BUILDING ORGANIZATIONAL RESILIENCE POTENTIAL:

AN ADAPTIVE STRATEGY FOR OPERATIONAL CONTINUITY IN CRISES

by

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ABSTRACT

There are questions as to whether a causal relationship exists between disaster planning and effective adaptive behaviors in crisis. Traditional planning has viewed the contingency plan as an outcome of a process to be utilized in a step-by-step fashion during a crisis. This dissertation challenges this orthodox view and suggests a new paradigm, one that focuses on creating organizational structures and processes that build organizational resilience potential. The purpose of this research is to theoretically and empirically connect the concept of high reliability organizational theory to a study of how one organized planning approach – continuity of operations planning – may help build latent resilience in organizations.

Several research questions reflect two empirical objectives of this dissertation. The descriptive objective is to characterize the prevalence of continuity of operations planning, as well as document the level of organizational resilience potential measured in a population of municipal organizations. The theoretical objective seeks to develop a scale to measure latent resilience in organizations and explore the relationship between six independent variables and measured organizational resilience potential. An Organizational Resilience Potential Scale (ORPS) was constructed based on the work of Larry Mallak, who tested several factors that measure dimensions of latent resilience in organizations. A questionnaire was mailed to a population of full-service, municipal public works departments in the southwest United States.

Scale Item Analysis verified that the ORPS contained statistically additive items, and a test-retest technique demonstrated its reliability. Pearson's product-moment

correlation coefficient and one-way analysis of variance (ANOVA) were used to examine the strength and direction of the bi-variate relationships posed in the research question. In addition, multiple regression analysis was used to examine the impact of all the independent variables acting upon ORPS scores. The results of these analyses support the relationships of three predictors to organizational resilience potential. While these findings cannot be generalized beyond this population, this exploratory and descriptive research begins to build a critical foundation of knowledge with which to consider whether a move toward a new paradigm in disaster planning – one based on building organizational resilience potential – should be the focus of future research.

DEDICATION

Although my name appears on the diploma, none of this would have been possible without the love and patience of my family. My wife Janell, son Tyler, and daughter Caitlin to whom this dissertation is dedicated, have been a constant source of love, support, and strength for these many years.

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Chapter 1 – Introduction

This dissertation seeks to investigate the variability of continuity of operations planning (COOP) among public works departments and to determine to what extent these organizations create resilient structures and processes that will allow for adaptive behaviors during crisis. There are two empirical thrusts in this study. The descriptive purpose is to document the prevalence of both COOP and resilience potential among public works departments. The theoretical objective seeks to measure the degree of correlation between five managerially influenced organizational variables and resilience potential. A standard questionnaire was determined to be the best method for collecting the data. The questionnaire was sent to directors of 142 municipal public works departments throughout the southwestern United States. Although there has been considerable discussion about protection of civil infrastructure, remarkably little academic attention has been focused on examining the preparedness of public works agencies (Brouillette, 1970).

The overall objective of this research is to expand our knowledge about developing latent resilience in organizations and examine whether or not COOP builds resilience potential. Building organizational resilience potential is offered as a new paradigm in disaster planning recommended practices, which has traditionally advocated the development of step-by-step plans to be utilized during crises. The theoretical foundation of this study is based on a subset of public institutional theory that attempts to explain why some highly complex organizations operate reliably even in unpredictable environments. From this perspective, a set of questions can be derived to explore whether

certain structural and organizational variables create high operational reliability for public agencies.

There are several policy issues relevant to this research: (1) In what ways should the improved understanding of what makes organizations more resilient improve the design and modification of disaster planning policies? (2) How should this improved understanding change the way public organizations are structured and operate? (3) In what ways should the improved understanding of what makes organizations more resilient affect recommended planning models and practices?

Background

When disaster strikes, municipal departments form the foundation of the local government response. These departments are expected to perform their essential functions in order to contribute productively to response and recovery efforts. Yet, local government agencies cannot serve their constituents and aid in local recovery efforts if they are pre-occupied with re-establishing their own critical organizational infrastructure after disaster. Viewed from an open systems perspective, disasters that negatively affect public organizations ultimately cascade through the community by way of disruptions that impact "the flow of goods and services, unemployment, business interruption, and declines in levels of economic activity and productivity" (Tierney, Lindell, & Perry, 2001, p. 6). Past research has alluded to the importance of local government organizations to social and economic systems (Bolin, 1990; Tierney, 1995, 1997; Ward, Morris, & Carlile, 1989) and documented the increase in demands for public services post-disaster (Alper & Kupferman, 2003; Brouillette, 1970; National Fire Protection Association, 1991). Thus, the resilience of public organizations and their ability to

maintain continuity of operations in disaster is critical to the health and welfare of the communities they serve.

Planning for providing services during and after a disaster is generally referred to as continuity of operations planning. Interest in such planning can be traced as far back as the 1950s. Although attention to such planning seemed to wane after the Cold War, the events of September 11, 2001 brought about renewed interest to how governments would continue their essential functions in the wake of a terrorist incident.

> Spurred in part by occasional warnings of potential terrorist threats in the post-9/11 era, some policymakers have intensified their focus on continuity of operations (COOP) issues. COOP planning is a segment of . . . government contingency planning linked to continuity of government (COG). Together, COOP and COG are designed to ensure survival of a constitutional form of government and the continuity of essential . . . functions. (Petersen, 2005, p. 1)

Disasters occur in many forms and may be categorized as political (e.g., terrorism or armed strife), economic-technical (e.g., building collapses, chemical spills), social (e.g., riots, violent labor strikes), and natural (e.g., earthquakes, hurricanes) (Kim & Lee, 2001). Such events can "scramble plans, interrupt continuities, and brutally paralyze normal government operations" (Farazmand, 2001, p. 3). Although much of the attention to COOP has been focused on preparedness for terrorism and WMD events, "operational activation of a COOP might also include routine building renovation or maintenance; mechanical failure of heating or other building systems; fire; and inclement weather or other acts of nature" (Petersen, 2003, p. 1). During the August 2003 power outage that affected much of the eastern United States and Canada, New York City struggled to

provide critical lifeline services to residents and businesses. Problems in maintaining these services were generally attributed to a lack of communication, inadequate redundancy of various essential systems, an inadequate cache of critical supplies, inability to mobilize essential personnel, inconsistent command and coordination among the various emergency operations centers, or a combination of these factors (Alper & Kupferman, 2003). A Mayor's task force formed to investigate New York City's response to the blackout concluded that city agencies must clearly identify their essential functions and provide plans for ensuring the continuity of those service (New York City Emergency Response Taskforce, 2003).

Federal Preparedness Circular-65 (FPC-65) recommends that all elements of a continuity plan be operational within 12 hours of activation, and that they be capable of providing sustained operations for up to 30 days (Federal Emergency Management Agency, 2004a). In addition to identifying the essential functions of an organization, elements of a complete COOP plan include establishing the concepts, actions and procedures for providing continued performance of the organization's essential functions; identifying a line of succession for essential positions and providing clear delegation of authority for making key decisions; preparation and maintenance of alternate operating facilities and emergency operations centers; creating interoperable modes of communication and building redundancy of critical communications and information technology; protecting vital records and databases including legal and financial records, preparing for the use and protection of human resources; testing, training and exercising the continuity plan; preparing for devolution of control and direction in the event that an agency's senior members are incapacitated or incapable of executing direction of the

agency's essential functions from either the primary or alternate facilities; and making plans for reconstitution of a new operating site and consolidation of resources after a catastrophic event.

COOP is intended to be an all-hazards planning tool (Federal Emergency Management Agency, 2004b). For decades before 9/11, emergency managers had been supporting the "all-hazards" approach to emergency preparedness and the Integrated Emergency Management System. Rather than planning and preparing for different types of events individually, the "all-hazards" planning focus is generic covering all hazards collectively. In this way, COOP plans are applicable to a wide range of events that have the potential to disrupt essential services.

To date, there has been little systematic research on continuity of operations plans. Those studies that have been conducted have primarily measured COOP planning at the federal level (Petersen, 2003, 2005). Tierney, Lindell, and Perry (2001) report that knowledge concerning planning and preparedness activities among government organizations – particularly those not directly involved in public safety – is lacking. Moreover, previous studies have tended to focus on specific disaster types such as hazardous materials releases and earthquakes.

There is an emerging literature and research focus that tries to assess how planning can build resilience in organizations or communities. Little (2002) noted that ". . . many years of observation of natural disaster events have produced a general postulate that *resilient* communities or systems (i.e., those having in place *robust* systems and institutions that possess a good deal of *redundancy*) fare the best" (p. 6, emphasis in original). Godschalk et al. (1999), define resilient communities as those that:

> . . . bend before the extreme stresses of natural hazards, but they do not break. They are consciously constructed to be strong and flexible rather than brittle and fragile. This means that their lifeline systems of roads, utilities, and other support facilities are designed to continue functioning in the face of rising water, high winds, and shaking ground. (p. 526)

The maintenance of these critical lifelines generally falls under the purview of the municipal public works department.

Statement of the Problem

There are questions as to whether a causal relationship exists between pre-disaster planning and effective response to crises (Tierney et al., 2001; Wenger, Quarantelli, & Dynes, 1986). In fact, Clark (1999) observed that "planning and success *do not* coincide but are loosely connected or even decoupled entirely" (p. 57, emphasis in original). And, it was suggested by Kartez and Kelley (1988) that "[t]he fact that local managers and agencies have adapted in the event is not evidence of preparedness, only of ingenuity and fortune" (p. 129). Weick and Sutcliffe (2001) believe that planning out a preconceived way to deal with hazards actually discourages organizations from recognizing and responding to the unique challenges and needs of each event. Given the conclusions reached by these researchers, does this mean that planning has no practical use? Rather than viewing plans as an outcome of a process to be utilized in a step-by-step fashion during a crisis, perhaps it is best to consider whether certain elements of planning activities can lead to effective response through building of organizational resilience potential that, when realized, enables adaptive behaviors and takes advantage of improvisation and creativity.

Definition of Resilience Potential

While definitions of organizational resilience will be explored in more detail in the literature review, a brief definition of the concept of resilience potential is necessary for an understanding of the focus of this research. Resilience is demonstrated *after* an event or crisis has occurred (Wildavsky, 1988). A move toward an adaptive approach to ensuring operational continuity during crises – one based on building organizational resilience potential – requires the ability to measure latent resilience in organizations; that is, resilience that is not presently evident or realized. It is theorized that organizations that score for high levels of resilience potential as measured on the scales developed for this study, will have a greater propensity to display adaptive behaviors than those with lower scores. This supposition is based on the work of Mallak (1998b) who developed initial scales for testing for latent resilience.

Theoretical Orientation

The development of the research questions and the data collected to answer them are reflective of the concepts of high-reliability theory. A peripheral component of public institutional theory, the earliest work on high-reliability theory originated at the University of California, Berkeley. Scholars began to examine how tightly coupled, technically sophisticated organizations delivered consistent performance relatively free of error while working in unpredictable environments where failure may have catastrophic consequences. Although generally studied in the context of complex organizations such as naval vessels (Bierly & Spender, 1995; Hutchins, 1995; Rochlin, Roberts, & LaPorte, 1987), air traffic control towers (LaPorte, 1988), and nuclear power plants (Bourrier, 1996; Marcus, 1995; Roberts, 1990), the concepts of high-reliability organizations (HRO)

have recently been applied to more routine organizations in areas such as education (Stringfield, 1994), "pastorialism" (Roe, Hintzinger, & Labnow, 1998), and medicine (Reason, 2000) in the effort to balance industrial efficiency or economy standards with the need for consistent operational reliability.

The source of high reliability is a series of cognitive processes and organizational practices that when implemented in times of stress give rise to positive adaptive behaviors. These processes begin with a preoccupation with the possibility of failure that causes an organization to imbue within its members with a culture of safety. In normal operating mode, highly bureaucratic practices including standard operating procedures, division of labor, technical specialization, and the strict adherence to a chain of command reflect this culture. Yet, in times of stress, this bureaucracy gives way to decentralized decision-making and emergent structures that disband after the emergency has been mitigated. Finally, HROs maintain a great deal of structural, procedural, technical, and material redundancy (Frederickson & LaPorte, 2002; Frederickson & Smith, 2003; Roberts, 1990) that allows for the organizational slack necessary to deal with the uncertainties of a dynamic environment.

These concepts highlight the fact that HROs display an organizational commitment both to anticipating potential sources of failure while simultaneously building elements of resilience to deal with unforeseen problems (Rochlin, 1993). Resilience is a concept that has been discussed from both a practitioner's perspective (Coutu, 2002; Hamel & Valikangas, 2003; Horne & Orr, 1998; Mallak, 1998a; Sutcliffe & Vogus, 2003) as well as studied in more empirical and theoretical research (Bruneau et al., 2003; Lengnick-Hall & Beck, 2003, 2005; Mallak, 1998b). Indeed, it will be

demonstrated through a review of the literature that many of the sources of resilience identified in past research correspond with the concepts of high-reliability theory.

Significance of the Study

This dissertation is based on the assumption that latent organizational resilience as previously defined, can be quantitatively measured and documented (Mallak, 1998b). It is simply argued that current models or methods of emergency planning do not adequately prepare organizations to adapt to rapid changes in their environment. Rather, a technique based on a strategy to improve organizational resilience is more in tune with emerging concepts in the field.

It is the overall intent of this research is to theoretically and empirically connect the concepts of high reliability organizational theory to a study about how continuity of operations planning – and other managerially influenced variables – may build resilience in municipal organizations. This dissertation adds to the emerging research on disaster planning that suggests that the focus of such planning should be on building resilient organizations; ones that create an environment conducive to post-disaster improvisation and adaptive behaviors (Kendra & Wachtendorf, 2001, 2003). "From both a theoretical and practical standpoint it is important to determine whether particular organizational strategies or approaches foster more comprehensive preparedness efforts" (Tierney et al., 2001, p. 72). This study attempts to measure the ability of an organized planning approach, in this case continuity of operations planning, to increase latent resilience in organizations.

