation requires organizations to be flexible, and to adopt training programs that give emergency personnel a learning environment, as well as the tools, to encourage self-improvement and the development of coordination. Likewise, political commitment from national and provincial governments helps to strengthen and ensure a continuity of development of emergency personnel, organization and infrastructure of all level of authorities. In conclusion, policy makers should focus their energy on developing a scalable emergency response that exhibits self-learning and adaptive characteristics.

7.0 THE INTEGRATION OF INTERGOVERNMENTAL COORDINATION AND INFORMATION MANAGEMENT IN RESPONSE TO IMMEDIATE CRISES

In a state of emergency, emergency response personnel must understand the nature of the emergency, and develop a coordinated and systematic response. Scales of severity from disaster or unexpected consequences are nonlinear and unpredictable. Emergency response may require multiple agencies to perform many tasks in different areas simultaneously. This complexity indicates the need for effective and efficient information sharing and communication between multiple agencies and communities at risks. Local emergency response personnel have the most experience and familiarity with the area in which they live and operate. Information and knowledge acquired by local personnel can help agencies operate faster and more effectively. The knowledge of emergency management is interdisciplinary and comes from multiple sources with various types of expertise. There is a high need for knowledge and information sharing to keep emergency personnel current e and able to function adaptively.

Adaptive capacity also requires the ability to coordinate actions during emergency response operations. Emergency personnel need to understand their operations, as well as the operations of other agencies, in order to meet their responsibilities. Additionally, emergency agencies need to be able to access updated disaster information and make it available to the public so that communities become familiar with the situation they are confronting. The availability of accurate information assists a community to learn, adapt, and recover in a time of crisis. This study provides a framework to improve Thailand's emergency response system. By integrating three emergency management functions -- intergovernmental coordination; information communication, and resilient community interaction -- Thailand can create an environment that encourages self learning and adaptive capability among emergency personnel. Such improvements will strengthen Thailand's ability to respond to complex disasters such as the December 26, 2004 tsunami.

7.1 RESPONSE TO THE RESEARCH QUESTIONS

This study focused on the following research questions, stated in Chapter Three:

1. To what extent do the key agencies responsible for disaster operations collaborate in large scale emergencies?
2. To what extent are authority and responsibility for emergency management assigned to specific public agencies?
3. To what extent does an intergovernmental coordination process operate in emergency management in practice?
4. To what extent does the use of information technology facilitate inter-organizational coordination and communication in emergency management?

4 In what ways are intergovernmental coordination and information management integrated in Thai emergency management?

5 What factors would move the existing emergency response system toward auto adaptation, and how?

The findings in reference to these research questions are spread out through the various chapters of this dissertation. Findings characterizing the national response to the December 26, 2004 tsunami are presented in Chapter 4. Chapter 5 takes a local perspective, and characterizes how emergency response personnel within in the Bangkok metropolitan region responded to two specific crises: flood and massive accident. The fact that the response to these two crises is governed by the same national emergency law, Emergency Act 1979, allows them to be organized and analyzed within a single chapter. For example, the emergency response to these two incidents was directed by the Bangkok Metropolitan Authority and managed by District Offices and Volunteer Units. Both cases share the same emergency response and support structure, the Civil Emergency Relief Department, which provides assistance in the event that operations become overloaded. The critical functions of the Flood Control Center and Vicinity's involvement in flood crisis management were discussed as well. The findings suggest that two emergency response systems are best described as non-adaptive, under the management of DDPM, and the third, managed by BMA, as an emergent adaptive system,. In Chapter 6, I examined the relationships among factors identified by the theoretical framework, and the emergency agencies' performance in unexpected events to determine their effects on emergency response operations. The intent of this analysis is to contribute to improving the emergency response system so that it becomes more auto-adaptive in performance.

The findings presented in the previous chapters demonstrate what must be done to improve Thailand's emergency response system at all jurisdictional levels, so that the system is in a state of constant auto-adaptation. This chapter, in conclusion, presents a conceptual model of the integration of intergovernmental coordination and information and communication management, toward establishing more effective, scalable emergency management. It also presents recommendations for improving the performance of emergency response in Thailand. These recommendations recognize the significance of individual units, as well as the need to coordinate operations across multiple units and jurisdictions. The emphasis is on building resilient communities and self learning environments to better cope with states of emergency.

To illustrate the translation of the integration of intergovernmental coordination and information management into a practice of emergency operation and management, this chapter will demonstrate how government agencies involved in emergency response perform their functions, and coordinate with each other by using the information that is available to them. The integration of the intergovernmental coordination and information management is illustrated in two steps of disaster management: disaster warning and emergency response.

7.2 THE INTEGRATION IN DISASTER WARNING MANAGEMENT

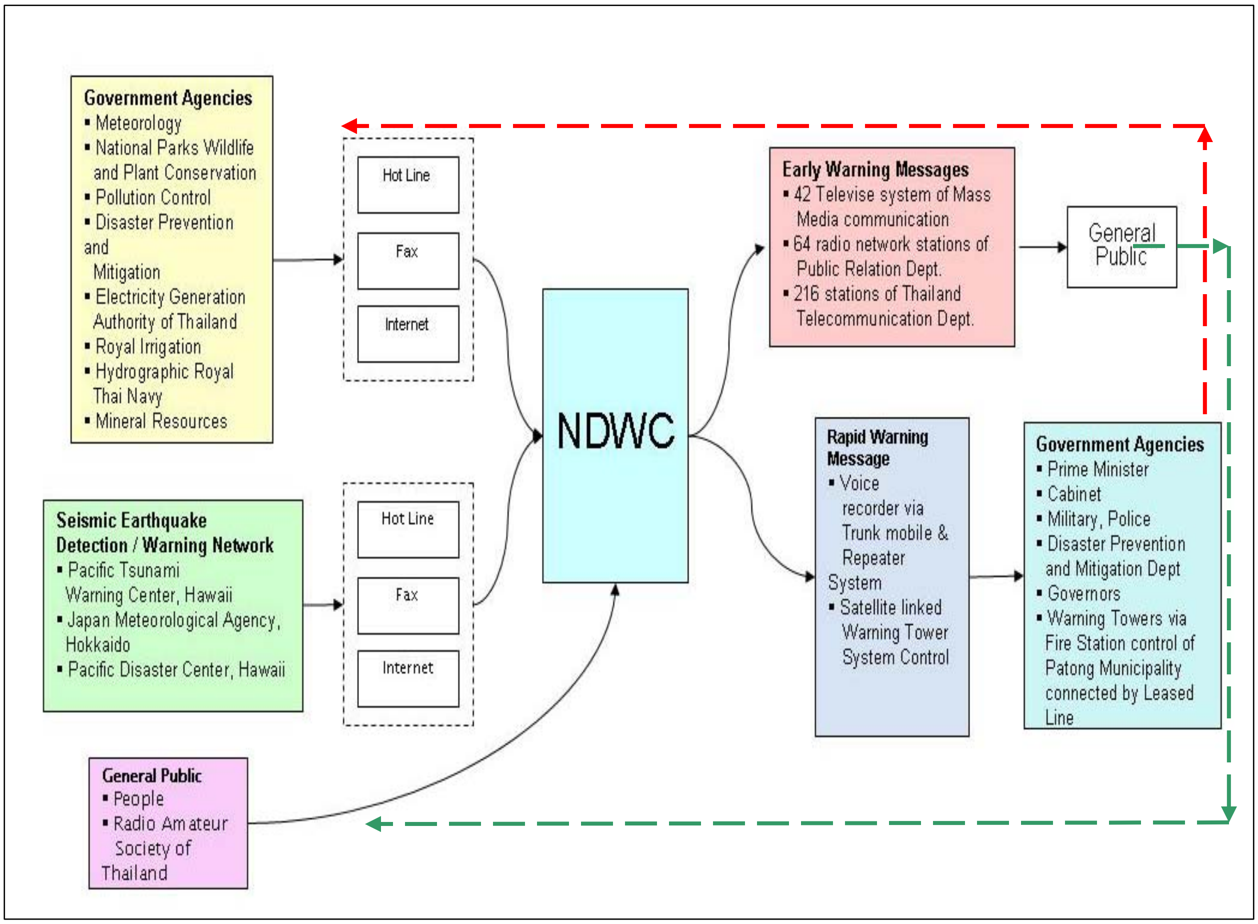


Figure 7.1 Map shows the integration of intergovernmental, information, and public network for Disaster Warning System

Source: Concept of Operations, National Disaster Warning Center, Thailand, modified by Stanley Goosby, Pacific Disaster Center, and Tavida Kamolvej, University of Pittsburgh, USA. 2006

To illustrate how this element works in disaster and emergency management, I use the concept of operations for the National Disaster Warning Center that was developed and implemented in Thailand after the tsunami disaster. Figure 7.1 shows how intergovernmental, information and public networks were integrated into the disaster warning system. What is most apparent is how the system utilizes communication and information technology to connect multiple networks together so that disaster warnings and information are better channeled and disseminated throughout Thailand.

7.2.1 Intergovernmental Coordination: Scalable Agency Management

As Figure 7.1 demonstrates, the National Disaster Warning Center (NDWC) receives its information from intergovernmental networks, international information providers and the general public. Under order of the Prime Minister's Office, November 2005, the NDWC is authorized to disseminate tsunami warning messages, for example the potential that a tsunami will be generated after an earthquake, to governmental emergency response agencies and the general public. The order requires all other agencies with emergency expertise to provide knowledge, information, analyses and technology to the NDWC if requested. Any conflict that might occur between or among the parties will be resolved by the Office of the Prime Minister. This official order supports emergency response coordination through a lateral line of authority.

Using the automated data integration and analysis from a decision support system about potential tsunami generation, analysts at NDWC will make decision whether or not, and at what level of alert, state of emergency occurs and is needed to be warned. Once a decision is made by the experts that state of emergency is at a high risk, the executive director of NDWC authorizes the dissemination of a warning message to the requisite governmental agencies. These agencies include high level decision-makers within the national government, middle level of managers within the provincial governments, and operational actors that reside at the local level, often the frontline of any given emergency. All levels of emergency response will prepare and mobilize their resources according to the emergency management laws and regulations. In addition, the military, police, coast guard and Civil Defense Volunteer Units receive the NDWC warning and will coordinate with provincial and local jurisdictions to assist with the process of evacuation. After the NDWC ensures the safety of the situation, a message of cancellation of evacuation will be disseminated through governmental agencies, emergency personnel and the general public.

Depending upon where the epicenter of an earthquake is located, Thailand could only have between forty-five and ninety minutes of response time before a tsunami strikes its coast. Because the potential area of tsunami impact covers six coastal provinces, the intergovernmental effort in delivering an informative warning message must be prompt and well distributed in order to be effective. Retrieving, analyzing and disseminating information for disaster warning requires effective and efficient information sharing and communication networks. In addition, this study emphasizes the importance of communication feedback, represented in Figure 7.1 by the dotted lines. Feed back ensures that both emergency personnel and the general public are informed about the status of the emergency by allowing the constant dissemination of situational updates, reports of change, and requests for critical information.