Why does resilience matter? "Organizational resilience is an essential corollary for positive organizational scholarship because it begins to articulate how organizations

behave efficaciously and thrive amid adverse condition" (Sutcliffe & Vogus, 2003, p. 98). Godschalk (2003) feels that resilience is an important objective for two reasons. "First, because the vulnerability of technological and social systems cannot be predicted completely" and "second, people and property should fare better in resilient cities struck by disasters than in less flexible and adaptive places faced with uncommon stress" (p. 138). To Mileti (1999), resilience is important from a community perspective because it insulates communities from the devastating effects of hazards and enables a locale to withstand such events "without suffering devastating losses, damage, diminished productivity, or quality of life" (p. 33). Local government organizations are key to community resilience because they assure that, "governments will be able to operate following disasters, when departments and agencies are called upon to respond not just to disaster-generated demands but also continue to meet 'normal' demands" (Tierney et al., 2001, p. 54).

Resilience may also be relevant to the examination of how organizations succeed in responding to crisis when an event exceeds prior expectations and planning. According to Schneider (1992, 1995), organizations base their response to disasters on traditional bureaucratic principles such as clearly defined objectives, division of labor, hierarchal structure, and standard operating procedures. The premise is that plans can be made to apply to nearly every contingency. Unfortunately, disasters, and human response to them, are rarely predictable. Tierney (2003) provides an illustration of this point:

> September 11 was a disaster that greatly exceeded the scope of prior planning in New York City. The city had engaged in considerable planning for both natural disasters, such as hurricanes, as well as for terrorist attacks, particularly those

> involving biological or chemical agents, but no prior planning had anticipated an event like the one . . . New York faced on September 11. (pp. 1-2)

Yet, despite the fact that the attacks far exceeded anything that had been anticipated or planned for, there is evidence that organizations were able to survive by filling the gap between "bureaucratic norms" and "emergent norms" (Schneider, 1992, 1995) by displaying various principles of resilience (Beunza & Stark, 2004; Freeman, Hirschhorn, & Maltz, 2004; Kendra & Wachtendorf, 2001).

Research Questions

Three research questions were developed based on the concepts of high-reliability organizational theory and the literature on continuity of operations planning and organizational resilience. These questions then guided the selection of a research design and the development of a data collection instrument. The first two questions seek to describe the prevalence of both continuity of operations planning and organizational resilience potential among public works departments in municipal governments. The third question addresses the theoretical objective of exploring the relationship between a set of organizational and structural variables and measured organizational resilience potential. All of the research questions, and the methods used to test them, will be described in more detail in Chapter 3.

1. **What is the observed range of organizational resilience potential among the public works departments in the study?** Organizational resilience potential will be measured by a simple scale created using the six factors identified by Mallak (1998b): goal directed solution seeking, avoidance or skepticism, critical understanding, role dependence, source resilience, and access to resources.

2. **What is the prevalence of continuity of operations planning among the public works departments in the study?** The extent of COOP will be assessed through the use of a questionnaire detailing the level of compliance with FPC-65, the federal guideline for COOP, and the FEMA (2004b) publication *Interim Guidance on Continuity of Operations Planning for State and Local Governments.*
3. **How do six managerially influenced organizational variables correlate to the measured level of organizational resilience potential?** The six organizational variables were derived from a review of the literature presented in Chapter 2. These variables include level of perceived risk by managers, managerial information seeking, organizational structure, participation in community organizations, extent of COOP, and department accreditation by the American Public Works Association.

Limitations and Delimitations

In exploring possible correlates of organizational resilience potential, it is important to remember that individual, community, and organizational factors have been shown to correlate to disaster preparedness. In order to keep the unit of analysis consistent throughout this research, only factors at the organizational level are explored. Furthermore, only those factors that can be controlled by managers were considered for inclusion. For example, studies by Perry and Lindell (1997), Banerjee and Gillespie (1994), Gillespie and Streeter (1987), and Quarantell (1984) have all demonstrated a relationship between preparedness and the size of the organization. But, the size of a public organization is generally controlled by elected officials and is a reflection of the size of the community. Since managers cannot significantly influence the size of their organization, this factor was left out of the analysis.

The population selected for this research is public works departments in Region VII of the American Public Works Association. This includes the states of Arizona, New Mexico, Texas, and Oklahoma. The sampling strategy is designed to yield a purposive sample of this population – that is, full service, municipal public works departments. However several issues of external validity are raised. First, it is not clear that the results of the study can be applied to public works agencies outside the defined population. It is, however, anticipated that the results would generalize to organizations with similar missions and organizational demographics regardless of location within the United States. Second, it is unclear if research outcomes can be applied to public or private organizations beyond public works. While the resilience potential index is not specific to public works agencies, it must be applied to different organizational types to determine its applicability to agencies with different missions. Third, the American Public Works Association is a voluntary membership organization. The roster used to create the population sample only includes public works directors that are members.

Any change to a new strategy invariably involves the development of a new theoretical approach. In this case, it is posited that latent organizational resilience can be measured using a scale based on six previously identified resilience factors (Mallak, 1998b). By its very definition, resilience potential is resilience that is not presently evident or realized. Therefore, this thesis remains entirely conceptual until further research can demonstrate that resilience potential – as measured here – positively correlates to post-disaster adaptive behaviors.

The final limitation deals with the research method itself. A limitation to the survey research method is that it can seldom deal with the context of social life (Babbie,

2005). Although questionnaires can provide information in this area, survey research can seldom develop the feel for the total life situation in which respondents are thinking and acting that, say, the participant observer or other method can. In addition, the researcher has limited control over the willingness of participants to respond honestly, reply in a timely manner, or reply to the survey at all. This has important consequences for the outcomes of the study.

Organization of the Dissertation

Chapter 2 – Literature Review – establishes the theoretical foundation for this dissertation by exploring the concepts of high reliability theory and organizational resilience. In support of the literature, information regarding the findings of prior qualitative research on resilient organizations will be presented. The chapter also provides an historical background to explain how government has attempted to assure continuity of operations post-disaster. Included is a discussion of the relative shortcomings of disaster planning and the establishment of a conceptual link between planning, especially continuity of operations planning, and organizational resilience. This literature will provide the basis for the development of a questionnaire to measure organizational resilience potential among municipal public works departments and quantify the level of variance in organizational resilience potential explained by selected variables.

Chapter 3 – Methods – describes and defines the parameters of the research methodology employed in this dissertation. The approach to the study involves executing the steps commonly used in sample surveys (Babbie, 2005). That is, we have selected a population of interest (municipal public works departments) and a sample frame

(American Public Works Association listing of public works directors). The third step involves deciding upon a sampling strategy and technique. Data collection methods included the administration of a questionnaire that gathered information related to the extent of COOP planning, organizational resilience potential, and organizational and structural variables.

Chapter 4 – Results – presents the results of the findings from the analysis of the data. Multiple regression analysis was used to measure the strength and direction of the correlation between the independent variables and organizational resilience potential.

Chapter 5 – Conclusion – provides a conclusion to this dissertation based on the results and findings. Additionally, the implications of this research and significance these findings have for public policy are discussed and recommendations are made for the direction of future research in this area.

Chapter 2 – Literature Review

Researchers and practitioners in the field of disaster management have long emphasized the need for planning for unexpected events (Drabek & Hoetmer, 1991; Dynes & Drabek, 1994; Dynes & Quarantelli, 1975; Gillespie & Banerjee, 1993; Kartez & Lindell, 1987, 1989; Lindell & Meier, 1994; Quarantelli, 1988). Particularly since the terrorist attacks on September 11th, 2001, there has been increased attention given to "business continuity planning" or "disaster recovery planning." A different issue is "government continuity planning:" how does government continue to execute its essential functions following the impact of a natural or technological disaster or terrorist attack?

Except for one study on government continuity following earthquakes (Perry & Lindell, 1997), remarkably little attention has been paid to continuity of operations planning for local government agencies. It is clear, however, that cities form the environment in which most terrorist attacks – as well as most natural and technological disasters – will take place. In spite of external (state and national government and private and nonprofit sector) aid, these governments will face the challenge of delivering both special citizen services associated with disaster impact and recovery *and* the routine municipal services that are required at any time.

Historically, government has devoted some time to planning for the delivery of public services. Such efforts have been "marked by tensions and shifts in emphasis between war planning – particularly plans for nuclear war – and efforts to manage natural and technological disasters" (Tierney, 2001). The terrorist attacks in New York and Washington, D.C. added a new term to the emergency management lexicon: homeland security. This new focus on responding to and preventing terrorist incidents threatens to

once again subsume all other emergency management functions toward a focus on terrorism (Sylves, 2005). The slow response to Hurricane Katrina has been offered as evidence of the consequences of a myopic focus on any single element of emergency management (Somers, 2006).

Presidential Decision Directive 67 (PDD 67) mandates that federal agencies of the executive branch establish continuity of operations plans (Federal Emergency Management Agency, 2004a). FEMA has created interim guidance for establishing these plans and state and local governments are increasingly following suit engaging their own continuity planning (Federal Emergency Management Agency, 2004b). While it may be intuitively sensible for governments to plan for operational continuity, discussions regarding the establishment of guidelines for such planning has lacked basis in organizational theory.

It is, therefore, necessary to examine the components of continuity planning in order to identify a theoretical foundation that will support such efforts. This process begins with an understanding of the open-systems nature of public organizations. The history and composition of continuity of government and continuity of government operations planning is then outlined followed by a discussion of the shortcomings of traditional disaster planning concepts. Next, a theoretical foundation for continuity planning is established through an examination of the concepts of organizational resilience and high-reliability organizations. Finally, examples of resilient organizations are identified in the literature of the September 11th, 2001 terrorist events and their lessons for building organizational resilience are discussed.

An Open Systems Perspective on Disasters

In his reassessment of natural hazards preparedness in the United States, Mileti (1999) states that "hazards researchers and practitioners would do well to take a more systems-based approach to understanding the complex interactions between the natural environment and human perceptions, actions, and organizations" (p. 106). Organizational systems theory has its origins in "structural-functional sociology" and "general systems theory" (Harmon & Mayer, 1986, p. 158). Biologist Ludwig von Bertanlanffy, who had used thermodynamic principles to advance the concept of the organism as an open system since 1932, also "argued that key concepts could have relevance across a broad spectrum of disciplines" (Scott, 2003, p. 82). By the late 1960s, "the systems perspective began to dominate organizational theory" and "became *the* mainstream of organizational theory for several decades" (Shafritz & Ott, 2001, p. 242).

A system is a set of interrelated, interdependent elements (Bertalanffy, 1969; Checkland, 1999; Scott, 2003) that include "inputs, processes, outputs and feedback loops and the environment in which it operates and with which it continuously interacts" (Shafritz & Ott, 2001 , p. 242) in order to achieve specific goals or general purposes (Boulding, 1956). Katz & Kahn (1966) note that "systems theory is basically concerned with problems of relationships, of structure, and of interdependence" (p. 22) and that "open systems theory emphasizes the close relationships between structure and its supporting environment" (p. 3). Components of an open system respond to a change in the environment by whatever means are available to maintain the throughput of energy and resources necessary to survive (Buckley, 1967). And, since the transfer of energy

from the environment is necessary for the viability of the system, system survival, rather than efficiency, is the objective of open systems (Bertalanffy, 1969; Boulding, 1956).

The concept of an organization as part of an open system is contrary to traditional organizational theories that viewed organizations using closed system assumptions (Harmon & Mayer, 1986). Thompson (1967) viewed the closed system approach as a search for certainty, which is important to the efficient accomplishment of organizational goals and objectives. Classical, closed system organizational theory generally ignores external environmental influences and "tends to be one dimensional and somewhat simplistic" (Shafritz & Ott, 2001, p. 242). Similarly, traditional models of disaster research are "typically linear and assume only one causal factor" (Mileti, 1999, p. 107). Katz & Kahn (1978) highlight the inadequacies of the closed systems approach holding that it "has led to an over connection on principles of internal organizational functioning, with consequent failure to develop and understand the process of feedback which are essential to survival" (p. 34).

Using an open systems perspective, Mileti (1999) notes that "disaster losses are the result of interaction among three systems and their many subsystems" (p. 107). These include the earth's physical systems (atmosphere, biosphere), human systems (population, culture, technology), and the constructed system (public infrastructure including bridges, roads, and buildings). The ability of the constructed system and their operating agencies "to withstand the impacts of extreme natural forces plays a direct role in determining the number of lives lost, the number and severity of injuries, and the financial impact of disasters" (p. 128). Godschalk's (2003) *human communities* is also a component of the open system approach. "Human communities are the social and

institutional components of the city" and include "schools, neighborhoods, associations, organizations, enterprises, task forces, and the like" (p. 137).

In a presentation at the 36th Hawaii International Conference on System Science, Little (2002) examines the interrelatedness of civil infrastructure and the national economy and quality of life. He points to the President's Commission on Critical Infrastructure Protection, which identifies critical infrastructure and services as including gas and oil, transportation, banking and finance, power, telecommunications, water supply, and emergency services. Given the interdependent and tightly coupled nature of many of these systems, they are increasingly susceptible to failure during a natural, technological or human caused disaster. Yet, "these vital systems are required for our economy, government and society to function" (Henstra, Kovacs, McBean, & Sweeting, 2004, p. 11). Little describes three broad classes of infrastructure failure. Cascading failures occur when "a disruption in one infrastructure causes a disruption in a second;" an escalating failure happens when "a disruption in one infrastructure exacerbates an independent disruption of a second infrastructure;" and a common cause failure is the "disruption of two or more infrastructures at the same time because of a common cause" such as a natural disaster (Little, 2002, p. 3). He concludes by noting that "many years of observation of natural disaster events have produced a general postulate that *resilient* communities or systems (i.e., those having in place *robust* systems and institutions that possess a good deal of *redundancy*) fare the best" (p. 6).

In remarks to the National Press Club in May 2006, Beverly O'Neill, President of the U.S. Conference of Mayors, observed that urban areas are critical to the U.S. economy accounting for 86-percent or $10.7 trillion of the Gross Domestic Product.

When disasters strike U.S. cities, the effects are often felt regionally, even nationally. Before Katrina, the New Orleans metro economy amounted to $49 billion, representing 30-percent of Louisiana's Gross Product. The hurricane had at least some short-term effects on fuel and energy prices since 20-percent of natural gas and 30-percent of U.S. oil production occurs in the Gulf of Mexico and 60-percent of the nation's oil imports arrive there each year (Samuelson, 2005). The economic impact on the Gulf Coast region has been estimated to exceed $150 billion (Burton & Hicks, 2005). The terrorist attacks of September 11, 2001 had adverse impacts on major U.S. industries – especially airlines, tourism, and insurance - that caused at least short-term consequences for the U.S. economy and "over the longer run 9/11 will adversely affect U.S. productivity and growth because resources are being and will be used to ensure the security of production, distribution, finance, and communication (Makinen, 2002, p. 1). Given the importance of cities to the national economy, Mayor O'Neill called for increased level of intergovernmental relations and cooperation in dealing with local issues that have national importance.

The impact of disaster on communities and organizations. During disasters, many public and private organizations expend significant resources in an effort to reestablish their own critical infrastructure before they are able to provide service to their communities or customers. Critical organizational infrastructures can be defined as the physical, social, economic, or cyber assets that, if disrupted or destroyed, would seriously degrade the ability of an organization to accomplish its mission (Moteff & Parfomak, 2004). Events such as the 2003 Northeast Blackout, the Northridge Earthquake, and the terrorist attacks of September 11, 2001, provide just a few examples of how natural,

technological, and human-caused disasters affect critical infrastructure and service demands on local government. They also illustrate the importance of building capacity for organizational resilience in order to ensure continuity of operations, particularly in support of response and recovery efforts. These disasters were selected for discussion because they reflect the spatial and temporal dimensions that disasters can take, from localized areas of heavy damage to wide areas of impact.

On August 14th, 2003, the largest power outage in North American history affected 8 states and the Canadian Province of Ontario. At approximately 4:10 p.m., 50 million people found themselves without power (U.S.-Canada Power System Outage Task Force, 2003). The blackout covered much of New York, Ontario, Canada, and northern Ohio, and extended west as far as Detroit, Michigan. A report to Mayor Michael Bloomberg prepared by the New York City Emergency Response Task Force documents the impacts the blackout had on that City. Among the increase in demand for City services the report notes a six-fold increase in serious fires, a 187 percent increase in 911 calls, and a 133 percent increase in demand for City Emergency Medical Services (Alper & Kupferman, 2003). Transportation services were also affected by a complete loss of the NYC Transit and Port Authority Trans-Hudson (PATH) subway and commuter rail services (DeBlasio & Volpe, 2004). Over 2 million people were stranded in Manhattan below 60th Street. As a result, "Commuters flocked to ferries in overwhelming numbers. New York Waterway...carried 170,000 people compared with typical volumes for an evening rush period of 30,000" (Alper & Kupferman, 2003, p. 13).

New York City also struggled to provide critical lifeline services to residents and businesses. Problems in maintaining these services were generally attributed to a lack of

communication, inadequate redundancy of various essential systems, a lack of a cache of critical supplies, inability to mobilize essential personnel, and/or inconsistent command and coordination among the various emergency operations centers (Alper & Kupferman, 2003). Despite these problems, the response by New York City departments and the business community was generally successful. This was due, in part, to the continuity of operations planning that many organizations had developed since September 11th, 2001:

> As a result, the City's public and private organizations were largely successful in maintaining critical operations. Many companies were open for business during the blackout, and the financial markets were able to open even while the blackout still disabled many areas of the City. Public goodwill, safety personnel, and provision of essential services make it possible to maintain order and limit injury or damage (p. 4).

Shortly after 4:30 p.m. on January 17, 1994, a magnitude 6.8 earthquake struck the greater Los Angeles area. Dubbed "Northridge" by geologists, horizontal and vertical accelerations of 2g (2 times gravity) resulted in significant damage to local roads and sections of four major freeways were heavily damaged (DeBlasio & Volpe, 2004; Foley, 1995). As a result, the METROLINK commuter rail line in Santa Clara County experienced an increase in riders from 950 to 23,000 in the days after the quake (Foley, 1995). Over 3 million homes and businesses lost power during the quake and nearly 100,000 customers were without electricity for 24-hours or more (Mileti, 1999). There were approximately 1400 breaks in gas distribution lines interrupting the supply of natural gas to nearly 150,000 customers (Foley, 1995). Water supply was compromised

in portions of the San Fernando and Santa Clarita Valleys due to damage to trunklines and pipes (Anthony, 1994; Foley, 1995).

"Much emphasis was placed upon repairing damaged Southern California freeways following the 1994 Northridge earthquake because millions of dollars worth of productivity were lost daily due to transportation delays that affected the entire Southern California region" (Tierney, Lindell, & Perry, 2001, pp. 7-8). A survey of local business after the earthquake found that 80% of those sampled experienced some degree of operational interruption either as a result of direct damage or loss of lifeline services (Gordon & Richardson, 1995). Indeed, damage to public transportation infrastructure and loss of public or quasi-public lifeline services has been demonstrated to be a major contributing factor to economic losses after earthquakes (Boarnett, 1995; Gordon & Richardson, 1995; Tierney, 1997).

Governmental responses to the Northridge earthquake demonstrate both the benefits of resilient organizations and the desire to build resiliency into urban infrastructure and public organizations. For example, in order to ensure adequate water supply for fire protection, the Los Angeles Fire Department worked cooperatively with the Department of Water and Power to provide an intersystem pumping effort that utilized 25 fire engines to temporarily provide adequate water pressure (Anthony, 1994). Learning lessons from the power failure that resulted from the Northridge earthquake, the City of San Francisco began to explore ways to reduce its reliance on a centralized electrical grid system and look toward decentralized renewable energy sources and disaster-resilient energy technologies (Mileti, 1999).

"The collapse of the World Trade Center (WTC) had a profound impact on civil infrastructure systems in the area" (Restrepo & Zimmerman, 2003, p. 53). Tierney et al (2001) note that disasters have a spatial dimension. Whereas the effects of the Northridge earthquake and the Northeast power blackout affected a wide geographic region, the direct impact of the attacks on the WTC in New York affected a relatively small area in lower Manhattan. The WTC consisted of 7 buildings located on 16 acres of land (National Commission on Terrorist Attacks, 2004).While there was "a significant amount of infrastructure was ruined in the neighborhood of the World Trade Center complex" (Rubin & Renda-Tanali, 2003, p. 593), much of the direct damage was limited to the WTC site itself due to the fact that the Towers collapsed largely within their own footprint.

Yet, the resulting damage to infrastructure under the WTC complex indirectly affected much of New York City and portions of the Tri-State Area. For example, public transportation and road infrastructure were severely affected by the collapse of the WTC. Both the NYC Transit and PATH rail lines below the WTC complex sustained severe damage and service interruptions (DeBlasio & Volpe, 2004; Restrepo & Zimmerman, 2003). "The Holland Tunnel was also disrupted" (Restrepo & Zimmerman, 2003, p. 53). As a result, ridership on the New York subway system and the waterborne ferry service increased markedly (Zimmerman, 2003).

While the Fire Department of New York (FDNY) reported no increase in the number of serious fires occurring on September 11, 2001 (McKinsey & Company, 2002), damage to eight to ten major water mains and related facilities (Zimmerman, 2003) began to hamper the fire department's rescue and fire fighting efforts (Restrepo & Zimmerman,

2003). Heavy damage to underground pipelines resulted in serious loss of pressure from hydrants surrounding the World Trade Center site" (Restrepo & Zimmerman, 2003, p. 54). According to Zimmerman (2003):

> . . . the flexibility of the system to bring water into the area in alternative ways was reflected in a range of efforts. These included volunteer bucket brigades, distribution systems for fire fighting operated by the New York City Department of Environmental Protection through its conventional water system, and the New York City Fire Department fire boat system, which can be connected to either the city's system or the Hudson River (p. 253).

These examples illustrate that a systems approach to disaster management is critically important because local government agencies are, in essence, part of a collection of dynamically interrelated and interdependent urban elements. Because public organizations are essential to a community's quality of life and the local economy, they must be made to be adaptable to changes in their environment including natural and human-caused disasters. Viewed from an open systems perspective, disasters that negatively affect public organizations ultimately cascade through the community through disruptions to transportations systems, public safety assets, and critical lifeline services to businesses and residents (Henstra et al., 2004; Tierney, 2001). Such disruptions interfere with recovery efforts and may lead to business interruption, declines in economic activity, and higher unemployment. Local government agencies cannot serve their constituents and aid in local recovery efforts if they are pre-occupied with re-establishing their own critical organizational infrastructure after disaster.

The Quest to Ensure Continuity of Government Operations

Day to day operations of business are predicated on the assumption that local infrastructure and public services, which citizens, businesses, and public agencies depend upon, will be available when they are needed (Emergency Management Australia, 1997). Following the Northridge earthquake, local governments in the Los Angeles area were inundated with demands not only for emergency services, but to maintain their routine services as well (California Governor's Office of Emergency Services, 1994; Cooke, 1994). Ward (2003) recounts the experience of the chief financial officer for West New York/New Jersey who witnessed the 9/11 attacks on the World Trade Center and realized that government would have to continue to deliver the daily services demanded by citizens and business. "Prudent management, therefore, requires that . . . agencies develop plans for dealing with emergency situations, including maintaining services, ensuring proper authority for government actions, and protecting vital assets" (Government Accountability Office, 2004, p. 4). Such planning is considered to be a "good business practice" for government agencies (Federal Emergency Management Agency, 2004a, p. 2).

"Continuity of operations (COOP) planning refers to the internal effort of an organization, such as a branch of government, department, or office, to assure that the capability exists to continue essential operations in response to a comprehensive array of potential operational assumptions" (Petersen, 2005, p. 1). The earliest concern for continuity planning arose out of the Truman Administration, which began planning for the continuity of government post nuclear attack. Senate Joint Resolution 145 (81st Congress) was passed in 1950 to define a process for protecting members of Congress

and reconstitute that body in the event that a large number of Representatives were killed, incapacitated, or missing. A number of measures were taken throughout the Cold War period including the construction of several underground alternate command-and-control centers in Pennsylvania, Colorado, Virginia, and West Virginia (Schwartz, 1998). Continuity of state governments was also being addressed. "During the early 1960s, more than two-dozen states passed 'survival amendments' to their constitutions granting emergency war powers to governors and legislators. And most states [had] constructed their own protected underground facilities" (Zuckerman, 1979, p. 228). Attention to the continuity of local governments was demonstrated through the construction of "more than 2,100 city and county Emergency Operations Centers" paid in part by Federal civil-defense funds, and which were required to be "blast- and fallout-resistant and to have several redundant types of communications equipment" (p. 228).

Following the Cold War, the priority for COOP waxed and waned "in response to the perception of diminished risk of widespread interruption to government operations as a result of an intercontinental nuclear attack" (Petersen, 2003, p. 3). As early as 1987, FEMA was issuing guidance to state and local governments on continuity of government capability (Federal Emergency Management Agency, 1987). In November 1988, President Reagan issued Executive Order 12656 (EO 12656), which assigns federal agencies specific roles and responsibilities in preparing for and responding to national security emergencies. While not specifically intended to create continuity of operations plans, E.O. 12656 requires agencies to implement measures – including the development of plans, policies, and procedures – to improve capabilities for federal response to a national security event. Section 202 of E.O. 12656 requires that each federal agency

"ensure the continuity of essential functions in any national security emergency by providing for: succession to office and emergency delegation of authority in accordance with applicable law; safekeeping of essential resources, facilities, and records; and establishment of emergency operations capabilities" (quoted in Petersen, 2003, p. 7). In 1998, President Clinton issued PDD 67 ordering the Federal Emergency Management Agency to begin an intensive 12-month effort to establish continuity of operations plans in each agency of the federal executive. Since 1990, FEMA has released several Federal Preparedness Circulars (FPC) to clarify the process and content of COOP documents including FPC 60, *Continuity of the Executive Branch of the Federal Government at Headquarters Level During National Security Emergencies* (November 20, 1990), FPC 65, *Federal Executive Branch Continuity of Operations* (July 26, 1999), FPC 66, *Test, Training and Exercise Program for Continuity of Operations* (April 30, 2001, and FPC 67, *Acquisition of Alternate Facilities for Continuity of Operations* (April 20, 2001).

The terrorist attacks of September 11, 2001, created a new sense of urgency in government for the creation of continuity of operations plans. The U.S. General Services Administration maintains a continuity of operations plan template for use by federal agencies. The Office of National Security Coordination has also developed a Department of Homeland Security COOP Guidance Manual that outlines policies, procedures, and planning requirements. Independent study courses for continuity of operations planning have been made available through FEMA's Emergency Management Institute and the U.S. General Services Administration.

Despite a concerted effort by the federal government to construct and implement continuity of operations plans, state and local governments have moved more slowly;

though its importance is rapidly being realized (Hoene, Baldassare, & Brennan, 2002). The need for local government agencies to prepare plans for operational continuity began as early as the 1980s when it became apparent that governments were increasingly dependent on their information technology (IT) and computer systems (Perry & Lindell, 1997). Realizing that these systems were subject to disruption from even the most routine of incidents such as electrical outages, heavy precipitation, pipe failures or fires, many IT departments began to develop "business continuity plans" similar to those in the private sector. Similarly, the public works department oversees critical municipal functions such as water distribution, wastewater treatment, road maintenance and other lifeline functions that are essential to a community's heath and welfare. As such, many public works agencies normally maintain both standard operating procedures and contingency plans to ensure continued internal operations.