7.2.2 Information and Communication Management

Within this system, information and data are retrieved from various domestic and international sources, integrated, recorded, processed, and analyzed by both an automated decision support system and experts on duty. The automation of data feed and electronic bulletins are designed to reduce the time it takes to generate the analysis and reports that experts need to make decisions. Once a decision to disseminate a warning message is made, it is distributed via facsimiles, cell phone text messages, emails, television broadcasting, radio transmissions, and phone lines to the governmental decision makers, emergency response agencies, and the general public. As of February 2006, 36 out of 72 warning towers within Thailand can be automatically activated from the NDWC. Once activated, the alarm disseminates warning messages in five different languages through broadcast equipment installed at these towers. This automated warning system provides information to local residents, as well as tourists, of the danger and the need to immediately start the process of evacuating coastal areas.

Another interesting communication channel is the process that is used to disseminate warning messages throughout local communities and villages. From field research and interviews, I found the use of "megaphones" within some villages. The megaphone functions as a radio station for the communities, and is utilized to communicate news and weather updates for the local residents, especially fishermen. This communication channel is crucial, not only because it is used to facilitate information among the locals in their native language, but also because it the channel is operated by a local resident who is often a trusted community representative. The fact that a trusted community representative disseminates information and warning messages increases cooperation between the community residents and governmental emergency response agencies. It also increases the strength of intergovernmental emergency response networks by enhancing the ability of a community to prepare for and confront the consequences of disasters. The local actor is a critical element in the construction of resilient communities.

7.2.3 Community Network: Resilient Community

The findings from this study revealed that local communities maintain strong communication and relationship networks. The trust that exists within local communities can assist governmental agencies disseminate warning messages, and can also serve as a basis for action in response to these warnings. As such, local communities are critical to the emergency response system. They possess specific knowledge of nature of disaster and risks being confronted. Often times, local communities can detect environmental abnormalities and changes just as fast as high technology equipment. They can quickly disseminate information through amateur radio networks and hotlines.

Building upon the strength of the local communities, the NDWC should create a local emergency agency and direct experts to collect the information informed generated and disseminated by the general public for the national information system. It is necessary to have the Department of Mineral Resource, the Department of Disaster Prevention and Mitigation and the various provincial governments work with local communities to develop evacuation routes, building codes, warning processes, procedures for resource allocation, and methods of communication and feedback. By including the knowledge and information maintained by local communities and actors, Thailand’s emergency response system would be better positioned to coordinate large scale operations, such as tsunami evacuations, across multiple jurisdictions.

While local residents provide knowledge and information that can assist governmental agencies disseminate accurate warning messages, the emergency agencies and expert organizations need to make knowledge and information available to the public. The more information that local communities have about disasters and emergencies, the higher their level of readiness when they are confronted by such events. Drills also help emergency agencies and local communities coordinate and understand emergency response and operations in practice. If steps are taken to improve the relationships, trust and information processes within Thailand's emergency response system, governmental and nongovernmental emergency response organizations will develop the tools they need to better coordinate and respond to the unanticipated problems that develop within the complex non-linear environment presented by natural disasters. Such coordination, however, requires an environment that encourages both organizational learning and adaptability.

7.2.4 Self-Learning: Adaptive Capability Building

The complex adaptive system (CAS) model recognizes that social systems engage in continuous learning and self organization in reciprocal interactions with the environment in which they are embedded (Comfort, 2000). As discussed previously, both emergency personnel and communities need to develop their adaptive capacity in order to deal with emergencies, disasters, as well as the unexpected consequences. Fortunately, the tsunami disaster, the frequent of flash flood and landslides throughout the country, and the recent deaths of emergency personnel in Bangkok has helped to develop an awareness of risk posed by natural disaster. Additionally, while these events revealed that Thailand lacked experience in effective emergency response management, the events have spawned a willingness to accept change, an interest in learning about the unknown, and most importantly, an increased interest in developing improved emergency response institutions and processes throughout the country.

The findings show that tsunami devastation and damage were the result of more than a simple failure to warn the public. There existed significant gaps between knowledge and information shared between experts. The Department of Mineral Resources had the knowledge that tsunami could be caused by underwater earthquake, but the Department of Meteorology owned the seismic equipment that operated around Thailand. It is clear that the two departments need to exchange information about their operations and share knowledge and data to enhance the capabilities of the disaster warning system for its effective implementation.

As Thailand's national center, the NDWC is the focal point of information that connects both domestic and international actors. The agency collects, analyzes and assesses information, disseminate warnings, and assists in the critical process of mobilizing emergency response activities. This agency can bridge the knowledge and information gaps that existed during the tsunami crisis. To do so, the NDWC needs to train its in-house experts and staff to analyze data and information received from multiple sources, as well as how to make decisions about whether to disseminate a warning. More importantly, the NDWC must also be prepared to expand its capacities so it can respond to multiple hazards, not only in terms of issuing warnings, but also coordinating and supporting the emergency response.

7.3 THE INTEGRATION IN EMERGENCY RESPONSE MANAGEMENT

The concept of integrating intergovernmental coordination and information management can be applied to the processes of emergency response. Using the latest tsunami response as a simulation of this integration system, given the situation that a potential of tsunami generating is confirmed and a warning message is already disseminated to general public, we can learn how the scenario should have been managed. Later, I will explore what would happen if a large scale emergency occurs in the Bangkok metropolitan area and a commander in chief at the emergency response command center requested assistance from emergency response agencies across jurisdictions.

7.3.1 Intergovernmental Coordination: Scalable Agency Management

The Ministers of national governmental agencies, the Governors of affected provinces, the Director Generals of participating agencies and Supreme Commanders of the Military get the information the same time as the governors and all emergency response personnel. The Minister of Interior can activate the National Command Center in case the scale of disaster is larger than provincial command centers can manage. Provincial governors start forming the command center with provincial Disaster Prevention and Mitigation personnel. The provincial command center personnel make all contacts to have all agencies in position as assigned in the drill manual. The sirens at the towers go off simultaneously along a coastal area with the relay time of satellite communication up to 2 minutes.

Provincial and local enforcement together with provincial DPM and Civil Defense Volunteer Units start evacuating the local residents and manage traffic through a planned evacuation map. Provincial governors are the commanders in chief of their provinces. Each province is divided by geography into municipalities that have designated personnel responsible by council or administrative law for initiating emergency response operations in their specific areas. Villages and communities are guided to move to safe places by the Civil Defense Volunteer Units, local police, local military, provincial DPM and the assistance of the leaders of such villages or communities. These leaders know not only the numbers and identification of the community residents, but also the scale of geographical area that can expedite the evacuation. Another team of police and military is in assigned positions to secure the safety of property from theft and other incidents so that the local residents evacuate willingly and will return upon the official cancellation of the state of emergency from the National Disaster Warning Center.

For other emergency agencies, there is a need for preparation and activation of a redundant emergency response as a back-up plan to assist provincial emergency response and personnel. BMA mobilizes an emergency response unit at CERD on stand-by alert to provide support, if requested. Air Force and Navy mobilize their transportation units and equipment to transport assistances and supplies. Local Army and Regional Center of Disaster Prevention and Mitigation begin to mobilize resources and relocate equipment, if necessary. All supervisors in each geographical area are authorized to take action and make decisions on upcoming problems and requests for assistance. Shelters as assigned in evacuation map are activated and receive evacuees until a safety message and cancellation of the emergency are disseminated.

In case of a large emergency in the Bangkok metropolitan area, as discussed of the assistances requested, collaboration between the BMA and DDPM (?) agencies should be two way in practice. BMA, with the governor or district deputy as a commander in chief is able to authorize a request of support and assistance from nearby DDPM personnel. There are five provinces in the Bangkok vicinity from whom BMA can request assistance in emergency situations. The central regional DPM center is located in PathumThani, vicinity province. Provincial governors and directors of provincial DPM and regional DPM centers should be authorized to mobilize resources and personnel to assist BMA emergency operations.

7.3.2 Information and Communication Management

The findings from this study show that scalable information sharing and communication management work effectively in emergency response. Municipality and provincial personnel keep in touch through their emergency radio network of DDPM frequency. Communication personnel keep updating and relaying information to the superiors and ministries in Bangkok. Emergency personnel frequently identify facsimiles and landline telephone as their critical communication channels. These channels are familiar and reliable in delivering detailed information and provide continuity of contact. Cell-phones and VHF radio networks are the most convenient types of equipment used in communication among agencies. There is a need to limit cell-phone use for the general public in states of emergency. Each call should be made only upon extreme necessity because such a network needs to maintain availability for emergency connections.

Based on lessons learned from the tsunami devastation, I recommend having representatives of each emergency agency sit in the command center communication room and function as focal point of contact. in case of communication failures due to the destruction of electrical and/or telecommunication infrastructures or overloaded emergency radio network, A continual feedback loop of communications activated during disaster operations among local, provincial and national agencies keeps all parties informed and enables them to react effectively. In the best scenario, an emergency frequency network is activated with sufficient availability for emergency personnel and participating agencies to communicate. Emergency communication via satellite phone should be made available for connections among headquarters and central offices to local agencies and centers. Updated situation reports and information needed for emergency response needs to be shared through the communication network so that all agencies can function effectively.

Lastly, the findings show that the Department of Disaster Prevention and Mitigation database is available, yet the processes of information sharing and accessibility have not been effectively implemented. The intra-network of DDPM is operated separately by each section, while the inter-network that links DDPM headquarters to the regional and provincial offices is not fully operational. DDPM provincial offices only updated daily reports to the disaster command center at headquarters. The systems lack a feedback loop of information. Since DDPM is the major emergency agency that has a network around the country, the information in the internal and external systems is critical for instruction of disaster prevention and mitigation tasks and public education. Internal information regarding resources, facilities, evacuation maps, statistical data, and disaster knowledge need to be made available and accessible to all emergency personnel. Knowledge required for the public to learn about disaster management should also be made widely accessible for public through internet or traditional means such as manuals. This sharing of knowledge and information will enable the DDPM agency, other emergency agencies and public to build a common understanding of disaster management. It also creates an environment for self-organization and good relationships among all parties.

7.3.3 Community Network: Resilient Communities

Communities and villages operate in the frontline of emergency response.. Their personnel are closer to events that may occur and know how to access the area more effectively. If local personnel are educated about disaster risk in their communities, it is in their best interest to interpret the situation accurately so they can react appropriately to save lives. Although it differs from Bangkok to other provinces, the involvement of local communities in public activities is crucial. In Bangkok, representatives of each district have a regular meeting with district officers and participate in the districts' public activities such as career week, school networking and community welfare on regular basis. In the southern provinces, representatives of the villages and communities participate more frequently in public activities with municipalities and sub-districts than with the provinces. However, after the 2004 tsunami, local residents are willing to participate in drills and training programs provided by provinces and other emergency agencies. Drills are the most useful tool to educate the public regarding the requirements of emergency response. The six provinces' interagency drill brings a new perspective to the national government. In a large scale emergency, effective coordination across jurisdictions and cooperation from local residents are essential..

Civil Defense Volunteer Units are volunteers from the local communities who participate in emergency operations. The CDVU are local representatives who are trained and have moderate levels of skill and knowledge to operate under states of emergency. The CDVU has also worked closely with local emergency personnel to build good relationships and trust between them in emergency operations. This unit can also reach out to the community to inform residents of emergency operations, rules, directions, procedures and shelters. The degree of understanding between the local residents and agencies increases the degree of effective cooperation and coordination. Redundancy in search and rescue operations is reduced by the presence of community representatives in the Emergency Operations Center and by updates from them regarding the emergency situation. In turn, public agencies and CDVU can train local personnel and provide information about disaster risk and how to cope with emergency situations to communities. Familiarity and trust among information providers and receivers increase the level of acceptance of warnings regarding risk and willingness to follow safety instructions. The communities learn to adapt to emergencies as well as to cooperate with public agencies.

Social networks serve as the means to integrate local citizens' groups into an organizational framework to work together with the government agencies to reduce risk and manage emergencies. Local communities have knowledge of their area and people. This familiarity of location and resources becomes crucial when the authorities and participating agencies are unable to access this potential. This study suggests the process of enlisting community representatives to work together with public agencies from the very first step of emergency management as in the disaster warning and preparation processes discussed earlier. It allows local representatives to share their specific knowledge of the area as well as understand the developing response process. This exchange of knowledge facilitates the implementation of the emergency operations.

7.3.4 Self-Learning: Adaptive Capability Building

The effective and efficient integration of all networks to function systematically and cooperatively in emergency response requires a certain level of adaptive capacities and a self-learning environment. Information communication technologies need to be created friendly to the users. Emergency response manuals, evacuation maps, directions, and signs on the beach need to be made available with easy access and in a format that is simple to understand and follow. The knowledge and information need to be transmitted to emergency agencies and general public in such ways that they can comprehensively understand and implement. This process also requires emergency personnel and local communities to learn and adapt through change.

Community outreach programs conducted by Thai Royal Navy, the Department of Disaster Prevention and Mitigation, and the provincial government educate local residents about disaster risk and survival skills. Emergency personnel also learn from the communities how to manage systematically in evacuation and emergency response. Through these programs, multiple emergency agencies create relationships and better understanding about their operations by exchanging information. The Department of Mineral Resources and the National Disaster Warning Center provide a toolkit and pocket books to schools to educate the children of such danger. In turn, these children learn and share their lessons with other members of their families, which spread knowledge and understanding of risks.

Drills help all parties to practice for emergency response. The language used in a warning message needs alteration to be simply interpreted by local residents without ambiguity. The volume of the sirens and broadcasts needs to be calculated against the degree of wind speed and noise caused by incidents that may disturb communication. Evacuation may cause accidents and injuries. Medical care units need to locate at critical points in the closest safety area and at the shelters. Hotels need to distribute manuals for how to differentiate warning signs and sirens for fire and tsunami, because the two types of disaster require different types of evacuation. In a fire incident, emergency personnel would evacuate people horizontally out of the building, while tsunami response suggests moving people up to a higher ground. Security teams of police and military need to be trained to secure property at the border of inundation and safety area. The teams need to be ale to function and make decisions in situations that threaten their lives and safety. The existence of an effective warning system does not eliminate disasters. Effective emergency response by each individual emergency responder and cooperative operations among agencies to manage the situation and return to normal are needed. Each individual still has the possibility of coping with unexpected consequences. At some level, they need to be able to adapt and help themselves and each other before assistance arrives. This is why self-learning and adaptive capabilities are crucial to emergency response and management.

7.4 FUTURE STUDY AND LIMITATIONS

7.4.1 Future Study

While conducting the content analysis and data-entry, I used a chaos code to identify the characteristics of each interaction or transaction between inter-organizational activities. With this chaos code, further analysis on functional interaction network can be effectively studied. A chaos code will be useful in conducting a functional analysis of emergency response operations. As discussed earlier, the emergency response network that developed in response to the 2004 tsunami in Thailand demonstrates a functional network. Chaos codes will help identify each functional network as well as to analyze how to mobilize resources in each network and how to coordinate among them more comprehensively.

I was also able to obtain the strength of each tie in the interactions between multiple organizations. The strength of tie is a numeric indicator of how many times each organization interacts with another. It can be used to identify the degree of relationships among organizations that operate in emergency response and to construct the core network for response, as well as an alternative network for activating a back-up plan.

I also collected data on the level of jurisdiction and source of funding for organizations participating in emergency response that can be used in multiple mode network analysis. This analysis is based on a nested case study of Thailand's emergency response network. With multiple mode analysis, instead of only reporting and identifying the number of organizations in each jurisdiction by source of funding, an emergency response network can be identified and analyzed separately by jurisdiction and source of funding. With such results, scalable emergency management can be studied more comprehensively to understand where bottlenecks exist and what critical paths may be used to mobilize resources more efficiently and prevent discontinuity.

Lastly, this study has focused on two perspectives of analyses; 1) macro: national-provincial-local emergency response performed by DDPM, and 2) Micro: provincial-local emergency response performed by BMA. There are 75 other provinces under the national emergency response system that can be examined. Specific characteristics regarding the nature of emergency and culture of emergency personnel may result in identifying significant differences and factors that affect their performance.

7.4.2 Limitation of the study

Studying complex systems such as Thailand's emergency response system is not without its difficulties. No matter how meticulous the methodology and analysis might be, there is arguably always room for improvement. As such, there are three specific limitations to this study that are worthy of further discussion: the scope of the study; the nature of the data collection; and the reliability and validity of the data.

7.4.2.1 Scope of the Study

Studying Thailand's emergency response system in its entirety would be a difficult and time consuming process. This study is limited by focusing on the in-depth field study of only three provinces, Phuket, PhangNga, and Bangkok, with an additional documentation and brief field study of another province, Krabi. Even with limiting the study to this small number of provinces, data collection, data entry and data verification took over 8 months to complete. The analyses of this data consumed an additional 4 months. There remains an additional 75 provinces within Thailand that could be the subject of investigation. Such an investigation, especially a quantitative investigation into the specific characteristics of emergency and emergency personnel, may provide a more comprehensive analysis of emergency response activities within Thailand. The ability to complete a more through study, however, is contingent on acquiring additional resources, specifically time and money.

7.4.2.2 Nature of the Data Collection

A significant section of data utilized by this study was derived from a content analysis of newspaper articles. This process of data collection is limited by the amount of information that is available from a single source, and most importantly, whether the information contained within that source is related to the research questions. As such, content analysis must be carefully performed by a well-trained and patient researcher. While cross-checking between sources was performed to obtain a higher accuracy and improved access to information, it is recognized that this process may have resulted in the duplication of information within the database.

7.4.2.3 Data Reliability and Validity

The findings of this study indicate that culture plays the most significant role in emergency response and management. While this study clearly identified the role of culture, it did not attempt to delve into or dissect the concept in any meaningful manner. The obvious problem with the concept of culture is that it is difficult to define, let alone measure and compare, especially across geographic regions in a country as diverse as Thailand. To this end, additional research is needed to understand the specific role that culture plays within Thailand's emergency response system. As discussed in chapter three, there are critical issues of measurement reliability and validity that must be taken into consideration when attempting to measure a concept as complex as culture.

7.5 CONCLUSION

The analysis and findings presented throughout this study demonstrates the significant need to integrate intergovernmental coordination, which requires collaboration among emergency agencies through a systematic scalable agency management, and information sharing through communication management. Such integration will enable multiple agencies to perform multiple tasks simultaneously, while allowing the agencies to stay connected and abreast of all situational changes. To strengthen their individual and cooperative capabilities to manage crises and emergency response capabilities, emergency agencies need a moderate to high level of technical infrastructure, organizational flexibility and cultural openness Effective interagency emergency response, however, must also take into account the need for multi-jurisdictional cooperation among all actors, whether they are governmental or non-governmental. A self-adaptive system will be managed from the top by national agencies through the operational level of local level actors and communities.

At the core of this self-adaptive emergency response system are the local actors and communities that feel the impact of any given disaster. Local actors are closer and more familiar to the area under stress, which makes their reaction to the situation critical to mitigation if they are informed and trained to perform basic steps of emergency response effectively. The knowledge and cooperation of these actors also helps to facilitate effective emergency operations. The effective development of understanding and trust between local communities and emergency agencies can work to eliminate risk in two ways. First, communities that learn to understand risks and cope with emergency can better adapt to situations that might cause a dramatic change to their lifestyle. This process strengthens the fundamental concept of resilient communities, which is argued, is the best manner to prevent the potential for disaster and massive crisis in local communities. Second, emergency personnel that understand local dynamics can better deliver emergency response activities in time of crisis. Both of these situations initiate a feedback loop of information that assists local communities operating under stress, as well as the emergency agencies providing relief.

An effective emergency response system requires two important elements. The first element is the development of a single emergency response network. The technical infrastructure, communication networks and organizational emergency structures must be designed to ensure that operations are properly assigned and managed. The second element consists of actors who are capable of learning and adapting under stressful environments. Emergency personnel must be able to use their equipment and resources while sharing information with local officials and communities. An organizational design that contains these two elements will provide the system with the flexibility to survive the shock created by an unforeseen disaster. This flexibility will enable the system and its actors to adapt and respond to the emergency before the full-scale emergency response assistance arrives.

To be effective, the individuals and organizations that operate within an emergency response system must have the ability to learn, cooperate and adapt. The ability to learn supports the management and coordination of operations under the time constraints and life threatening circumstances presented by disasters and complex emergencies. The ability to cooperate though the sharing of information and knowledge assists with building and reinforcing of mutual understanding between the actors within the emergency response system. The ability to adapt strengthens the emergency response network as a whole so that governmental agencies and local communities can better confront the complex problems that arise during extreme events. In such an environment, emergency response personnel will develop tools and techniques that will assist them to make informed policy decisions that affect the safety of the general public.

APPENDIX A

DATA COLLECTION PHASE III: SEMI-STRUCTURED INTERVIEW QUESTIONS

This interview is to explore how different levels of participating agencies contribute to emergency management and operations, and how information technology and communication systems are used in coordinating inter-agency operations and supporting their decision making under states of emergency.

All your response and personal information will be strictly confidential and will not be released to any party. The information obtained from the interview by tape-recorder for transcription will only be used for analyses of this research. The final report and results may be provided at your request.

1. How do you view states of emergency, and to what extent is your agency involved in emergency management and operation?