Since 9/11, many states have begun the process of continuity planning and both state and federal authorities are encouraging municipalities to do the same. In California, Governor Schwarzenegger issued Executive Order S-04-06 directing the Office of Emergency Services to promulgate and provide guidance on a mode of continuity of government and continuity of operations planning for use by the state and local governments (California Governor's Office of Emergency Services, 2003). Federal guidance on creating continuity of operations plans has come in the form of the *Interim Guidance on Continuity of Operations Planning for State and Local Governments* prepared by FEMA (2004b). This document does not establish a federal requirement for COOP on state and local governments, rather it provides a detailed planning aid which addresses the planning process, plan content and implementation, including templates for

assessing risk and identifying essential functions, and a COOP Planning Guidance Toolkit. In addition, the National Fire Protection Association has issued NFPA 1600, a document that provides a "total program approach" to disaster management, recovery, and continuity of operations (National Fire Protection Association, 2004, p. 1).

FPC-65 recommends that all elements of a continuity plan be operational within 12 hours of activation, and that they be capable of providing sustained operations for up to 30 days (Federal Emergency Management Agency, 2004a). A complete continuity plan must identify and prioritize the essential functions of an organization, as well as establish the concepts, actions and procedures for providing continued performance of the organization's essential functions. A completed COOP plan also incorporates unambiguous lines of succession for key personnel; authority delegations and identification for emergency decision-makers; selection and preparation of alternate work facilities; establishment of reliable, interoperable communications; protection of vital records and data bases; provisions for logistical support; and security measures for personnel, facilities, and critical resources.

Mission Essential Functions. A key component of continuity of operations planning is the identification of an organization's essential functions. An essential function is any service which, "enable agencies to provide vital services, exercise civil authority, maintain safety and well being of the general populace, and sustain the industrial/economic base in an emergency" (Federal Emergency Management Agency, 2004a, p. 5). According to the guidelines released by FEMA (2004b), determining which of an organization's functions are essential depends greatly on the organization's structure and mission; time-critical factors; and consequences for failure to perform such

functions on public health and safety. At the federal level, agencies of the executive branch are responsible for identifying mission functions that are essential to meeting eight national priorities including preserving constitutional government, national defense, international relations, and providing federal services that are critical to the health, safety and welfare of the nation (Petersen, 2005). On a local level, objectives might include the preservation of life, health and property; maintenance of confidence in government; ability to keep civil order; protection of civic infrastructure; and the vitality of the local economy. State and local functions generally considered to be essential to meeting these objectives include law enforcement, fire protection, emergency medical services, engineering, finance, and social services (Federal Emergency Management Agency, 2004b).

The U.S. Department of Homeland Security and some states have specified matrices of time and impact to define essential functions based on the *National Response Plan*, which advises that federal support to state and local governments is minimally 72 hours away. For example, the *State of North Dakota Continuum of Government Processes* creates four categories of functions to aid agencies in identifying their essential functions. Essential functions are defined as those that, if disrupted for more than 24 hours, will result in significant loss of life, confidence in government, and/or loss of economic integrity. Vital functions create these outcomes after 72 hours. Functions that can be delayed for two weeks are classified as *necessary*, while all other functions are considered as *desired* since they can be disrupted for more than two weeks but are still considered to be necessary for the normal operations of government. By weighing the time frame for negative outcomes against specific government-provided services,

organizational leaders can "triage" services into categories and focus planning efforts on those services that are essential for the continuity of government. These efforts also help to identify key interdependencies and interrelationships with non-response agencies. Departments without a public safety role – such as human resources, public information, information technology, purchasing, public transportation, and administration – indirectly perform functions that are essential for emergency response and good governance.

Delegation of authority and orders of succession. The collapse of 2 World Trade Center (WTC) destroyed the Fire Department incident command post weakening the FDNY's ability to orchestrate rescue efforts. Command was further degraded with the collapse of 1 WTC, which killed the Chief of Department and other command officers leaving the incident without an effective commander (McKinsey & Company, 2002). Ensuring an orderly succession and decentralizing authority are essential elements of continuity planning. Such elements are usually specified in the city charter, local ordinances, and organizational charts. "Clearly established delegations of authority are vital to ensuring all agency personnel know who has authority to make key decisions" and orders of succession ensure a successful transition of control in the event that senior officials are "incapacitated or unavailable" (Federal Emergency Management Agency, 2004a, pp. 5-6). Orders of succession always designate position titles rather than specific individuals. For example, a line of succession for a public works agency might include the Director, Deputy Director, Water Superintendent, and so forth. Optimally, orders of succession and delegation of authority documents include directions for notification and any limits on authority, position training for successors, and rules for termination of authority and even transfer of authority to persons outside the line of succession.

Alternate operating facilities. The New York City Office of Emergency Management (OEM) and the Emergency Operations Center (EOC) were located at 7 WTC. There was no backup site (National Commission on Terrorist Attacks, 2004). Although the OEM recovered quickly from the destruction of the EOC through improvisation, the loss initially reduced New York City's capacity to manage the incident (Kendra & Wachtendorf, 2001). COOP guidance requires the identification and preparation of alternate facilities that have sufficient space, utilities, logistical support, communications and data access to carry out the essential functions of the agency. A principle criterion for alternate facilities is that they are resistant to hazards identified in a jurisdictional vulnerability assessment.

Interoperable communications. Interoperability refers to the ability of emergency responders to communicate and work seamlessly via a myriad of voice and data systems. "Communications problems and the inability to coordinate with other disciplines and jurisdictions have been recognized as major operational limitations in every major incident, from the shootings at Columbine High School to the terrorist attack on the World Trade Center" (Pessemier, 2006, p. 2). Implementation of a unified command structure at the WTC was hampered due to a lack of interoperable communications between the FDNY, the New York Police Department, and the Port Authority of New York (National Commission on Terrorist Attacks, 2004). A survey by the U.S. Conference of Mayors found that 50-percent of local jurisdictions had interoperable communications between their police, fire, emergency medical services, and public works departments; and 88-percent of cities were not interoperable with the U.S. Department of Homeland Security (U.S. Conference of Mayors, 2004). Yet, the "ability

of an agency to execute its essential functions . . . is dependent upon the identification, availability, and redundancy of critical communications and information technology systems to support key government leadership, internal elements, other agencies, critical customers, and the public" (Federal Emergency Management Agency, 2004a, p. 6). COOP plans should identify communications systems that directly support an agency's essential functions, provide protection from disruption to primary channels of communication, and ensure sufficient redundant backup systems are in place.

Vital records and databases. Vital records, documents, and databases that directly support an agency's essential functions must be protected in order to ensure they are available to support continuity of those functions during a disruption in normal operations. COOP preparations should include the identification of records that are necessary to support essential functions. There are two subsets of vital records, emergency operating records and legal and financial records. Agencies should "pre-position and update on a regular basis duplicate records or backup electronic files" (Federal Emergency Management Agency, 2004a, p. 7). Protective measures might include replicating agency servers at an off-site facility, scanning paper documents to store in a secure computer; conversion of vital records to digital format; storage of vital records in multiple secure sites; and protection of off-site facilities from jurisdictional hazards.

Human capital. Specific staffing requirements will vary among different agencies and decisions must be made requiring members to perform the agency's essential operations and functions. Addressing the human capital involves personnel notification and callback, employee communication, pay flexibility, staffing flexibility, benefit issues, employee

roles and responsibilities, telework, among others. Of course, personnel remaining at work for extended periods of time will also feel an obligation to family. Planners are wise to assuage such concerns by developing programs that report on employee status to family members as well as initiate welfare checks of family members for employees. The presence of such programs has a tendency to strengthen motivation and reduce anxiety.

Testing, training and exercises. To be meaningful and effective, plans must be exercised and updated frequently. Exercises serve as a structured means to check the functionality of COOP plans. FPC 65 requires agencies to develop a multi-year testing, training, and exercise plan that addresses all components of a COOP plan. All personnel who may be impacted by a COOP activation should received proper training and orientation in the plan. This includes familiarity with operating under the National Incident Management System. At a minimum, all agency personnel should receive an orientation seminar in the COOP plan that includes activation, notification, evacuation, and other emergency procedures. Key agency personnel and COOP team members require advanced training to include tabletop and full-scale exercises. Scenarios should include relocation and operation from identified alternate operating facilities.

Devolution of control and direction. "Devolution planning refers to preparation necessary to transfer mission-essential functions of a department or agency to another organizational element, such as a field office, should an organization's AOF or emergency relocation personnel be rendered unavailable or incapacitated" (Department of Homeland Security, 2006, pp. 10-11). The objective of the devolution of control section of COOP is to "address how an agency will identify and conduct its essential functions during increased threat situations or in the aftermath of a catastrophic

emergency" (Federal Emergency Management Agency, 2004a, p. 9). It requires that personnel be empowered with the authority to make decisions and direct the operations of the organization in order to execute the agency's essential functions.

Reconstruction. This final element recognizes that "extensive coordination is necessary to procure a new operating site once an agency suffers a facility loss" (Federal Emergency Management Agency, 2004a, p. 9). Agencies should have procedures for returning to normal operating status once a threat or disruption has passed. Plans to return to normalcy should include notification of personnel that the threat has been mitigated; identification of specific actions for transferring communications, direction and control, and operations to primary facilities; and the conducting of an after-action review to assess all elements of the COOP implementation (Federal Emergency Management Agency, 2004b).

Planning such as continuity of operations planning "is designed to provide some element of stability – whether of organizational structure, role, task responsibility, or the physical environment – when other elements are in flux or situations demand unplanned-for action" (Wachtendorf, 2004, p. 18). Previous research suggests that high levels of preparedness are directly correlated to effective response in crisis situations (Mileti, Drabek, & Haas, 1975) and planning has been demonstrated to be a key component of such preparedness (Kartez & Lindell, 1987; Mileti et al., 1975). Thus, an axiom of the integrated emergency management system is that governments, and organizations, can and should plan for disasters (Drabek & Hoetmer, 1991; McLoughlin, 1985; Petak, 1985; Schneider, 1995).

How Effective is Traditional Planning?

Yet, despite the impact disasters such as September 11th have had on government, the adequacy of planning among government agencies is still in question. A post-9/11 study conducted by the U.S. General Accounting Office (2004) documented compliance with FPC 65 and found that most federal plans were inadequate or incomplete. While the GAO report only considered COOP plans active as of October 1, 2002, and ongoing changes to these plans have been occurring since that date, "GAO's conclusion that agencies are likely to continue to base their COOP planning on ill-defined assumptions that could limit effectiveness of resulting plans, might still be salient" (Petersen, 2005, p. 15). With regard to local-level COOP planning, Bruno (2005) reported that more than half of the 75 plans collected from local Pennsylvania governments didn't include basic emergency information and only one-third were specific enough to make any meaningful comparison to FEMA criteria. Peterson (2003) notes that as "the memory of dramatic interruptions such as the September 11 attacks and anthrax incidents fade, attention to administrative operations like COOP planning may receive lower priority attention from agency planners" (p. 9).

Furthermore, it may be incorrect to conclude that there is a causal connection between detailed planning and response effectiveness. Clark (1999) observes that "planning and success *do not* coincide but are loosely connected or even decoupled entirely" (p. 57, emphasis in original). In an examination of the governmental response to Mount St. Helens, Kartez (1984) noted that successful response by local agencies was more a result of improvisation than of prior planning. A 1986 Disaster Research Center study on the response of local emergency management systems in six community

disasters concluded that, despite improved planning and preparedness efforts local governments, the effectiveness or response had not improved (Wenger, Quarantelli, & Dynes, 1986). Finally, in their assessment of the Northridge earthquake response, Tierney, Lindell, and Perry (Tierney et al., 2001) wrote:

> Following the 1994 Northridge earthquake it was widely acknowledged that, had the temblor not occurred at around 4:30 in the morning on a national holiday, responding organizations would have faced many more sever challenges than that event presented. Was the fact that the city of Los Angeles responded so effectively to the earthquake the result of the planning that had been done beforehand – which was extensive – or due to the fact that the problems that developed did not really tax the response system? (p. 71)

While some organizations may mitigate a crisis using plans that are highly instrumental and applicable to the situation, others may find that pre-established plans are not relevant to the situation at hand (Turner, 1995). Clark's (1999) thesis on planning is particularly intriguing. In *Mission Improbable*, Clark provides a counter argument to the "Theory of Good Planning," which holds that good planning is related to effective response to crises. Yet, Clark observes that there are situations where "the mere existence of the plan doesn't seem to matter much, because people don't follow the plan or abandon it as their crisis develops. In still other instances – the cases of accidental success – there is effective response but there isn't even a plan available" (p. 65). Clark also notes that "planning is deeply, unavoidably political" (p. 13) leading to situations where "organizations and experts use plans as forms of rhetoric, tools designed to convince audiences that they ought to believe what an organization says. In particular,

some plans have little instrumental utility in them that they warrant the label 'fantasy documents'" (p. 2).

While crises provide an opportunity for institutions to improve efficiency, too often plans are developed around one particular strategy or approach (Inam, 2005). In their examination of high-reliability organizations (HRO), Weick and Sutcliffe (2001) observe that non-HROs "defend against possible threats through . . . conventional mechanisms such as plans, standard operating procedures, professional standards, and informal prescriptions" (p. 78). The problem with traditional planning is that plans typically "embody expectations" (p. 79) and instill a false belief that crises will lay out in a predetermined manner. This creates a sense that emergencies can be handled with a set of pre-arranged responses. This creates a mindset that precludes exploring solutions to unexpected events that do not fall within the realm of pre-existing plans. Thus, even if an event falls outside what has been planned for, employees may only look for solutions within organizationally specified contingent actions. Innovation and adaptive behaviors are quashed. Weick and Sutcliffe conclude that ". . . the typical organization's emphasis on routine and contingency planning embodies assumptions that weaken the ability to respond to the unexpected and foster new learning" (p. 83).