2. How would you describe the structure of your agency's legal responsibilities and operations in states of emergency?

3. How would you describe the effectiveness of your agency's performance and/or entire operations in managing emergency? (use cases)

4. How would you describe obstacles of your agency's performance in responding to extreme events? (use cases)

5. Are collaborations or coordination established vertically and/or laterally? In the other words, how would you explain the collaborations between your agency and the other agencies under the same and across jurisdictions?

6. How important is support from other agencies to meet your agency's needs? In what specific ways do you think your agency has collaborated or coordinated with other agencies?

7. What types of communication technology and management does your agency uses to facilitate information needed for operational procedure and decision making within your organization and among participating agencies? How effective and efficient do you think existing information and communication systems are?

8. How much do you think the information and knowledge sharing within your organization and among participating agencies help in decision making?

9. To what extent has increasing interactions, co-training, information and knowledge sharing, and communication contributed to your agency's performances to the entire emergency operation effectiveness? Why?

10. How would you compare your agency's emergency management and emergency response readiness before and after the nation-wide awareness of disaster and emergency management of December 26, 2004 tsunami.

APPENDIX B

DATA COLLECTION PHASE III: STRUCTURED SURVEY QUESTIONS

This survey is designed to explore how emergency response agencies understand their specific tasks and adaptive capacities under states of emergency. It seeks to document how core agencies operate their functions in intergovernmental network as well as how they facilitate their knowledge and information through inter-agency communication systems.

Please answer all questions corresponded with your belief, feeling, and practice as realistically as you can. Circle (o) or cross (x) the number which best response to your answer. All your answers and information are strictly confidential and will not be released to other parties. Thank you for your cooperation.

[Organizational Information]

1. In what organization you are working ……………………………………….…
   What is the main responsibility or task of your unit in emergency management and operations?
   1) Field Personnel (Emergency Operation Unit)
   2) Communications Function (Radio Unit)
   3) Coordination Center (Arrangement Unit)
   4) Auxiliary (Resource and Transportation Unit)
   5) Command (Administrative Unit)
   6) Others, please specify …………………………………………………..

2. In how many emergency incidents has your agency participated? Please indicate the number of times for each type of incident.

_____Flood ………. times

_____Fire ………. times

_____Earthquake ………. times

_____Building Collapse ………. times

_____Landslide ………. times

_____Massive Traffic Accident ………. times

_____Bio or Chemical Hazard ………. times

_____Animal Control ………. times

_____Terrorism ………. times

_____Others, please specify ……………………………………………..

3. Did your agency participate in emergency incidents listed below? Please check all possible answer(s) and indicate how long your agency had participated?

____December 26th 2004 Tsunami for _____________ (hours, days, weeks)

____Flood in Bangkok Metropolis for _____________ (hours, days, weeks)

____Massive accident in Bangkok for _____________ (hours, days, weeks)

***** For flood and massive accident in Bangkok, please indicate an average time your agency encounters emergency each time.*****

[Organizational Flexibility and Collaboration]

4. How would you describe the level of overall performance of your unit in managing emergency and crises?

Excellent	Very Good	Good	Fair	Poor
5	4	3	2	1

APPENDIX B, continued

5. To what extent do you think your unit is capable of confronting unexpected situations or sudden impacts?

Great extent	Moderate extent	Small extent	Not at all	NA.
5	4	3	2	1

6. How would you assess the organizational flexibility that your agency has to operate in emergency management, please rate according to the following characteristics?

Organizational Flexibility	**High**	**Med**	**Low**	**None**	**NA**
1. Existence of national law establishing legal authority for emergency response.					
2. Existence of special law or regulation indicating emergency response plan to be activated at local.					
3. Existence of emergency response plan that integrates capacity from several jurisdictional levels to meet the needs of assistance.					
4. Existence of emergency response plan that indicates the authorization of command center to coordinate resources from private and non governmental sectors.					
5. Existence of an inter-organizational, inter-jurisdictional knowledge base for emergency risk, response, and possible consequences for the **community.**					
6. Existence of an inter-organizational, inter-jurisdictional knowledge base for emergency risk, response, and possible consequences for the **participating agencies.**					
7. Existence of multi-way patterns of information exchange **between agencies and jurisdictions.**					
8. Existence of multi-way patterns of information exchange **across sectors**.					
9. Existence of trained, professional managers with the experience and authority to adapt existing administrative plans to the demand of the event.					
10. Existence of trained reserve personnel available on recall in emergency events.					

Indicators are modified from Shared Risk (Comfort, 1999)

7. With what other agencies did you interact in managing emergencies? Please order in terms of frequency of interaction, from 8=highest to 1=lowest.

_____National agencies

_____Provincial agency

_____Local agencies

_____NGO

_____Private emergency response units

_____Municipal or District volunteers

_____Locals

_____Others, please specify ……………………………………….

8. How frequently you communicate with other units or agencies in your operation?

Frequently	Occasionally	Unlikely	Not at all	NA.
5	4	3	2	1

9. How would you describe the dominant pattern of interaction between your agency and other agencies? Please order in terms of most frequent pattern? (6 is the most frequent)

____Persuasion

____Negotiation

____Assistance

____Command or Directing

____Routine (such as regular meeting, official documentation contact)

____NA.

____Others, please specify …………………………………………..

10. To what extent does your agency cooperate with, or coordinate its actions with other agencies?

Great extent	Moderate extent	Small extent	Not at all	NA.
5	4	3	2	1

11. How often does your agency have training exercise?

Frequently	Occasionally	Unlikely	Not at all	NA.
5	4	3	2	1

12. How often does your agency participate in training exercises with other agencies?

Monthly	Quarterly	Twice a year	Not at all	NA.
5	4	3	2	1

[Technical Infrastructure, Information Technology and Communication]

13. How would you assess the technical infrastructure and mechanisms that your agency has to support in emergency operations? Please rate according to the following characteristics?

Technical Structure	**High**	**Med**	**Low**	**None**	**NA**
1. Informed assessment of risks					
2. Building codes calibrated to risks					
3. Requirements for structural inspection prior to constructions of buildings, transportation					
4. Alternative communications capabilities					
5. Alternative electrical facilities and equipment					
6. Special Emergency Operations Centers and equipment for emergency response					
7. Identification of major facilities in community					
8. Alternative rescue or emergency response mechanisms					
9. Self technical manual procedure and equipment in community					
10. If others are available, please specify ………………………………………………… ……………………………………………					

Indicators are modified from Shared Risk (Comfort, 1999)

14. How frequently does your unit or agency use technical support and back up assistance from other agencies in managing your emergency operations?

Frequently	Occasionally	Unlikely	Not at all	NA.
5	4	3	2	1

15. In states of emergency, what kinds of communication mechanisms are available? Please rank in terms of frequency of use? (6 is the highest) If any of them is not available, please leave it blank.

_____Low Frequency Radio

_____Special High Frequency Radio

_____Cell phone

_____GPS and GIS

_____Satellite Real-time Monitoring

_____Others, please specify ………………………………………….

16. How would you describe the direction of the information flow in your agency?

All-Ways	Lateral	Bottom-up&Top-down	Bottom up	Top down	None
6	5	4	3	2	1

17. To what extent do you get the information you need within your agency?

Great extent	Moderate extent	Small extent	Not at all	NA.
5	4	3	2	1

18. In which circumstances your unit or agency most communicate most frequently with other units or agencies? Please rank from 1 to 6? (6 is the most frequent)

_____Emergency Field Operation

_____Resource Transfer

_____Regular Meeting

_____Personal Pleasure

_____Official Documents

_____Personnel Training

19. How often do you use the information provided to your agency to make decisions related to your work operations?

Frequently	Occasionally	Unlikely	Not at all	NA.
5	4	3	2	1

[Cultural Openness]

20. At what level in your agency or unit are decisions formally made?

1) Widely throughout organization or unit
2) Most decisions are made by particular groups at the operational level
3) Most decisions are made by chief of operation unit but under supervision
4) Most decisions are made by the middle management but under supervision
5) Most decisions are made by the top management
6) Others, please specify ______________________________________

21. To what extent do you think the regulations and procedures in which you have been trained help to accomplish the goals of emergency operations?

Great extent	Moderate extent	Small extent	Not at all	NA.
5	4	3	2	1

APPENDIX B, continued

22. How often do you estimate that you and/or your colleagues make contingent decisions under states of emergency?

Frequently	Occasionally	Unlikely	Not at all	NA.
5	4	3	2	1

23. To what extent do the participation and support from other organizations help to make more accurate decision related to your work?

Substantially	Moderately	Somewhat	Not at all	NA.
5	4	3	2	1

24. After the December 26, 2004 tsunami, how would you describe the perception of public to your organization and emergency management?

Highly favorable	Favorable	Neutral	Slightly unfavorable	Unfavorable
5	4	3	2	1

25. How would you assess the cultural openness that your agency has to operate in emergency management, please rate according to the following characteristics?

Cultural Openness	**High**	**Med**	**Low**	**None**	**NA**
1. Shared value regarding humanitarian assistance to those need.					
2. Commitment to goal of protecting life and property for all members of community.					
3. Willingness to share information needed					
4. Ready acceptance of new information from valid source					
5. Openness to new methods of working or acting with other organizations					
6. Willingness to review actions taken					
7. Willingness to correct mistakes discovered between organizational working groups.					
8. Willingness to accept responsibilities and solve conflicts					
9. Willingness to service public and build trust among agencies and citizen. (friendly and trust building program)					
10 Continual search for relevant, accurate, timely, information to protect community					

Indicators are modified from Shared Risk (Comfort, 1999)

APPENDIX B, continued

[Demographic Information]

26. Age: ___20-25 ___26-35 ___36-45 ___45-55 ___over 55

27. Gender: ___ male ___female

28. Position: ______________________________

29. Years of service: ___under 5 ___6-10 ___11-15 ___16-20 ___over 21

30. Type of your organization: ___national ___provincial ___local

Thank you for your cooperation

APPENDIX C

LEGEND FOR FIGURE 4.1

Interacting Organizations within the Thailand Emergency ResponseSystem, December 27, 2004 through January 17, 2005: Spell out the acronyms in full name of organizations

Acronym	**Organization**	**Acronym**	**Organization**
AC_Bank	Agricultural and Coop Bank	PVC	Phuket Vocational College
BIFIOC	Body Identification and Forensic Investigation Operations Center, Th	PVS	Phuket Vocational School
CAT	Communication Authority of Thailand	Ran_Hosp	Ranong Hospital
CCE	Committee of Compulsory Education, Th	Ran_Prov_FO	Ranong Provincial Fiscal Office
Chul_Univ	Chulalongkorn University	Ran_Prov_LR	Ranong Provincial Labor Relation
CMCU	Central Medical Care Unit, Th	RCCTEV	Relief Command Center of Tsunami and Earthquake Victims, Phuket
CND	Committee of National Disaster, Th	RPAB	Ranong Provincial Administration Board
CVRF	Committee of Victims Relief Fund, Th	Sat_Prov_FO	Satoon Provincial Fiscal Office
Dep_NRG	Department of Natural Resource and Geology, Th	Siri_Bank	Siriraj Hospital, Bangkok
Dep_Tax	Department of Tax Collection, Th	SP_Prov_ODC	Sra Buri Provincial Office of Disease Control
Dept_CE	Department of Civil Engineering, Th	ST_Hosp	Surath Thani Hospital
Dept_COR	Department of Correction, Th	Trang_Hosp	Trang Hospital
Dept_CRP	Department of Civil Right Protection, Th	Trang_Prov_FO	Trang Provincial Fiscal Office
Dept_Cust	Department of Custom, Th	BM_DO	Bang Muang District Office

APPENDIX C, continued			
Dept_DC	Department of Disease Control, Th	BSNP	Bun Sea National Park
Dept_DPM	Department of Disaster Prevention and Mitigation, Th	IVC	International Volunteer Center
Dept_Fish	Department of Fishery, Th	KK_SD_Admin	KeukKuk Sub-District Administration
Dept_GAO	Department of General Account Office, Th	KP_Hosp	Krabi Provincial Hospital
Dept_Geol	Department of Geology, Reg. 4 Office, Th	Krabi_Mun_DO	Krabi Municipality District Office
Dept_High	Department of Highway Transportation, Th	Kratu_DO	Kratu District Office
Dept_Ins	Department of Insurance, Th	LDPM_LU	Local Disaster Prevention and Mitigation, Loma Unit
Dept_LG	Department of Local Governance, Th	Loc_Schools	Local Schools
Dept_MA	Department of Medical Administration, Th	LP_Nak	Local Police, Nakornsrithammaraj
Dept_Met	Department of Meteorology, Th	LP_PN	Local Police, Phang Nga
Dept_MH	Department of Mental Health, Th	LP_PP_Isl	Local Police, PP Island, Krabi
Dept_UP	Department of Urban Planning, Th	NT_Mun	New-Thai Municipality
Dept_WT	Department of Water Transportation, Th	NTCVG	Nara Thiwat Citizen Volunteers Group
ERAT	Electricity Regional Authority of Thailand	NTPCP	Nara Thiwat Provincial Community Police
EXIM_Bank	EXIM Bank	PDO_Ed	Phuket District Office of Education
FIO_Thai	Forensic Investigation Office, NPD, Th	PMKKC	Pra Mong Kut Klao Camp
FSI	Forensic Science Institute, Th	PN_DO_Ed	Phang Nga District Office of Education
Gov_Thai	Government of Thailand	PT_Hosp	Pha Thong Hospital
IT_Bank	Islam-Thai Bank	Ran_DO_Ed	Ranong District Office of Education
KT_Bank	Krung Thai Bank	SPPol_Acad	Sam Pran Police Academy
Mil_Thai	Military of Thailand	SSR_Mun	Suk Sum Ran Municipality
Min_Ag_Thai	Ministry of Agriculture, Th	TGP_Hosp	Ta Gua Pa Hospital
Min_Cul_Thai	Ministry of Culture, Th	TGP_Mun_DO	Ta Gua Pa Municipality District Office
Min_Def_Thai	Ministry of Defense, Th	TGP_Mun_DO_RO	Registar Office of Ta Gua Pa Municipality District Office
Min_Ed_Thai	Ministry of Education, Th	TGP_Mun_FD	Ta Gua Pa Municipality Fishery Department

APPENDIX C, continued			
Min_Eng_Thai	Ministry of Energy, Th	TGP_Mun_HEC	Ta Gua Pa Municipality Hygienical Environment Control
Min_FA_Thai	Ministry of Foreign Affairs, Th	TGP_Mun_PHO	Public Health Office of Ta Gua Pa Municipality District
Min_Fin_Thai	Ministry of Finance, Th	TM_Mun_Do	Tai Mueng Municaipality District Office
Min_ICT_Thai	Ministry of Information and Communication Technology, Th	TVC	Thai Volunteer Center
Min_Ind_Thai	Ministry of Industry, Th	DTA	Domestic Travel Association, Th
Min_Int_Thai	Ministry of Interior, Th	InsAssoc	Insurance Association, Th
Min_Jus_Thai	Ministry of Justice, Th	NBAssoc	National Budhism Association of Thailand
Min_LR_Thai	Ministry of Labor Relation, Th	NRNA	News Reporter and Newspaper Association, Th
Min_NRE_Thai	Ministry of Natural Resource and Environment, Th	OHB	Office of Head of Budhism
Min_PubHth_Thai	Ministry of Public Health, Th	PCSS_Found	Pra Cha Sunti Suk Foundation
Min_SDHS_Thai	Ministry of Social Development and Human Stability, Th	POWLOLP	Private Organization of We Love Our Land and People
Min_Tour_Thai	Ministry of Tourism and Sport, Th	PPYY_Found	Peun Peng (Pa) Yam Yak Foundation
Min_Transp_Thai	Ministry of Transportation, Th	PT_Found	Portek Tung Foundation
Nat_Pol	National Police Department, Th	PUA	Private University Association
NMC	Narainthorn Medical Center	RCPCNK_Found	Raj Cha Pra Cha Nu Kroh Foundation
OCE	Office of Compulsory Education, Th	RK_Found	Ruam Katanyu Foundation
OCSC	Office of Civil Service Committee, Th	TBNOP	To Be Number One Program
Off_Crown	Office of the Crown	Thai_Bank_Assoc	Thai Bank Association
OLEF	Office of Loan for Education Fund, Th	Thai_RC	Thai Red Cross
Omms_Bank	Ommsin Bank	UNICEF_Th	UNICEF Thailand
OMW	Office of Ministers' Wives	CDPM	Center of Disaster Prevention and Mitigation, Phuket
ONHI	Office of National Health Insurance, Th	CLRSDI	Coast Line and Sea Resource Development Institute of Phuket
Pol_Acad	Police Academy	KTBA	Krabi Travel Business Association

APPENDIX C, continued			
Psy_Assoc	Psychiatrist Association, Th	PCC	Phuket Commerce Council
RS_Dept_PR	Radio Station of Department of Public Relation	SBU_RC	Supan Buri Unit of Red Cross
SDPMC	Songkla Disaster Prevention and Mitigation Center	TTBAP	Tourism and Travel Business Association of Phuket
SMEDT_Bank	Small and Medium Enterprise Development of Thailand Bank	BM_Temp	Bang Muang Temple
SMIL_Corp	Small and Medium Industrial Leasing Corp.	BMPG	Bang Muang Protest Group
SO_PM_Thai	Secretary Office of the Prime Minister, Th	BN_Temp	Bang Niang Temple
SRMU	Sena Ruk Military Unit	CKKF	Chumporn Karn Kusol Foundation
STDPMC	Surath Thani Disaster Prevention and Mitigation Center	KP_Temp	Kongka Pimuk Temple
STY_Hosp	Sri Tun Ya Hospital, Bangkok	LaKa_Temp	Lak Kaen Temple
Thai_AirForce	Thai Air Force	Nik_Temp	Nikorn Temple
Thai_Army	Thai Army	Samuk_Temp	Samukkee Temple
Thai_CoastGuard	Thai Coast Guard	Samuk_Tham_Temp	Samukkee Tham Temple
Thai_Mil_Bank	Thai Military Bank	Suw_Temp	Suwankiri Temple
Thai_Navy	Thai Royal Navy	YY_Temp	Yan Yao Temple
Thai_PA	Thailand Port of Authority	APFC_Ltd	Aisa Plus Finance Co., Ltd.
Tham_Univ	Thammasat University	Ban_Bank	Bangkok Bank
Tour_Th	Tourism Authority of Thailand	GMMM_Ltd	GMM Media Ltd.
TR_Emb	Thai Royal Embassy, DC.	GSC_Ltd	Grand Sport Co., Ltd.
Unit425	Unit 425 of Border Protection Police	KKT_Bank	Kasi Korn Thai Bank
BMA	Bangkok Metropolitan Authority	KSAY_Bank	Krung Sri Ayutha Ya Bank
CERD	Civil Emergency Relief Department, CERD	NKLT_Bank	Na Korn Luang Thai Bank
CKUFCI	Chomporn Ket Udonsak Fishery College Institution	Pet_Ltd	Petroleum (Thailand) Ltd.,Plc.
Dept_For	Department of Forest, Th	Prax_Ltd	PraxAir (Thailand) Co., Ltd.
HY_Hosp	Had Yai Hospital	RAEC_Ltd	Rome Apollo Electronics Co.,Ltd.
ILTCC	Immigration Labor Temporary Control Center, Ranong	SC_Bank	Siam Commercial Bank
KK_Univ	Kon Kaen University	SCNKT_Bank	Standard Charter-Na Korn Thon Bank

APPENDIX C, continued			
Kra_Hosp	Krabi Hospital	SET	SET Thailand
Krabi_Prov_FO	Krabi Provincial Fiscal Office	SLIC	Southern Local Insurance Center
Krabi_Prov_TCC	Krabi Provincial Travel Coordination Center	Thai_Bank	Thai Bank
Krabi_Prov_TWD	Krabi Provincial Transportation Way Department	TIAC_Ltd	Thai International Airways Co., Ltd.
LP_Phu	Local Police, Phuket	TNC_Bank	Tha Na Chart Bank
NST_Hosp	Nakorn Sri Thammaraj Hospital	TOT_Corp	Telephone Organization of Thailand Corporation
Ph_Prov_FO	Phuket Provincial Fiscal Office	TPI_Ltd	TPI Cement Plc., Ltd.
Ph_Prov_PHO	Phuket Provincial Public Health Office	TRN_Ltd	Thai Rath Newspaper Co., Ltd.
Phu_Hosp	Phuket Hospital	UOB	UOB Group
PN_Hosp	Phang Nga Hospital	VR_Ltd	Vergin Radio Ltd.
PN_Prov_FO	Phang Nga Provincial Fiacal Office	VR1_Ltd	V R 1 Radio Ltd.
PN_Prov_PHO	Phang Nga Provincial Public Health Office	CTC_Ltd	Cement Thai Co., Ltd.
PNNP	Phang Nga National Park	Krabi_FI	Krabi Financial Institution
PPHO	Provincial Public Health Office, Phuket	Naka_Hosp	Nakarintara Hospital, Nakornsrithammaraj
Prov_Gov_Ayu	Ayuthaya Provincial Government	PFI	Phuket Financial Institution
Prov_Gov_Krabi	Krabi Provincial Government	PN_FI	Phang Nga Financial Institution
Prov_Gov_Ph	Phuket Provincial Government	PPRC_Ltd	PP Princess Resort Co., Ltd.
Prov_Gov_PN	Phang Nga Provincial Government	PRC	Private Rescue Center
Prov_Gov_Ran	Ranong Provincial Government	Ran_FI	Ranong Financial Institution
Prov_Gov_Sat	Satoon Provincial Government	Sat_FI	Satoon Financial Institution
Prov_Gov_SB	Supan Buri Provincial Government	TFI	Trang Financial Institution
Prov_Gov_Trang	Trang Provincial Government		