Given the conclusions reached by these researchers, does this mean that planning has no practical use? Rather than viewing plans as an outcome of a process to be utilized in a step-by-step fashion during a crisis, perhaps it is best to consider whether certain elements of planning activities can lead to better response through building of organizational resilience that enables improvisation and takes advantage creativity. This

thesis coincides with an emerging literature on disaster planning that suggests just such a focus. Wachtendorf (2004) notes:

> Research suggests that organizations engage in collective sense-making when faced with uncertainty and the need to act under time constraints. In doing so, they draw upon plans and experience and take cues from one another and the broader social environment to define emergency needs. Through this process, organizations determine whether they will maintain organizational continuity, shift to contingency plans, or instead engage in one of three forms of improvisation: 1) reproductive, 2) adaptive, or 3) creative. (p. xiii)

In assessing New York City's Office of Emergency Management during the September 11 terrorist attacks, Kendra & Wachtendorf (2003) document creativity in organizations during the response and recovery. They note a paradox of creativity in emergency management:

> . . . even though creativity and flexibility are regarded as important qualities of emergency managers, and people involved closely with emergency response recognize that emergencies demand these qualities, exercising creativity during a response is, paradoxically, often regarded as dysfunctional for emergency personnel. It appears as an indication of failure to plan properly ahead of time. (p. 128)

This attitude presents a challenge to changing the traditional model of planning toward building resilience potential. Yet, they also observe that:

> Disasters create new environments that must be explored, assessed, and comprehended. They change the physical and social landscape, and therefore

> disasters require a period of exploration, learning, and the development of new approaches. (p.128)

Therefore, organizations may be better prepared if they seek to utilize the planning process, relationships, experience, and training and exercising to ensure continuity through resilience and build the capability to take advantage of improvisation and by removing organizational behaviors, procedures, and structures that impede flexibility and adaptive behavior.

Defining Resilience

The concept of organizational resilience has been studied in and applied to a number of settings including hospitals (Mallak, 1998b), fire fighting teams (Weick, 1993), business and industry (Coutu, 2002; Hamel & Valikangas, 2003; Horne & Orr, 1998), and high reliability organizations (LaPorte, 1988; Rochlin, 1993; Rochlin, Roberts, & LaPorte, 1987; Weick, Sutcliffe, & Obstfeld, 1999). More recently, researchers have begun to examine response and recovery efforts from the September 11, 2001 terrorist attacks on the World Trade Center from the perspective of resilience (Beunza & Stark, 2004; Freeman, Hirschhorn, & Maltz, 2004; Kendra & Wachtendorf, 2001; Tierney, 2003). But, defining resilience has proven difficult (Kendra & Wachtendorf, 2001). What constitutes resilience and its definition have been the focus of considerable debate (Klein, Nichools, & Thomalla, 2002) and appears to differ within and among the various disciplines (Longstaff, 2005; Sutcliffe & Vogus, 2003) and units of analysis in which it has been used.

Psychologists and social workers have contributed significantly to the knowledge base on resilience from an individual perspective. But, is personal resilience equivalent to

organizational resilience? Citing Ashmos & Huber, Legnickhall & Beck (2003) acknowledge that resilience is a reflection of the relationship between the organization and the individuals that work within. "This reasoning leads to two important implications. One, resilient individual organization members do not necessarily yield resilient organizations. Two, individuals who are not resilient on their own can become collectively resilient" (p. 9). Thus, while the study of what makes individuals resilient is necessary to the study of organizational resilience, it is not sufficient to explain how organizations exhibit resilience under adverse conditions.

In organizational theory, resilience is often defined in passive terms. For example, resilience has been seen as the ability of the organization to simply "bounce back" (Wildavsky, 1988) from a "distinctive, discontinuous event that creates vulnerability and requires an unusual response" (Lengnick-Hall & Beck, 2003, p. 2). Or, as the ability to "absorb" strain or change with a minimum of disruption (Horne & Orr, 1998; Sutcliffe & Vogus, 2003). Wildavsky (1988) further characterizes resilience as the "capacity to cope with unanticipated dangers after they have become manifest" (p. 77). Framed this way, resilience is simply a *reaction* to a crisis situation and is considered a "pattern rather than a prescribed series of steps or activities" (Lengnick-Hall & Beck, 2003, p. 2).

But, some authors distinguish between passive resilience, "the mere ability to bounce without breaking," and active resilience, "a deliberate effort to become better able to cope with surprise" (Lovins & Lovins, 1982, quoted in Wildavsky, 1988, p. 98). From this perspective, resilience is more than mere survival; it involves identifying potential risks and taking proactive steps (Longstaff, 2005) to ensure that an organization *thrives* in the face of adversity (Kanigel, 2001). The objective is to build resilience by maximizing

the capacity of the organization to adapt to complex situations (Lengnick-Hall & Beck, 2005; Wildavsky, 1988). Lengnick-Hall & Beck (2003) believe that "organizational resilience is a complex blend of behaviors, perspectives, and interactions that can be developed, measured, and managed" (p. 10). Indeed, examining what measures enhance resilience in organizations is becoming an emerging concept for understanding and efficaciously responding to crises.

Toward Resilient Organizations: Lessons from Mann Gulch

The concept of resilience has traditionally been studied at the individual level of analysis, particularly within the fields of psychology and social science (e.g. Karapetian-Alord & Johnson-Grados, 2005; Werner & Smith, 2001). It has also been applied to examinations of "post-traumatic growth" in individuals after disaster (Jang, 2005). But, resilient individuals within an organization do not necessarily produce resilient organizations (Lengnick-Hall & Beck, 2003) and may, in fact, be detrimental to the creation of organizational resilience (Horne & Orr, 1998). A stark example is the Mann Gulch fire in central Montana; an event that became the focus of an award-winning book by Norman Maclean (1992) entitled *Young Men and Fire*. On August 5th, 1949, thirteen of the U.S. Forest Service's elite smokejumper unit parachuted into a rugged, inaccessible region of the Gates of the Mountains Wilderness 20 miles north of Helena in the Helena National Forest. Thirty-three-year-old R. Wagner Dodge was selected to lead the fifteen-man crew into Mann Gulch. Described as "gifted with his hands, silent on principle, and fastidious" (p. 29), Dodge was an experienced outdoorsman and seasoned firefighter with over 9-years in the field. His crew was an eclectic mix of forestry

students (p. 28), adventurers (p. 29), and World War II veterans (p. 31) with varying levels of firefighting experience.

Within hours of parachuting into Mann Gulch, the smokejumpers found themselves threatened by a 30-foot wall of fire moving rapidly toward the ridge (Maclean, 1992). As the firefighters made their escape up the steep slope they emerged from the trees into tall grass, which Dodge knew would burn very fast. It was at this point that Dodge did something completely unheard of at the time; he lit the grass ahead of him "instantly inventing what would become known as the 'escape fire'" (p. 92).

> Some if not all of the crew stopped briefly to see what Dodge was doing and listen to his pleas for them to get into the burned-out area he was preparing. Someone is reported to have said, "To hell with that, I'm getting out of here!" No one stayed with Dodge. The crewmembers split up afterward, with the majority continuing to run up the canyon. (Rothermel, 1993, p. 6)

Only three of the smokejumpers survived the fire; Dodge in his escape fire and two other firefighters who took the shortest route up the steep walls of the gulch and happened upon a rockslide area where no vegetation had taken root (Maclean, 1992; Rothermel, 1993; Weick, 1993).

Maclean's account of the Mann Gulch fire became the subject of an examination of resilience by Karl Weick. In *The Collapse of Sensemaking in Organizations*, Weick (1993) "strips Maclean's elegant prose away" (p. 628) to reanalyze the event in an effort trace the fatal behaviors of the smokejumpers to identify (1) why organizations unravel and (2) how organizations can be made more resilient. In the case of Mann Gulch, a number of factors ultimately lead to the collapse of the smokejumpers as an organization.

These included a prevailing attitude that viewed all fires as "ten o'clock" fires as if the firefighters had them extinguished before they jumped (Maclean, 1992); poor development of unit cohesion, organizational culture, and leadership prior to the jump (Useem, 1999); an inability to create and maintain a flexible group structure capable of adapting to rapid changes (Sutcliffe & Vogus, 2003); a loss of sensemaking in the face of the unexpected (Weick, 1993); and a fire that could not be outrun (Rothermel, 1993).

In combination, these events created what Weick refers to as a cosmology episode. "A cosmology episode occurs when people suddenly and deeply feel that the universe is no longer a rational, orderly system" (Weick, 1993, p. 633). When faced with such situations, people lose the ability to make sense of their surroundings or find solutions to their dilemma. Unit cohesion and organizational resilience fail:

> As their group disintegrated, the smokejumpers became more frightened, stopped thinking sooner, pulled apart even more, and in doing so, lost a leader-follower relationship as well as access to the novel ideas of other people who are a lot like them. As these relationships disappeared, individuals reverted to primitive tendencies of flight. Unfortunately, this response was too simple to match the complexity of the Mann Gulch fire. (p. 638)

Weick (1993) finds four potential sources of resilience from his analysis. *Improvisation and bricolage* involve creativity in problem solving. Weick cites Bruner to describe creativity as "figuring out how to use what you already know in order to go beyond what you currently think" (p. 639). Clearly Dodge exhibited this trait. His experience as a woodsman made him a bricoleur; someone able to "remain creative under pressure, precisely because they routinely act in chaotic conditions and pull order out of

them. Thus, when situations unravel, this is simply normal natural trouble for bricoleurs and they proceed with whatever materials are on hand (p. 639). It was in his personality to remain calm and continue thinking even in the face of danger. "His running but not his thinking stopped when he saw the top of the ridge, for he immediately thought his crew could not make the top and so he immediately set his escape fire" (Maclean, 1992, p. 103). Unfortunately, the creative solution to the impending danger in Mann Gulch – the escape fire – was a product of individual resilience that did not translate into organizational resilience. Dodge's own "personal capabilities were not enough to persuade the group to act in a resilient way and consequently thirteen men died in the fire" (Lengnick-Hall & Beck, 2003, p. 9).

"Social construction of reality is next to impossible amidst the chaos of a fire, unless social construction takes place inside one person's head" (Weick, 1993, p. 640). Weick's first source of resilience, *virtual role systems,* involves the ability of each individual in an organization to understand the system of which they are a part and the various roles within the group. In this way, when disaster strikes, "each person can reconstitute the group and assume whatever role is vacated, pick up the activities, and run a credible version of that role" (p. 640). In 1949, the smokejumpers were still such a young organization that most of them had not been on a large fire so they did not have the experience of working together as a team. "The almost total experience each crew member had had as a firefighter was being almost his own boss on almost his own fire where for most practical purposes he was the only one who was in a position to save his own life" (Maclean, 1992, p. 218). As a result, they had little conception of the individual

roles within their group and were not able to "maintain a shared vision of risks, goals, and possible solutions" to their situation (Kendra & Wachtendorf, 2001, p. 12).

Wisdom is an attitude rather than a base of knowledge. It is the ability to question beliefs, values and knowledge about what is traditionally held in order to seek out new information. "Wise people know that they don't fully understand what is happening right now, because they have never seen precisely this event before" (Weick, 1993, p. 641). Weick examines the perception of all fires as "ten o'clock fires" as a violation of wisdom. The smokejumpers did not understand "the principle that little things suddenly and literally become big as hell, the ordinary can suddenly become monstrous, and the upgulch breeze suddenly can turn to murder" (Maclean, 1992, p. 217). This attitude created a gap between expectations and emergent conditions that the smokejumpers were not able to cognitively overcome in order to develop creative solutions of their own or see their salvation in Dodge's unique solution.

The forth source of resilience – *respectful interaction* – follows Campbell's (1990) three imperatives for social life including (1) respecting reports from others and being willing to take action based on them, (2) reporting honestly to others, and (3) respecting one's own perceptions and beliefs and integrating them with those of others. These maxims create a triangle of trust, honesty, and self-respect, which are conspicuously absent in the Mann Gulch fire:

> Wagner Dodge was a boss of few words, a person who neither expected much information from his people nor gave much in return. As the men flew over Mann Gulch, sixteen pairs of eyes and ears were gathering information on the conditions below, and some might have guessed that the swirling smoke and air turbulence

> signaled dangerous ground conditions. Yet Dodge relied on only a single pair of eyes, his own. Similarly, in moving toward the fire, then around it, and finally away from it, others reached their own assessment of the best way out. Yet in no case did Dodge ask for their appraisal. (Useem, 1999, p. 55)

The result was a lack of trust in Dodge's leadership decisions, a collapse of role systems, and an increase in panic that resulted in the deaths of the smokejumpers. In contrast, "if a role system collapses where trust, honesty, and self-respect are more fully developed, then new options, such as mutual adaptation, blind imitation or creative solutions, and trusting compliance, are created" (Weick, 1993, p. 643).

Anticipation, Resilience and the Fallacy of a Dichotomy

A fundamental question in risk management – including emergency management – is whether organizations should seek to anticipate disasters and create comprehensive plans for mitigating loss, or implement measures that enhance the ability to respond to disasters by increasing resilience. In *Searching for Safety*, Wildavsky (1988) lays out a dichotomous theory of how institutions and governments respond to risk in an effort to seek safety. Two alternative approaches are examined: anticipation and resilience. "Anticipation is a mode of control by a central mind; efforts are made to predict and prevent potential dangers before damage is done". In contrast, ". . . resilience is the capacity to cope with unanticipated dangers after they have become manifest, learning to bounce back" (p. 77). Wildavsky argues that, "anticipation can only secure safety and cope with risk if (1) we can predict with high probability the worst outcomes we face and (2) we can apply that foresight in policies to avoid or mitigate these outcomes" (Freeman et al., 2004, p. 6).

Wildavsky (1988) explores the balance between anticipation and resilience using four very different examples: non-human life forms, the inspection of nuclear power plants, the human body, and tort law. Nonhuman life forms, he contends, operate with a considerable degree of both anticipation and resilience. Nuclear power plants operate under procedures that attempt to anticipate all potential risks. On the opposite side of the spectrum, the human body exhibits the use of resilience over anticipation. Finally, tort law is identified as an area where neither anticipation nor resilience is exercised. From these observations, Wildavsky concludes that risk and safety are intertwined and thus there can be no safety – and no resilience – without risk taking. "Encouraging trial and error promotes resilience" (p. 2) whereas "[a] strategy of anticipation is based on [a] fear of regret" (p. 225) that dangerously "restricts [the] search for safety" (p. 227).