APPENDIX D

COMBINED ORGANIZATIONS WITHIN THE THAILAND NETWORK

Organizations Originally Coded As				Organizations Originally Coded As			
Organization	**Acronym**	**Jurisdiction**	**Source of Funding**	**Organization**	**Acronym**	**Jurisdiction**	**Source of Funding**
Ban Koh PP School	BK_Sch	Public	Local	Local Schools	Loc_Schools	Public	Local
Ban Tub La Mu School	BTLU_Sch	Public	Local	Local Schools	Loc_Schools	Public	Local
Less Damaged School Center	LDSC	Public	Local	Local Schools	Loc_Schools	Public	Local
Most Damaged School Center	MDSC	Public	Local	Local Schools	Loc_Schools	Public	Local
Krabi District Office of Education	Krabi_DO_Ed	Public	Local	Local Schools	Loc_Schools	Public	Local
Ingka Yut Army Camp	IYAC	Public	Local	Military of Thailand	Mil_Thai	Public	National
Local Army, Krabi	LA_Krabi	Public	Provincial	Military of Thailand	Mil_Thai	Public	National
Local Army, Nakorn Sri Thammaraj	KA_NST	Public	Provincial	Military of Thailand	Mil_Thai	Public	National
Local Army, Nara Thiwat	LA_NT	Public	Provincial	Military of Thailand	Mil_Thai	Public	National
Local Army, Phang Nga	LA_PN	Public	Provincial	Military of Thailand	Mil_Thai	Public	National
Local Army, Phuket	LA_Phu	Public	Provincial	Military of Thailand	Mil_Thai	Public	National
Local Army, Songkla	LA_Song	Public	Provincial	Military of Thailand	Mil_Thai	Public	National
Thai Development Military Unit	TDMU	Public	National	Military of Thailand	Mil_Thai	Public	National
Thai Mechanical Military Unit	TMMU	Public	National	Military of Thailand	Mil_Thai	Public	National

APPENDIX D, continued							
Thai Supreme Commander of Military	TSCM	Public	National	Military of Thailand	Mil_Thai	Public	National
Department of Air-Medical Care, Air Force	Dept_AMC	Public	National	Military of Thailand	Mil_Thai	Public	National
Secretary Office of Princess Ploy Pilin	SO_PPP	Public	National	Office of the Crown	Off_Crown	Public	National
Secretary Office of Princess Siripa Jutaporn	SO_PSJ	Public	National	Office of the Crown	Off_Crown	Public	National
Secretary Office of the Crown Princess, Th	SO_CP	Public	National	Office of the Crown	Off_Crown	Public	National
Secretary Office of the Queen, Th	SO_Queen	Public	National	Office of the Crown	Off_Crown	Public	National
Secretary Office of the King, Th	SO_King	Public	National	Office of the Crown	Off_Crown	Public	National

APPENDIX E

CLIQUES IN THE THAILAND RESPONSE SYSTEM: 27 DECEMBER 2004 THROUGH 17 JANUARY 2005.

1:	Dept_DPM; Gov_Thai; Min_Cul_Thai; Min_Int_Thai
2:	CVRF; Gov_Thai; Min_Int_Thai
3:	CND; Gov_Thai; Min_Int_Thai
4:	Gov_Thai; Min_Fin_Thai; Min_Int_Thai; Min_SDHS_Thai
5:	Gov_Thai; Min_Int_Thai; Prov_Gov_Krabi; Prov_Gov_Ph
6:	Dept_Fish; Gov_Thai; Prov_Gov_Krabi
7:	Dept_WT; Gov_Thai; Thai_Army
8:	FIO_Thai; Gov_Thai; Min_PubHth_Thai
9:	FSI; Gov_Thai; Min_FA_Thai; Min_PubHth_Thai; Nat_Pol
10:	FSI; Gov_Thai; Min_Jus_Thai; Nat_Pol
11:	FSI; Gov_Thai; Min_NRE_Thai
12:	FSI; Gov_Thai; LP_PN
13:	FSI; Gov_Thai; PPYY_Found
14:	Gov_Thai; KT_Bank; Min_Fin_Thai
15:	Gov_Thai; KT_Bank; RCPCNK_Found
16:	Gov_Thai; Min_Ag_Thai; Prov_Gov_Sat
17:	Gov_Thai; Min_Def_Thai; Thai_AirForce; Thai_Navy

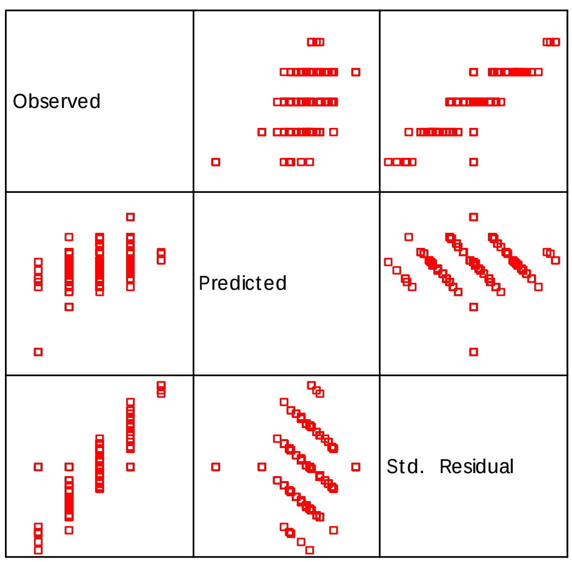
APPENDIX E, continued	
18:	Gov_Thai; Min_Def_Thai; Thai_Army; Thai_Navy
19:	Gov_Thai; Min_Def_Thai; Min_SDHS_Thai
20:	Gov_Thai; Min_Def_Thai; Min_PubHth_Thai
21:	Gov_Thai; Min_Ed_Thai; RK_Found
22:	Gov_Thai; Min_FA_Thai; Min_ICT_Thai; Nat_Pol
23:	Gov_Thai; Min_FA_Thai; TIAC_Ltd
24:	Gov_Thai; Min_ICT_Thai; Tham_Univ
25:	CND; Gov_Thai; Min_ICT_Thai
26:	CND; Gov_Thai; Min_NRE_Thai
27:	Gov_Thai; Min_NRE_Thai; TGP_Mun_DO
28:	CVRF; Gov_Thai; Min_PubHth_Thai
29:	Gov_Thai; Thai_AirForce; Prov_Gov_Ran
30:	Gov_Thai; Thai_Army; Thai_Navy; Prov_Gov_Krabi
31:	Gov_Thai; Thai_Army; Prov_Gov_Krabi; Prov_Gov_Ph
32:	Gov_Thai; Thai_Army; Prov_Gov_PN
33:	Gov_Thai; Thai_Army; Prov_Gov_Sat
34:	Dept_DPM; Gov_Thai; Thai_CoastGuard
35:	Gov_Thai; Thai_CoastGuard; Prov_Gov_Krabi
36:	CVRF; Gov_Thai; Thai_Navy
37:	Dept_DPM; Gov_Thai; Thai_Navy
38:	CVRF; Gov_Thai; Tour_Th
39:	Gov_Thai; Prov_Gov_PN; LP_PN
40:	Gov_Thai; Prov_Gov_PN; TGP_Mun_DO
41:	Dept_CE; Min_Int_Thai; Prov_Gov_Krabi
42:	Dept_GAO; Prov_Gov_Krabi; Prov_Gov_Ph
43:	Dept_UP; Min_Int_Thai; Prov_Gov_Krabi

APPENDIX E, continued	
44:	Mil_Thai; Min_Def_Thai; Thai_Army; Thai_Navy
45:	Mil_Thai; Thai_Army; Thai_Navy; Prov_Gov_Krabi
46:	Mil_Thai; Off_Crown; Thai_Army; Prov_Gov_PN
47:	Mil_Thai; Min_Int_Thai; Off_Crown
48:	Mil_Thai; Min_Int_Thai; Prov_Gov_Krabi
49:	FSI; Mil_Thai; Nat_Pol
50:	Mil_Thai; Min_Def_Thai; Thai_AirForce; Thai_Navy
51:	FSI; Mil_Thai; LP_PN
52:	Mil_Thai; Off_Crown; Prov_Gov_PN; LP_PN
53:	Mil_Thai; LP_PN; PRC
54:	Mil_Thai; Prov_Gov_Krabi; PRC
55:	Min_Int_Thai; Off_Crown; Prov_Gov_Ph
56:	Off_Crown; Thai_Army; Prov_Gov_Ph
57:	Min_Ed_Thai; Off_Crown; Loc_Schools
58:	Min_Int_Thai; Prov_Gov_Krabi; Prov_Gov_Ph; TBNOP
59:	FSI; LP_PN; BMPG

APPENDIX F

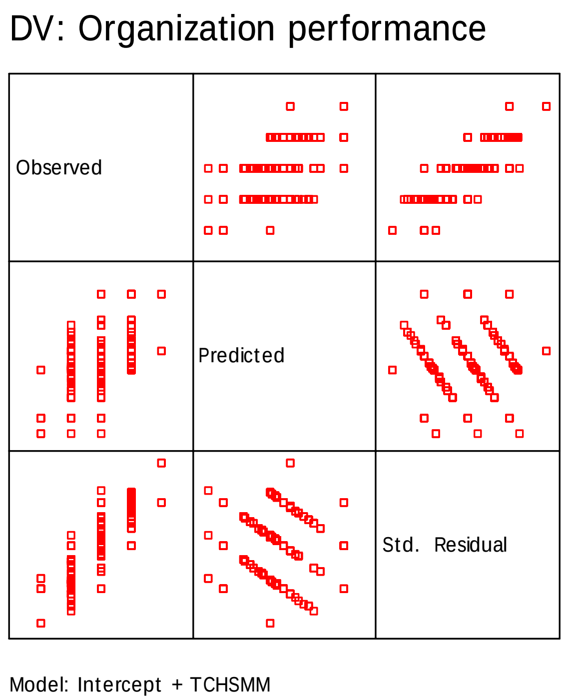
RESIDUAL PLOT OF DEPENDENT VARIABLES ORGANIZATIONAL PERFORMANCE & READINESS IN UNEXPECTED EVENTS