Derived from the ecological literature, Wildavsky (1988) cites twelve underlying principles of stability adapted from the work of Kenneth Watt and Paul Craig. Six are categorized as being strategies of risk reduction associated with resilience and are worth more detailed discussion. First, the *homeostasis principle* "means pure movement – a reaction for every action, a sources of information for every component" (p. 120). Systems with greater variety or diversity are able to more effectively respond to negative feedback thus increasing their adaptability.

The ability to forge relationships to ensure key resources has been identified as an essential component of resilience (Coutu, 2002; Lengnick-Hall & Beck, 2003; Werner & Smith, 2001). The *omnivory principle* holds that "the greater the number of pathways by which resources can flow to dominant system components, the less likely is the system to become unstable because of a supply failure of a single resource" (Wildavsky, 1988, p.

113). An example of this principle is provided in a discussion by Lengnick-Hall & Beck (2003) of a fire that crippled the Philips Electronics' plant that left Nokia and Ericsson without their key mobile-phone chip supplier. While Ericsson lost a month of production and market share, Nokia was able to use its network to secure other suppliers and increase orders from other Phillips facilities.

Two principles deal with a theme of surplus or overlap. The *redundancy principle* can be applicable to an overlap of resources or organizational operations. Such overlap "would permit essential functions to continue" (Wildavsky, 1988, p. 115) while accommodating for "high rates of failure" (p. 120). For example, after the terrorist attacks on September 11th, 2001 overwhelmed communications systems of emergency responders recommendations were made to integrate redundancy or backup systems into their communications including priority wireless access (McKinsey & Company, 2002; Titan Systems Corporation, 2002), amateur radio operators (Lindquist, 2001), and even foot runners (Titan Systems Corporation, 2002). "The *buffering principle* fosters stability by maintaining a surplus. Buffering is equivalent to organizational slack, i.e. a capacity in excess of immediate needs" (Wildavsky, 1988, p. 116). The strategic petroleum reserve is an example of the federal government buffering against the possibility of interrupted oil supplies or unanticipated increases in demand.

The availability of resources is important, but a system in distress needs the right resources, in the right place, at the right time, and in the right quantity. According to the *high-flux principle*, the more resources that are available at the time they are needed the more resilient a system will be. "Once having been disturbed, a system will take a longer time to recover if the necessary resources take a long time to reach it. Whether the

resources are used efficiently may matter less that whether the right ones reach the system in time to be responsive" (Wildavsky, 1988, p. 113).

This brings up a classical debate in public administration theory about the importance Western society places on efficiency. Many early writers fully accepted the criterion of efficiency as a yardstick with which to measure the operations of public organizations (Gulick, 1937; L. White, 1948) while others challenged efficiency as the preeminent value in the field (Dimock, 1936; Waldo, 1948). For some, "the criterion of efficiency might conflict with other criteria that we might use to assess the work of public organizations" (Denhardt, 2004, p. 62) such as effectiveness or responsiveness. Longstaff (2005) holds that efficiency can be the enemy of resilience. He notes that a farming community made up of "many small individuals that reproduce quickly" (p. 30) will be more resilient than a community with large farms due to their ability to adapt and recover more quickly. While large farms may operate more efficiently than small ones, a community comprised of smaller farms will "bounce back more quickly as it does not require rebuilding all the coordination functions necessary for putting larger organizations back together" (p. 30).

Another well-discussed theme in public administration is hierarchy versus participation (Denhardt, 2004). Early theorists such as Woodrow Wilson ([1887]1997), Leonard White (1926), and W.F. Willoughby (1927) sought efficiency through hierarchal organizational structures. More recent scholars have challenged this approach calling for greater cooperation and participation (Golembiewski, 1967; Thayer, 1973; O. White, 1969). The *flatness principle* addresses organizational structure. It states that "the wider the base of . . . organizational pyramids . . . relative to the number of hierarchal levels, the

more stable they will be. Put positively, a larger number of independent actors increases stability" (Wildavsky, 1988, p. 114). Beunza & Stark (2004) provide an excellent example of the flatness principle at work in the survival of a wall street trading organization after the September 11th, 2001 attacks on New York City:

> With its socio-technical network of instrumentation and interacting desks, the trading room at International Securities had used a socially distributed cognition to profit from market uncertainty on a daily basis. It had succeeded in a highly competitive industry through heterarchical organizational structure with a flat hierarchy and competitive subgroups that made sense of the environment in rivalrous ways. (p. 5)

Although quite intriguing, Wildavsky's (1988) hypothesis that "resilience is often . . . superior to anticipation" (p. 107) "has not widely diffused into practice, policy, or theory" (Freeman et al., 2004, p. 29). Indeed, his conclusions have even been described as biased if not downright dangerous given his belief that learning from trial-and-error is the preferred approach to developing resilience and achieving safety (Short, 1990). But perhaps the main reason is that anticipation – or strategies that Wildavsky identifies with anticipation – is often identified as an integral component of resilience rather than a dichotomous approach to safety (Coutu, 2002; Kendra & Wachtendorf, 2001; Lengnick-Hall & Beck, 2003). Indeed, Kendra and Wachtendorf (2001) conclude that "there is no effective resilient response without anticipation. Stated differently, anticipation and resilience are related and mutually reinforcing activities, knowledge, and skill sets" (p. 28).

Contingency Theory: Acknowledging Uncertainty for Organizations

As evidenced by Wildavsky's work, the resiliency described in the ecological literature has been translated into organizational terms by the conceptualization of the central tenets and suppositions of contingency theory. Contingency theory is an attempt to integrate the closed-system logic of the rational model (which attempts to eliminate the variable of uncertainty), with an open-systems approach that recognizes the influence of outside factors. It asserts, essentially, that organizational structures and procedures are contingent upon current environmental conditions. There are three assumptions that underlie contingency theory: (1) variations of organizational structure are related to variations in the environment, (2) the effectiveness of the organization is contingent upon the "goodness of fit" between structural and environmental variables (Pennings, 1992, p. 269), and (3) the best way to organize depends on the nature of the environment to which the organization relates (Scott, 2003, p. 96). Accordingly, there is no ideal form of organization, since even highly effective organizations will at times demonstrate some form of contingent arrangement.

Conceptualization of the contingency theory is generally attributed to Paul Lawrence and Jay Lorsch (1967) who argued that different environments place different demands on organizations. Through empirical studies of the relationship between organizations and their environment, as well as assessments of the various internal structures of each type of organization, these authors concluded that uncertain and rapidly changing environments call for flexibility and dynamic organizational structures, while more stable environments allow for greater centralization and formal organizational

forms. In addition, they argue that each subunit of an organization should be suited to deal with the stability or uncertainty of its own operational environment.

Scott (2003) notes that the ecological approach to organizations has its origins in the Darwinian Evolutionary Model in that organizations that continuously adjust their internal functions to match the operational environment are more likely to survive and prosper. This perspective differs greatly from those of closed-systems thinking that attempts to limit uncertainty using control mechanism designs. Examples of this approach include Taylor's scientific management, Weber's concept of bureaucracy, and Gulick's administrative management (Thompson, 1967). These theories are based on a Newtonian expectations that systems are stable and predictable, therefore there is a smooth linear relationship between inputs and outputs (Kiel, 1994).

The contingency theory perspective certainly has relevance to the study of organizational adaptation – or lack thereof – during crises. While much of contingency theory generally considers environmental change as gradual and permanent, short, punctuated events can have similar Darwinian implications for organizations, even when the environment returns to its pre-event norm. Thus, the central tenets of contingency theory hold true in the crisis environment. Furthermore, there is a balance to be struck between the need to control the technical core tasks of an organization, with the need to deal with a high degree of uncertainty. Thompson (1967) believed that it is the purview of management to influence the organizational variables that strike that balance. "If the organization must approach certainty at the technical level to satisfy its rationality criteria but remain flexible and adaptive to satisfy environmental requirements, we might expect the managerial level to mediate between them, ironing out some irregularities stemming

from external sources but also pressing the technical core for modifications as conditions alter" (p. 12). These findings are illustrated in the literature on high-reliability organizations, which exemplify both the open-systems and contingency theory perspectives.

Resilience Concepts in High Reliability Organizations

The concept of organizational resilience is also discussed in the academic literature on high-reliability organizations (HRO). Scholars such as Paula Consolini, Louise Comfort, Martin Landau, Todd LaPorte, Gene Rochlin, and Karl Weick have contributed to our understanding of these organizations. In general, HROs are defined as exceedingly reliable, failure-free systems that function in high-risk environments. While Wildavsky (1988) argues that trial-and-error promotes resilience, HROs "operate in an unforgiving social and political environment, an environment rich with the potential for error, where the scale of consequences precludes learning through experimentation" (Weick et al., 1999, p. 82). Commonly discussed examples of HROs include such tightly coupled organizations as nuclear submarines (Bierly & Spender, 1995), aircraft carriers (Rochlin et al., 1987), air traffic control (LaPorte, 1988), and nuclear power plants (Bourrier, 1996; Marcus, 1995; Roberts, 1990a). "HROs are important because they provide a window on a distinctive set of processes that foster effectiveness under trying conditions" (Weick et al., 1999, p. 82). These processes, and the mechanisms that create them, are "often underdeveloped in non-HROs where people tend to focus on success rather than failure and efficiency rather than reliability"(p. 82).

While scholarship focused on the study of HROs remains on the periphery of "mainstream" organizational theory (Frederickson & Smith, 2003; Weick et al., 1999), an

understanding of the characteristics that contribute to the ability of HROs to perform in high-risk, high-consequence environments relatively free from error, may prove instrumental in developing the capacity for resilience in everyday organizations (Kendra & Wachtendorf, 2001). Four key strategies applied by HROs to ensure operational reliability appear to be congruent with many of the principles of resilient organizations. First, is a preoccupation with a possibility of catastrophic failure (Weick et al., 1999), the prevention of which requires constant vigilance (Rochlin, 1993), continuous training (Frederickson & LaPorte, 2002), and a culture that imbues its members with "clear operational goals, decision premises and assumptions" (Rijpma, 1997, p. 17). This approach reflects an attitude of wisdom as described by Weick (1993).

Second, there is a concurrent centralization and decentralization of operations (Rochlin, 1993). "Ordinarily such systems are rather hierarchal, both in the system and within the organization that make up the system" (Frederickson & Smith, 2003, p. 81). During times of crises, decentralized "epistemic networks" (Rochlin, 1989, pp. 161-168) emerge that allow for contingent coordination of problem solving efforts (Kettl, 2003, 2004) while still maintaining a formal chain of command (Marais, Dulac, & Leveson, 2004). Such flexibility supports improvisation – organizational bricolage – by creating the structure necessary to find solutions to the crisis at hand (Weick et al., 1999). These structures quickly dissolve once the crisis has abated. This type of environment engages coordination through decision-making espoused by Simon (1997) and requires respectful interaction amongst an organization's members particularly management's trust in employees to make decisions and take proper action.

Hutchins (1995) provides an excellent example of this principle in his study of organizational behavior aboard a U.S. Navy vessel. As described by Beunza & Stark (2004):

> While . . . on a U.S. Navy vessel, the electrical power of the ship in which the author's navigated failed just as it was entering San Diego harbor. The engines could be reversed but they would not take effect before the initial speed and the weight of the vessel would carry it on a calamitous course of collision with other ships anchored at bay. There was no time for orders down a chain of command. Hutchins documents, in a literally second-by-second account, how the vessel was safety navigated in a process of self-organized, laterally coordinated, and socially distributed cognition. (p. 5)

Here, even in the tightly coupled, strict hierarchal organization that exists aboard a U.S. Navy combat vessel, the simultaneous use of centralization and decentralization was applied in order to avert disaster. This fits Dynes' (2002) assertion that "since an emergency is characterized by decentralized and pluralistic decision making, the autonomy of decision-making should be encouraged, not centralization of authority" (p. 14).

Public works departments share with HROs the notion of a complex system. While technical sophistication tends to be the source of complexity in HROs, public works agencies involved complex interactions that stem from their multi-goal focus and loose coupling; that is, they are "characterized by personnel specializations that limit awareness of interdependencies, unintended feedback loops, inferential information sources, and the availability of alternate methods as well as buffers and redundancies"

(Inam, 2005, p. 46). Perrow (1999) argues that decentralization of complex, loosely coupled organizations is most desirable. Such arrangements allow field personnel to analyze and address problems at the point of disturbance in order to "prevent the propagation of errors" (p. 332).

Third, there is an "organizational commitment to anticipatory as well as reactive modes of dealing with real and potential problems" (Rochlin, 1993, p. 23). Thus, HROs take on principles of both resilience and anticipation as defined by Wildavsky (1988).

> While it is to be expected that HROs would devote enormous attention to anticipating possible failure modes, it may be less obvious that HROs develop capacity for resilience. Resilience is not only about bouncing back from errors, it is also about coping with surprises in the moment. It is important to retain both connotations of resilience to avoid the idea that resilience is simply the capacity to absorb change and still persist. (Weick, Sutcliffe, & Obstfeld, 1999, p. 100)

This is congruent with the Lovins' notion that resilience is more than a passive ability to bounce back, but an active, deliberate effort to better cope with surprises (Wildavsky, 1988).

Lastly, HROs maintain a great deal of structural, procedural, technical, and material redundancy (Frederickson & LaPorte, 2002; Frederickson & Smith, 2003; Roberts, 1990b). Authors such as Sagan (2004) feel that "there are inherent limits to the reliability redundancy can offer" and that redundancy can even lead to increased risks of "catastrophic common-mode errors, social shirking, and overcompensation" (p. 945). Landau (1969), however, argued previously that redundancy is not "waste" rather, it "provides a safety factor, permits flexible responses to anomalous situations and provides

a creative potential for those who are able to see it" (p. 356). Frederickson & Smith (2003) point to the Apollo 13 mission as an example of how the extensive use of redundancy by NASA helped save the crew. In addition, as illustrated by the popular Tom Hank's film *Apollo 13*, engineers, flight controllers, and the astronauts themselves engaged in significant team-oriented improvisation in an effort to save the mission.