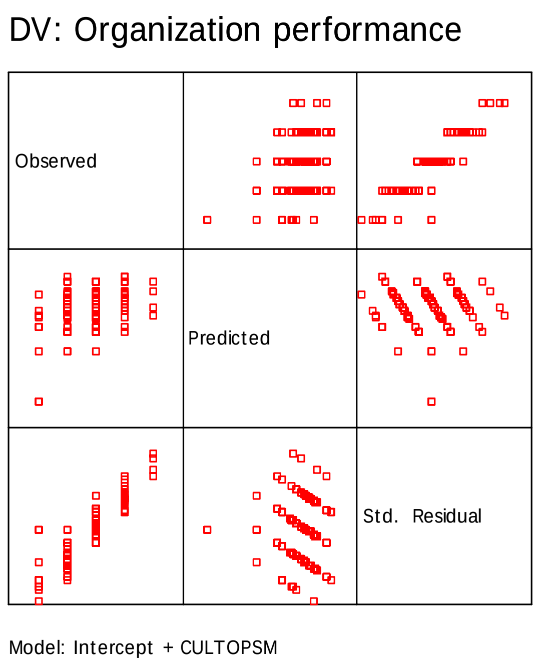
DV: Organization performance



Model: Intercept + ORGFLXSM

NOTE: ORGFLXSM: Organizational Flexibility, TCHSMM: Technical Infrastructure, CULTOPSM: Cultural Openness

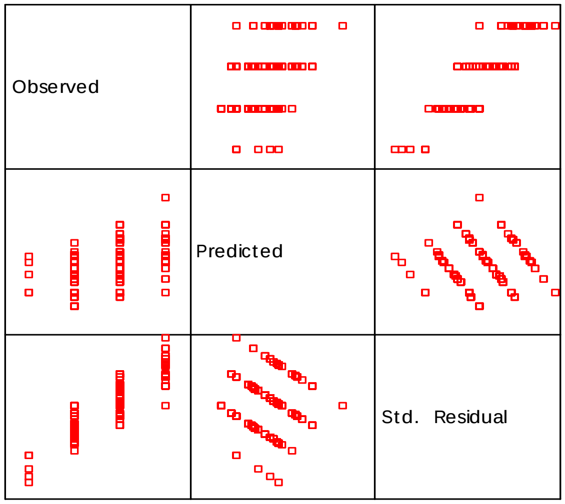




NOTE: ORGFLXSM: Organizational Flexibility, TCHSMM: Technical Infrastructure, CULTOPSM: Cultural Openness

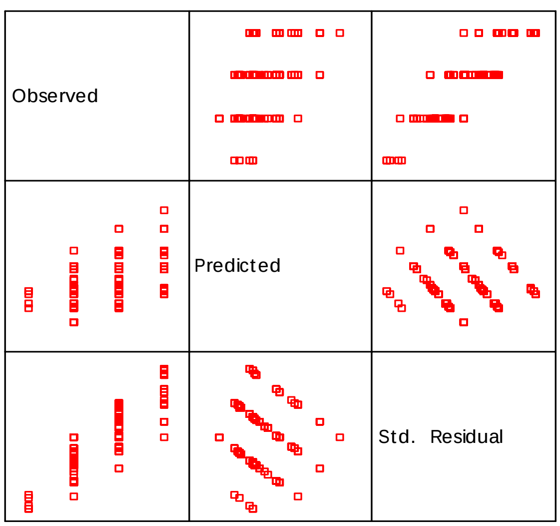
APPENDIX F, continue

DV: Organization unexpected event



Model: Intercept + ORGFLXSM

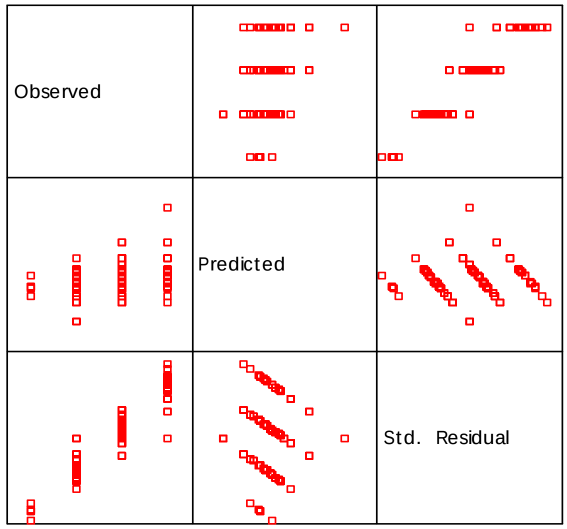
DV: Organization unexpected event



Model: Intercept + TCHSMM

NOTE: ORGFLXSM: Organizational Flexibility, TCHSMM: Technical Infrastructure, CULTOPSM: Cultural Openness

DV: Organization unexpected event



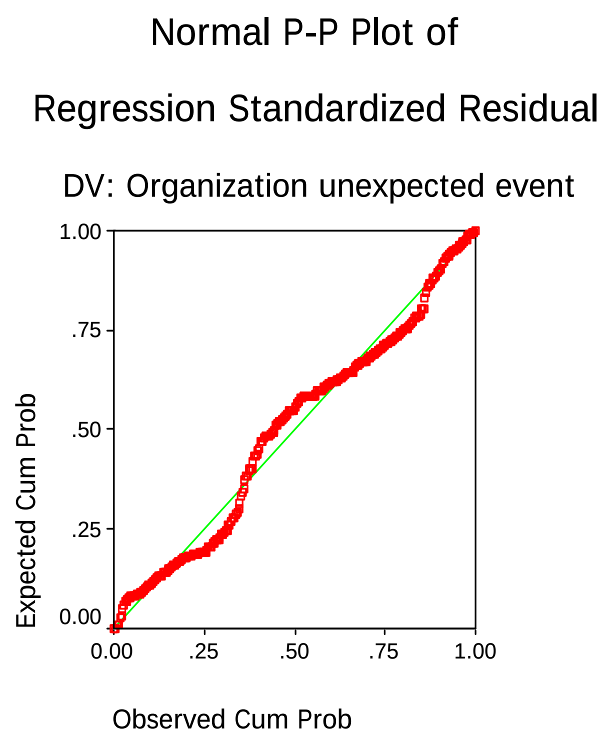
Model: Intercept + CULTOPSM

Source: Regression Analysis, Data from structural survey distributed to Thailand emergency personnel, dated July – August 2005

NOTE: ORGFLXSM: Organizational Flexibility, TCHSMM: Technical Infrastructure, CULTOPSM: Cultural Openness

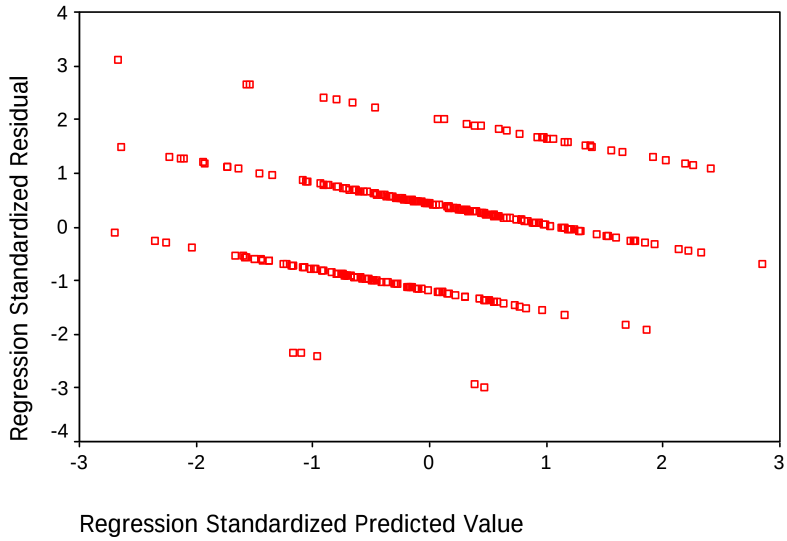
APPENDIX G

CHARTS OF REGRESSION STANDARDIZED RESIDUAL OF DEPENDENT VARIABLES: ORGANIZATIONAL PERFORMANCE AND ORGANIZATIONAL IN UNEXPECTED EVENTS



Scatterplot

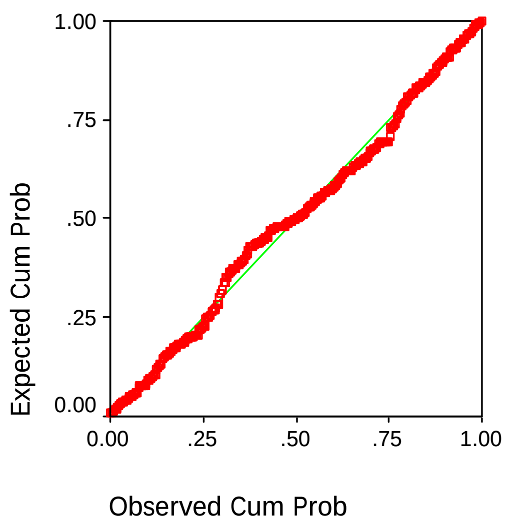
DV: Organization unexpected event

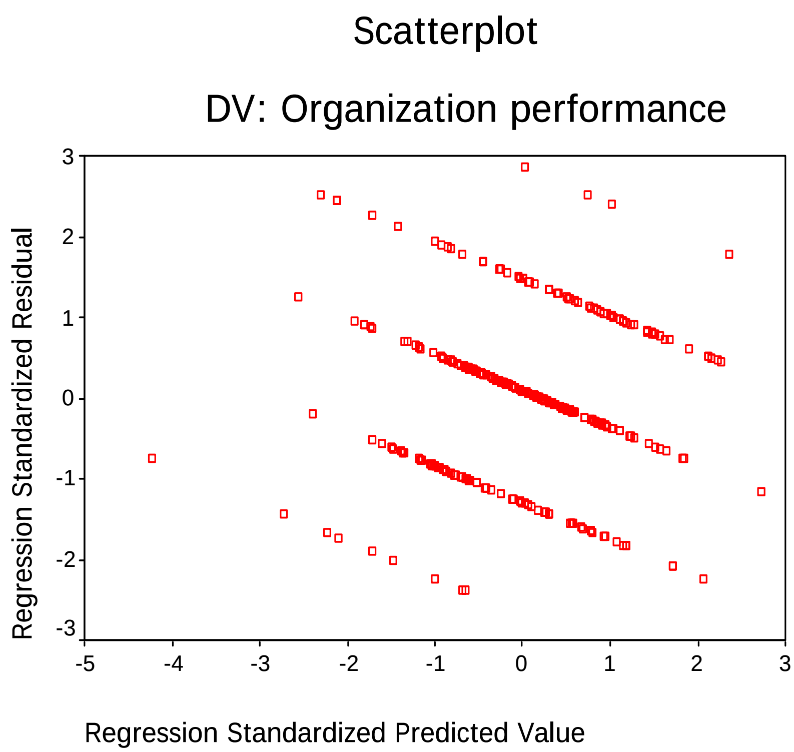


Normal P-P Plot of

Regression Standardized Residual

DV: Organization performance




Scatterplot
DV: Organization performance
Regression Standardized Residual
3
2
1
0
-1
-2
-3
-5
-4
-3
-2
-1
0
1
2
3
Regression Standardized Predicted Value

APPENDIX H

FREQUENCY DISTRIBUTION TABLE: THE EXTENT TO WHICH SOCIO-TECHNICAL ELEMENT EXISTS IN EMERGENCY MANAGEMENT SYSTEM

National emergency laws

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	13	3.7	4.0	4.0
	Low	69	19.6	21.2	25.2
	Medium	182	51.7	55.8	81.0
	High	62	17.6	19.0	100.0
	Total	326	92.6	100.0	
Missing	0	11	3.1		
	Not Applicable	15	4.3		
	Total	26	7.4		
Total		352	100.0		

Special emergency regulations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	5	1.4	1.5	1.5
	Low	81	23.0	24.2	25.7
	Medium	203	57.7	60.6	86.3
	High	46	13.1	13.7	100.0
	Total	335	95.2	100.0	
Missing	0	6	1.7		
	Not Applicable	11	3.1		
	Total	17	4.8		
Total		352	100.0		

APPENDIX H, continued

Emergency integrated response plans

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	4	1.1	1.2	1.2
	Low	62	17.6	18.3	19.5
	Medium	215	61.1	63.6	83.1
	High	57	16.2	16.9	100.0
	Total	338	96.0	100.0	
Missing	0	10	2.8		
	Not Applicable	4	1.1		
	Total	14	4.0		
Total		352	100.0		

Emergency commands and coordinations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	6	1.7	1.8	1.8
	Low	67	19.0	19.6	21.3
	Medium	216	61.4	63.2	84.5
	High	53	15.1	15.5	100.0
	Total	342	97.2	100.0	
Missing	0	9	2.6		
	Not Applicable	1	.3		
	Total	10	2.8		
Total		352	100.0		

Emergency interorganization for communities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	11	3.1	3.3	3.3
	Low	71	20.2	21.1	24.4
	Medium	198	56.3	58.9	83.3
	High	56	15.9	16.7	100.0
	Total	336	95.5	100.0	
Missing	0	9	2.6		
	Not Applicable	7	2.0		
	Total	16	4.5		
Total		352	100.0		

Emergency interorganization for agencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	7	2.0	2.1	2.1
	Low	91	25.9	26.8	28.9
	Medium	200	56.8	59.0	87.9
	High	41	11.6	12.1	100.0
	Total	339	96.3	100.0	
Missing	0	9	2.6		
	Not Applicable	4	1.1		
	Total	13	3.7		
Total		352	100.0		

Multi-ways of info exchange between agencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	12	3.4	3.6	3.6
	Low	102	29.0	30.2	33.7
	Medium	191	54.3	56.5	90.2
	High	33	9.4	9.8	100.0
	Total	338	96.0	100.0	
Missing	0	12	3.4		
	Not Applicable	2	.6		
	Total	14	4.0		
Total		352	100.0		

Multi-ways of info exchange across sectors

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	13	3.7	3.9	3.9
	Low	107	30.4	32.1	36.0
	Medium	184	52.3	55.3	91.3
	High	29	8.2	8.7	100.0
	Total	333	94.6	100.0	
Missing	0	10	2.8		
	Not Applicable	9	2.6		
	Total	19	5.4		
Total		352	100.0		

APPENDIX H, continued

Trained professional managers on duty

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	11	3.1	3.3	3.3
	Low	122	34.7	36.1	39.3
	Medium	173	49.1	51.2	90.5
	High	32	9.1	9.5	100.0
	Total	338	96.0	100.0	
Missing	0	11	3.1		
	Not Applicable	3	.9		
	Total	14	4.0		
Total		352	100.0		

Trained reserved personnel on recall

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	10	2.8	2.9	2.9
	Low	94	26.7	27.6	30.6
	Medium	183	52.0	53.8	84.4
	High	53	15.1	15.6	100.0
	Total	340	96.6	100.0	
Missing	0	9	2.6		
	Not Applicable	3	.9		
	Total	12	3.4		
Total		352	100.0		

Risk assessment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	6	1.7	1.8	1.8
	Low	76	21.6	22.9	24.7
	Medium	218	61.9	65.7	90.4
	High	32	9.1	9.6	100.0
	Total	332	94.3	100.0	
Missing	0	14	4.0		
	Not Applicable	6	1.7		
	Total	20	5.7		
Total		352	100.0		

APPENDIX H, continued

Building codes

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	34	9.7	10.6	10.6
	Low	107	30.4	33.2	43.8
	Medium	165	46.9	51.2	95.0
	High	16	4.5	5.0	100.0
	Total	322	91.5	100.0	
Missing	0	15	4.3		
	Not Applicable	15	4.3		
	Total	30	8.5		
Total		352	100.0		

Structural inspection

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	54	15.3	17.1	17.1
	Low	105	29.8	33.3	50.5
	Medium	130	36.9	41.3	91.7
	High	26	7.4	8.3	100.0
	Total	315	89.5	100.0	
Missing	0	16	4.5		
	Not Applicable	21	6.0		
	Total	37	10.5		
Total		352	100.0		

Alternative communication

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	19	5.4	5.9	5.9
	Low	92	26.1	28.4	34.3
	Medium	182	51.7	56.2	90.4
	High	31	8.8	9.6	100.0
	Total	324	92.0	100.0	
Missing	0	17	4.8		
	Not Applicable	11	3.1		
	Total	28	8.0		
Total		352	100.0		

APPENDIX H, continued

Alternative electrical facilities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	24	6.8	7.4	7.4
	Low	99	28.1	30.6	38.0
	Medium	163	46.3	50.3	88.3
	High	38	10.8	11.7	100.0
	Total	324	92.0	100.0	
Missing	0	15	4.3		
	Not Applicable	13	3.7		
	Total	28	8.0		
Total		352	100.0		

Special emergency operation and equipment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	13	3.7	4.1	4.1
	Low	96	27.3	30.1	34.2
	Medium	171	48.6	53.6	87.8
	High	39	11.1	12.2	100.0
	Total	319	90.6	100.0	
Missing	0	23	6.5		
	Not Applicable	10	2.8		
	Total	33	9.4		
Total		352	100.0		

Identification of major facilities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	13	3.7	4.0	4.0
	Low	78	22.2	23.7	27.7
	Medium	197	56.0	59.9	87.5
	High	41	11.6	12.5	100.0
	Total	329	93.5	100.0	
Missing	0	16	4.5		
	Not Applicable	7	2.0		
	Total	23	6.5		
Total		352	100.0		

Alternative rescue or emergency response

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	13	3.7	3.9	3.9
	Low	86	24.4	25.7	29.6
	Medium	188	53.4	56.3	85.9
	High	47	13.4	14.1	100.0
	Total	334	94.9	100.0	
Missing	0	13	3.7		
	Not Applicable	5	1.4		
	Total	18	5.1		
Total		352	100.0		

Self technical mannual procedure

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	30	8.5	9.1	9.1
	Low	107	30.4	32.3	41.4
	Medium	166	47.2	50.2	91.5
	High	28	8.0	8.5	100.0
	Total	331	94.0	100.0	
Missing	0	14	4.0		
	Not Applicable	7	2.0		
	Total	21	6.0		
Total		352	100.0		

Other technical support

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	9	2.6	10.0	10.0
	Low	33	9.4	36.7	46.7
	Medium	46	13.1	51.1	97.8
	High	2	.6	2.2	100.0
	Total	90	25.6	100.0	
Missing	0	244	69.3		
	Not Applicable	18	5.1		
	Total	262	74.4		
Total		352	100.0		

APPENDIX H, continued

Shared value of humanitarian assistance

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	3	.9	.9	.9
	Low	19	5.4	5.6	6.5
	Medium	158	44.9	46.9	53.4
	High	157	44.6	46.6	100.0
	Total	337	95.7	100.0	
Missing	0	14	4.0		
	Not Applicable	1	.3		
	Total	15	4.3		
Total		352	100.0		

Commitment to goal of protecting life

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	1	.3	.3	.3
	Low	24	6.8	7.1	7.4
	Medium	194	55.1	57.7	65.2
	High	117	33.2	34.8	100.0
	Total	336	95.5	100.0	
Missing	0	15	4.3		
	Not Applicable	1	.3		
	Total	16	4.5		
Total		352	100.0		

Willingness to share information needed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	1	.3	.3	.3
	Low	40	11.4	11.9	12.2
	Medium	198	56.3	59.1	71.3
	High	96	27.3	28.7	100.0
	Total	335	95.2	100.0	
Missing	0	16	4.5		
	Not Applicable	1	.3		
	Total	17	4.8		
Total		352	100.0		

Acceptance of new information

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	2	.6	.6	.6
	Low	28	8.0	8.4	9.0
	Medium	210	59.7	62.9	71.9
	High	94	26.7	28.1	100.0
	Total	334	94.9	100.0	
Missing	0	18	5.1		
Total		352	100.0		

Openness to new methods

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	5	1.4	1.5	1.5
	Low	51	14.5	15.1	16.6
	Medium	182	51.7	54.0	70.6
	High	99	28.1	29.4	100.0
	Total	337	95.7	100.0	
Missing	0	15	4.3		
Total		352	100.0		

Willingness to review actions taken

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	3	.9	.9	.9
	Low	47	13.4	13.9	14.7
	Medium	190	54.0	56.0	70.8
	High	99	28.1	29.2	100.0
	Total	339	96.3	100.0	
Missing	0	13	3.7		
Total		352	100.0		

APPENDIX H, continued

Willingness to correct mistakes

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	2	.6	.6	.6
	Low	46	13.1	13.8	14.4
	Medium	182	51.7	54.7	69.1
	High	103	29.3	30.9	100.0
	Total	333	94.6	100.0	
Missing	0	15	4.3		
	Not Applicable	4	1.1		
	Total	19	5.4		
Total		352	100.0		

Willingness to accept responsibility, solve conflicts

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	3	.9	.9	.9
	Low	47	13.4	14.2	15.2
	Medium	174	49.4	52.7	67.9
	High	106	30.1	32.1	100.0
	Total	330	93.8	100.0	
Missing	0	18	5.1		
	Not Applicable	4	1.1		
	Total	22	6.3		
Total		352	100.0		

Willingness to service public

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	1	.3	.3	.3
	Low	22	6.3	6.5	6.8
	Medium	168	47.7	50.0	56.8
	High	145	41.2	43.2	100.0
	Total	336	95.5	100.0	
Missing	0	15	4.3		
	Not Applicable	1	.3		
	Total	16	4.5		
Total		352	100.0		

Continual search for relevant, accurate info

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	3	.9	.9	.9
	Low	33	9.4	9.9	10.8
	4	1	.3	.3	11.1
	Medium	199	56.5	59.6	70.7
	High	98	27.8	29.3	100.0
	Total	334	94.9	100.0	
Missing	0	14	4.0		
	Not Applicable	4	1.1		
	Total	18	5.1		
Total		352	100.0		

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