Of course, most government agencies are not as complex or tightly coupled as HROs. Nor, do their failures generally lead to the dire social, political, and environmental consequences that would accompany, say, a meltdown at a nuclear power generating station. Yet, for some government agencies – such as those operating during crises or natural disaster – there is zero tolerance for mistakes. In this respect, they share with HROs a need for the principles that lead to high-reliability (Frederickson & LaPorte, 2002).

Dimensions of Organizational Resilience

All of the concepts presented in the literature can be distilled into three interrelated dimensions that conceptualize latent organizational resilience: structural, material, and cognitive. An organization's resilience potential is maximized when all three factors are addressed. The structural dimension considers the capacity of an organization to implement policies that lead to reduced vulnerability and service disruption. High-reliability theory identifies the practices and processes necessary for consistent operational reliability in chaotic situations and the study of HROs illustrates their relevance to resilience. Three constructs of the structural dimension can be derived from this literature. Resilient organizations share with their HRO counterparts a pre-occupation with failure, concurrent centralization of authority that decentralizes during

crises, and a commitment to both anticipatory and reactive models to deal with unforeseen events. The forth construct is Wildavsky's (1988) Flatness Principle, which addresses organizational structure and holds that the wider the base of the organization in comparison to the number of hierarchal levels, the more stable it will be.

The material dimension encompasses physical, informational, and technological assets as well as the relationships with internal and external suppliers of those assets. Constructs of the material dimension refer to the extent to which assets are substitutable to sustain operations in the event of a disruption or loss of functionality. They also address the capacity of an organization to mobilize resources when conditions exist that threaten to disrupt operations. Put simply, the material dimension addresses the ability to mobilize human and physical resources to meet established priorities and achieve goals. Six principles identified by Wildavsky (1988) as being associated with resilience partially make up the material dimension. To an extent, all of these factors relate to maintaining redundancy – a principle identified not only in Widavsky's work but is also discussed in the literature on high-reliability theory. These principles foster resilience by maintaining a surplus in physical assets or establishing a greater number of pathways by which resources can flow to meet organizational needs.

The cognitive dimension captures the collective knowledge, skills and abilities of all of an organization's human resources. It enables employees to detect, interpret, and understand critical situations in order to form responses that adjust to fluid situations and engage in positive adaptive behavior. The cognitive dimension also encompasses aspects of human behavior that facilitate cooperation so that members of an organization can better identify problems, establish priorities, and engage in collaborative solution

seeking. These concepts are captured in Weick's (1993) examination of the Mann Gulch disaster and subsequent construction of four elements of resilience: bricolage, virtual role systems, an attitude of wisdom, and respectful interaction.

Mallak (1998b) provides an intriguing foundation for the development of an index or scale to measure resilience potential. This concept is difficult to gauge since resilience can only be accurately measured once it has been manifest after some crisis. Through a survey of nursing executives at 168 acute care healthcare facilities, Mallak developed several scales designed to measure aspects of resilience building in organizations. These measures encompass the three dimensions of resilience potential identified in this research. *Goal Directed Solution Seeking*, "brings together the need for goals and a vision to guide creative processes in seeking solutions to problems" (p. 151). *Source resilience* requires multiple sources of information and the ability to construct a reality "based on richer information" (p. 152). *Avoidance or skepticism* involves "approaching new situations with skepticism, an item associated with the attitude of wisdom concept" (p. 151). Effective use of information that leads to a critical understanding of the situation in times of chaos is the third factor associated with resilience. *Role dependence* "is the ability to fill in for missing team member" (p. 152). This is aligned with Weick's virtual role system. This factor requires an organization to establish the structure and processes to educate, train, and test members in those roles. Finally, resilience requires *access to resources* and the knowledge to do the job.

Organizational Resilience in the Wake of Disaster

"General organizational theory suggests that organizations are not particularly resilient – at least not in the positive sense of being able to respond effectively to

catastrophic events" (Freeman et al., 2004, p. 4). Certainly, the terrorist attacks on New York and Washington, D.C. on September 11, 2001 constituted one of the worst urban disasters in United States history (Restrepo & Zimmerman, 2003). Beunza & Stark (2004) point out that the attacks fit within Weick's (1993) definition of a "cosmology episode," where people suddenly feel that the universe no longer makes sense:

> . . . the destruction of the twin towers precipitated an ontological crisis in which the basic laws of matter that one has learned as a child now seem to be violated: chairs can tip over, trees fall down, but buildings of that size and scale should not so quickly vanish. (Beunza & Stark, 2004, p. 5)

Thus, 9/11 provides an unprecedented opportunity for scholars to examine the application of organizational resilience theory after disaster. Tierney (2003) confirms that, "the attack on the World Trade Center constitutes an important case study that can lead to a better understanding of how organizations . . . achieve resilience in the face of near-catastrophic and catastrophic disaster events" (p. 2). Three studies have focused specifically on organizational resilience in the wake of the attacks. Organizations included in these studies include an equity department and trading firm (Freeman et al., 2004), the New York City Emergency Operations Center (Kendra & Wachtendorf, 2001), and a Wall Street investment bank (Beunza & Stark, 2004).

In presenting these cases, it is important to consider that, unlike Wagner Dodge in Mann Gulch (Maclean, 1992; Weick, 1993), there is no evidence that any particular individual within these organizations independently exhibited traits of resilience. Instead, the organizations themselves seemed to provide a vehicle through which collective action leads to resilience. This occurred despite the fact that these organizations faced an

unprecedented event that could have easily led to their failure. Rather than succumbing to potentially paralyzing anxiety and fear, this crisis appears to have elicited improvisation, opened up new opportunities, and created emergent networks and partnerships that led to the survival and even the post-traumatic growth of the organization and its members.

As the physical danger from the collapse of World Trade Center had passed, people were left with potentially crippling anxiety, questions of professional identity, and doubts about their own future (Beunza & Stark, 2004). Schneider (1992) notes that this is a typical post-disaster psychological response and "represents a situation where people do not know how to act because their usual sources of guidance are unavailable and/or irrelevant" (p. 137). Within organizations, this creates a potential for the collapse of sensemaking and a breakdown in virtual roles (Weick, 1993) that can ultimately lead to a dissolution of unit cohesiveness. The smokejumper crew at Mann Gulch suffered just such a breakdown. With the crew in rapid retreat, Dodge ordered his men to discard their tools. "When firefighters are told to throw away their tools, they don't know who they are anymore" (Maclean, 1992, p. 226). They begin to ask themselves, "'If I am no longer a firefighter, who am I?' With the fire bearing down, the only possible answer becomes, An endangered person in a world where it is every man for himself" (Weick, 1993, p. 637). The result was that, while Dodge survived because of his personal capacity for resilience, the organization fell apart and 13 firefighters died.

An ethnographic study by Freeman et al. (2004) provides an intriguing insight into just how precarious a position many organizations faced after September 11th. Sandler, O'Neill & Partners, an investment bank offering equity investment management and trading for banks, was nearly decimated by the attacks. Thirty-nine percent of its

workforce perished in the collapse of WTC, including nine partners and two-thirds of its management team. All of the firm's records and offices were destroyed. "In spite of these devastating losses, Sandler O'Neill . . . managed not only to survive, but to thrive" (p. 4). Despite the devastation, no clients were lost, the firm was making a profit within two months of the attacks, and the new business ventures were begun.

Freeman et al. (2004) attribute Sandler O'Neill's remarkable resilience to a number of factors. First, employees knew their jobs as well as the jobs of their colleagues, and were intimately familiar with the overall organization (virtual role system). Second, the firm was structured in a decentralized, self-regulating workforce with distributed authority. Third, Sandler O'Neill had a great deal of resources in terms of financial wealth, cognitive capabilities in their partners and employees, and social capital. Indeed, many of the practices and principles suggested by the literature on organizational resilience and high reliability organizations played some role in Sandler O'Neill's recovery.

But, perhaps the most unique resource available to Sandler O'Neill was a sense of "moral purpose" exhibited by its surviving employees as well as those outside the firm (Freeman et al., 2004). Moral purpose provided the motivation for Sandler O'Neill employees to "rebuild for their dead colleagues – to protect and provide for their families; to fight on the front line of the battle against terrorism – to not let those who attacked bring them down; and to accept a challenge to rebuild better than ever" (p. 31). The same feelings were also exhibited by outside agencies and individuals who were encouraged to help rebuild the firm. The authors note that Sandler O'Neill demonstrated wisdom (in a broad sense as defined by Weick, 1993) by capitalizing on opportunities to develop new

business ventures, capturing new clients while holding on to existing ones, obtaining and utilizing assistance from external sources, utilizing help from prominent CEOs and professionals who volunteered time to the company, and attracting and hiring quality talent from prestigious firms and universities. None of these opportunities would have been possible without the events of 9/11.

Kendra & Wachtendorf (2001) examined the resilience of the New York City Emergency Operations Center (EOC) after the destruction of the World Trade Center towers. At 9:03 a.m., United Flight 175 struck the South Tower of the World Trade Center (National Commission on Terrorist Attacks, 2004). Debris from the impact severely damaged 7 World Trade Center, where on the EOC and headquarters of the Office of Emergency Management (OEM) were located. Richard Sheirer, the director of the New York City OEM, was forced to evacuate the EOC and set up temporary operations at an intermediate facility (Cohen, Eimicke, & Horan, 2002). Eventually, a semi-permanent operations center was located at Pier 92 on the Hudson River (Kendra & Wachtendorf, 2001) where over 300 people per shift coordinated the response to the event (Restrepo & Zimmerman, 2003). While the site was certainly not as well-designed as the EOC at 7WTC, it was larger at nearly two-blocks long. The size of the space accommodated "an expanding number of people, work tables, copy machines, charts, and over two hundred computers, all networked and functioning" (Kenra & Wachtendorf, 2001, p. 20). As it turned out, this facility proved far more flexible and effective than the original EOC might have been.

OEM exhibited many of Karl Weick's (1993) sources of resilience during the response on September 11th. First, OEM members exhibited adaptive behavior and

bricolage in the creation of a fully functioning, makeshift EOC. This is especially impressive given there was inadequate redundancy built into the system. This adaptation was facilitated by virtue of New York City's size and heterogeneity. OEM had tremendous access to external resources and talent and the capacity to process and put these resources to use. Second, EOM staff had established working relationships with outside organizations through mutual aid agreements and interacted with colleagues at meetings and conferences. These activities established a foundation for a relationship that encouraged *respectful interaction.* Third, frequent training and exercising reinforced the *virtual role system.* As one member of the EOC noted, "It [the organization] was in my head" (Kendra & Wachtendorf, 2001, p. 25).

As previously noted, one shortcoming of the EOC in New York was a lack of redundancy. Many authors have pointed to the importance of redundancy to organizational resilience (eg. Bruneau et al., 2003; Wildavsky, 1988) and high reliability (Frederickson & LaPorte, 2002; Frederickson & Smith, 2003; Roberts, 1990a). Indeed, Kenra & Wachtendorf (2001) admit that greater material redundancy "might have increased the City's resilience, and therefore response capacity" but, they also note that such redundancy "would probably have been inadequate given the wide-ranging demands of [the] disaster" (p. 21). Ultimately, this reinforces the importance of improvisation and bricolage.

Beunza & Stark (2004) explore resilience in a Wall Street equity trading organization under the pseudonym International Securities. Their study is unique in that the researchers were present in the organization prior to the attacks on the World Trade Center as well as during its recovery. This provides a "privileged entry point to

understand organizational resilience" (p. 3). While all of the traders survived, the firm's trading room and technology were completely destroyed in the attack. Thus, employees were subject to acute anxiety and insecurity about the future of the company. The traders had to cope with "anxiety about additional attacks, questions of professional identity, doubts about the future of the firm, and ambiguities about the future re-location of the trading room" (p. 2).

The traders' anxiety was exacerbated by their own improvisation. Employees of International Securities established an Internet chat room to contact each other and express their feelings. This type of activity is indicative of the "milling process," (Schneider, 1992, 1995) an effort to search for meaning and a "means of sensemaking: sharing their puzzlement, asking questions of each other, etc." (Beunza & Stark, 2004, p. 10). While, Weick (1993) discusses bricolage in a positive sense of resilience, the traders were, in fact, engaging in a potentially destructive form:

> [T]his interactivity posed a problem: the medium gave every employee a view into everyone else's confusion. Instead of structuring the ways in which the employees made meaning of the tragedy in a way that gave reassurance, the web site was promoting anxiety. (Beunza & Stark, 2004, p. 10)

What led to resilience at International Securities? One component of their success was strong leadership coupled with a decentralized organizational structure similar to that exhibited by HROs during times of crisis and increased operations tempo (Frederickson & Smith, 2003; Rochlin, 1993). This structure created an organizational culture that "profitably exploited the uncertainties that the market threw at them" during normal business operations and "proved a resource to cope with the more difficult uncertainties

created by the attack on the World Trade Center" (Beunza & Stark, 2004, p. 9). There was also a concerted effort by the employees to confirm their identity as traders thus, preserving the virtual role system and respectful interaction. Unlike the smokejumpers at Mann Gulch who were instructed to throw away their tools (Beunza & Stark, 2004; Maclean, 1992; Weick, 1993), the employees of International Securities were told to "'pick up your tools' – begin the process of sensemaking and orienting yourself in the world by affirming your identity as a trader through the act of trading" (Beunza & Stark, 2004, p. 14). Of course, this effort required considerable positive bricolage in establishing a temporary trading room by using available warehouse space, combining old and new technologies, and showing a "willingness to solve problems" in creative ways (p. 15).

Conclusion

Public safety administrators and emergency managers have long advocated pre-disaster planning as a necessary element of effective organizational preparedness (eg. Alper & Kupferman, 2003; Banerjee & Gillespie, 1994; Drabek, 1990; Enders, 2001; Gillespie & Streeter, 1987; Lindell & Meier, 1994; Perry & Lindell, 1997; Philpott, 2004). Yet, threats to systems and the impact disasters have on those systems can never be fully anticipated (Godschalk, 2003). "As a result, an organization . . . is compelled to improvise to establish new courses of action consisting of structures, activities, resources, or tasks" (Wachtendorf, 2004, p. 156). Thus, a fundamental question in risk management is whether organizations should seek to anticipate disasters and create comprehensive plans for mitigating loss, or implement measures that enhance the ability to respond to disasters by creating the internal structures and policies that enhance resilience.

The continuity of government operations is an important topic for urban policy given the importance of public organizations to the health and welfare of citizens, as well as the dependence of the business community on services provided by public agencies. Local government agencies cannot serve their constituents and aid in local recovery efforts if they are pre-occupied with re-establishing their own critical organizational infrastructure after disaster. Continuity of operations planning is an internal effort to assure continuing capability after crisis, whether localized – such as the closure of the Brentwood Post Office in Washington, D.C. after the discovery of anthrax – or regional – such as Hurricane Katrina. Yet, good planning does not necessarily lead to an effective response to a crisis. Resilient organizations are able to successfully mitigate loss and continue to provide essential services by being flexible enough to adapt to new environments and taking advantage of improvisation and creativity during crisis.

While general organizational theory suggests that organizations are not particularly resilient during disasters (Freeman et al., 2004), qualitative and case study research have begun to document examples of organizational resilience in the wake of the 9/11 terrorist attacks. Sandler O'Neill, the New York City EOC, and "International Securities" (a pseudonym for a Wall Street trading company) are important case studies "that can lead to better understanding of how organizations . . . achieve resilience in the face of near-catastrophic and catastrophic disaster events" (Tierney, 2003, p. 2). An interpretation of this literature suggests that organizations facing a crisis that they did not anticipate may be more resilient than has been previously presumed. However, an important question remains: can organizations increase resilience through pre-disaster continuity planning?

The literature presented on organizational resilience can be codified into three distinct but interrelated dimensions: structural, material, and cognitive. The structural dimension encompasses organization and procedural elements that allow employees closest to the point of disturbance the freedom to interpret a situation and create indigenous solutions. The material dimension addresses redundancy or the alternative paths to resources necessary to address a crisis. Finally, the cognitive dimension captures the knowledge, skills and abilities of employees and requires continuous education of personnel so that they have the capacity to interpret and understand critical situations. The concepts of resilience identified in High reliability organizational theory coupled with the work of Larry Mallak and Karl Weick provide a framework with which to measure the cognitive processes and organizational practices within organizations that create resilient structures.

Chapter 3 - Methods

The challenge of this dissertation is to translate the concepts of high reliability organizational theory and resilience into measurable constructs to develop a latent organizational resilience index. Mallak (1998b) created and tested six factors for measuring resilience potential that are congruent with research conducted by Weick (1993) who examined why organizations fail and how they can be made more resilient. These factors will form the basis of the index developed to measure the three dimensions of organizational resilience identified in this research. This index will be used to document the variability of resilience potential among municipal public works agencies. Additionally, a review of the literature on disaster preparedness has identified six managerially influenced structural and organizational variables that may have a relationship with organizational resilience potential.

This chapter details the methods used to obtain answers to the research questions. It presents the data collection plan and provides the rationale for selection of a survey research design. A statement of the logic for selecting a target population and the sampling strategy follows this discussion. The bulk of this chapter is dedicated to a thorough explanation and justification of the techniques used for the measurement of continuity of operations planning, organizational resilience potential, and correlates of latent resilience.

The Unit of Analysis

A literature review on organizational resilience and High Reliability Organization Theory provided the necessary background with which to develop a set of research questions. The research questions then guided the selection and development of a

research design and data collection instrument. These questions reflect two empirical objectives of this research. The descriptive objective is to characterize the prevalence of both continuity of operations planning in public works departments and the level of resilience potential measured in these organizations. The theoretical objective seeks to develop a scale or index to measure resilience potential in organizations and explore the relationship between a set of independent variables and the level of organizational resilience potential displayed by public works agencies. Given that measurements of prevalence occur within a defined population and that the correlates to resilience are largely structural variables, a survey research design executed in a selected population will adequately accomplish the two empirical objectives.

The unit of analysis for this research is the organization; specifically, municipal public works departments. The reason for selecting public works is that relatively little research has been conducted on this municipal agency despite its importance to the daily operations of the city (Perry & Lindell, 2006). Brouillette (1970) observed that the public works department is responsible for such vital services as keeping the streets open, the distribution of water for both drinking and fire suppression, and maintaining the sewer system. While these services are not generally considered to be emergency services, they are key to a community's crisis response and disaster recovery efforts. It is essential that support agencies such as the public works department are capable of responding not just to disaster-generated demands, but are also able to meet the everyday demands for service after a disaster (Anthony, 1994; Cooke, 1994; Wolensky & Wolensky, 1991).

In one sense, the overall structure of this dissertation is that of a case study (Yin, 2003). The goal is to select a class of organizations for study and collect information on

their performance. The population and sample frame for this study involves DPW agencies in Region VII of the American Public Works Association. Region VII encompasses the states of Arizona, New Mexico, Oklahoma, and Texas. This requires qualification in regard to external validity. It is important to understand that the purpose of this research was not to execute a random sample survey in order to collect data to make projections back to a defined population, or inferences about the prevalence of specific relationships in a defined population. If this were the case, a different sampling technique – one based on probability sampling – would have been used to create the database. Rather, the *primary* objective here is theoretical in that it seeks to explore the possibility of creating a tool or technique to empirically measure the presence of latent resilience in organizations. A non-probability sample is appropriate to this task (Glaser & Strauss, 1967; Stake, 1978). Therefore, no attempts will be made to statistically project the findings of this research beyond the selected population.

The sample for this research was obtained from a membership roster of the American Public Works Association, an international educational and professional association comprised of public agencies, private contractors, elected officials, city managers, and interested individuals. It is the largest public works organization of its kind with a reported membership of over 26,000. An initial query of Region VII (the area representing the target study population) produced a list of 1,810 members representing 350 municipal and county public works agencies as well as private sector contractors. Some of these agencies represented a single aspect or division of public works such as roads, utilities, or solid waste, rather than a full-service public works department. The search was refined to include municipal (cities and towns), full-service public works

agencies. The result was a sample of 194 members representing 142 municipal public works organizations. One individual from each agency – in most instances the public works director – was contacted to complete the questionnaire.

Research Questions

Research questions provide a means for guiding the kinds of data that are collected; suggesting how data should be analyzed and interpreted; and maintaining a focus on exploring relationships that have some degree of theoretical importance. Chapter 2 examined the body of literature that discusses the concepts and principles of high-reliability organizations, resilience theory, and continuity of operations planning. This can be used to formulate specific research questions related to the study of latent resilience in organizations, as well as examine possible independent variables that may impact resilience potential. In general, two questions drive this research. First, what is the distribution of public works departments along a continuum of organizational resilience potential and continuity planning? Second, what is the relationship between variables that managers can directly control or implement in their organization and resilience potential?

Much of the research undertaken here has both an exploratory and descriptive component. The exploratory component stems from the fact that only one previous researcher has attempted to quantitatively measure organizational resilience. Subsequent research identified in the literature review has been largely qualitative, single-case studies that are descriptive in nature. Thus, this dissertation explores the extent to which these concepts can legitimately be operationally defined as a scale that forms a measurement tool. Additionally, it explores the extent to which public works organizations can be characterized as resilient. The research is also descriptive in that, once scaled, it

documents the range of observed resilience levels in these same public works departments. The third research question also seeks to describe the relationship between organizational resilience and a variety of variables.

1. **What is the observed range of organizational resilience potential among the public works departments in the study?** Organizational resilience potential will be measured by creating an index using the six factors identified by Mallak (1998b). Each factor is measured with a single question on a discrete visual analog scale. The objective is to measure organizational resilience potential from low to high. In answering this question, the central tendency and dispersion of public works departments with respect to resilience potential is described in the sample population.
2. **What is the prevalence of continuity of operations planning (COOP) among the public works departments in the study?** The extent of continuity of operations planning in public works agencies is measured through use of a questionnaire. Each element of a COOP is measured with a single question in an ordered-category item response format. The objective is to measure the level of COOP completeness from low to high. In answering this question, the central tendency and dispersion of the public works departments with respect to COOP is described in the sample population.
3. **How do six managerially influenced organizational variables correlate to the measured level of organizational resilience potential?**

   3a **Level of Perceived Risk.** Several researchers have demonstrated a positive correlation between the level of perceived risk by managers and disaster preparedness (Drabek, 1990; Mileti, 1983; Mileti & Sorensen, 1987; Perry &

Lindell, 1997). Studies suggest that when management perceives risks in their environment there is a higher level of organizational preparedness for crisis (Drabek, 1990; Hoetmer, 1983). This same positive correlation is predicted between perceived risk and resilience. Respondents were asked whether their organization is likely to experience an event that disrupts their essential operations in the next five years.

3b **Managerial Information Seeking.** Research suggests that when senior managers request hazard or threat information from emergency services organizations, they increase the level of preparedness capacity (Stallings, 1978), enhance effective disaster planning (M. Lindell, C. Whitney, C. Futch, & C. Clause, 1996), and provide for a more effective disaster response (Quarantelli, 1970). Similar to the study on earthquake preparedness by Perry and Lindell (Perry & Lindell, 1997), the logic for including information seeking as a correlate of organizational resilience potential is the expectation that managers that actively seek information about potential threats will have a higher level of motivation toward mitigating their effects. Therefore, a positive correlation between managerial information seeking and resilience potential is predicted.

3c **Organizational Structure.** In their exploration of high-reliability organizations, Weick and Sutcliffe (2001) observe that decentralized decision-making in times of crisis adds to the resilience of organizations. By its simplest measure, decentralized organizations have fewer levels of management and wide spans of control giving employees greater freedom of action. All things being equal, a wide span of control can be more responsive to unstable situations because it

places decision-making in the hands of field personnel rather than requiring problems to be brought through the chain-of-command. The levels of management between the public works director and field personnel measure the correlate describing the structure of the organization. It is anticipated that more decentralized structures will be positively correlated with resilience potential.

3d **Participation in Community Organizations.** Social scientists have discovered that social involvement in clubs, teams, groups, and even religious organizations has the effect of building resilience in individuals (Karapetian-Alord & Johnson-Grados, 2005p. 241). Interpersonal relationships have also been shown to be important to personal recovery after a disaster (Jang, 2005). At the organizational level, community connections have been found to positively correlate to effective coordination among disaster response and other organizaitons (Drabek, 2003, 2005). Participation in community planning organizations and communication with emergency services departments may provide opportunity to create information and resource networks that are important to building high operational reliability and resilience potential. Consequently, it is expected that greater involvement of management in the planning community will be positively correlated with resilience potential.

3e **Extent of Continuity of Operations Planning.** With the exception of one study on continuity planning for earthquake preparedness (Perry & Lindell, 1997), COOP in local government has not been well documented. The extent of COOP certainly has not been examined as an independent variable. The review of the literature demonstrates that the elements of COOP have commonalities with the

concepts of high-reliability theory and organizational resilience. A plausible argument could be made that suggests that organizations with more extensive COOP plans will demonstrate higher levels of resilience potential. However, since the literature on COOP does not endorse or even suggest either a positive or negative relationship, no prediction regarding direction is made.

3f **Department Accreditation.** There has been increasing interest in the public sector in accreditation of municipal departments by relevant professional organizations. Many cities have sought nationally recognized accreditation for law enforcement agencies and fire departments. Ambulance companies have used the Commission on Accreditation of Ambulance Services accreditation as a selling point for municipal private provider contracts. The American Public Works Association provides an accreditation process that purports to provide tangible evidence that a public works department is managed and operated according to industry recognized standards. An element of accreditation is compliance with Emergency Management practices. The accreditation process involves a number of activities – strategic planning, records maintenance, communication, risk management, and others (American Public Works Association, 2004) – that may help build resilience potential.

The Survey Approach

A standard questionnaire was the avenue chosen for delivering the questions. Following Dillman's (1978) total design approach, updated by Mangione (1998), each questionnaire was mailed with a cover letter explaining the purpose and sponsorship of the project. The questionnaire was mailed to the director of the public works department

requesting that she or he complete the survey, or that a senior executive in the department with responsibilities for continuity planning do so. The process for insuring an adequate participation level involves three measures. First, a postage-paid, pre-addressed envelope was included with the questionnaire. Respondents were also provided the option of returning the questionnaire via fax. Second, a series of three follow-up mailings was sent to non-respondents. Electronic mail (e-mail) was utilized wherever possible. This allows for simple and rapid communication between respondents and the researcher. Out of the list of 142 agencies, 17 did not have an e-mail account on file with the American Public Works Association. In these cases, two direct mail reminders were sent. Subsequent mailings also include a copy of the survey in the event that the original was misplaced (Babbie, 2005). Finally, a summary of the study results was offered to participants. Questionnaire coding was changed with each new mailing to preclude the possibility of redundant data entry.

The questions developed to examine correlations between organizational variables and resilience potential were tested for reliability by means of a test/re-test technique (Carmines & Zeller, 1979; Edwards, 1957). The questionnaire was administered at a "time one" point, then the order of presentation of the items randomized and the questions re-administered to the same group ten days later. Eleven managers from public works departments in the metro Phoenix area served as the group on which the scales were pre-tested. A Pearson's product-moment correlation between the first and second administration was calculated to determine the reliability of the Organizational Resilience Potential (ORP) scale and the Continuity of Operations Planning (COOP) scale. The correlation for the ORP scale was $r = .97$, while the correlation for the COOP scale was

r = .86. Using Edward's criterion that correlations above .80 represent acceptable reliability, the scales were determined to be reliable.

Measuring organizational resilience potential. While the concept of resilience potential may seem to be an intangible one, there are measurable defining features that can be scaled or indexed to describe low to high success. In a study involving a survey of nursing executives in the acute healthcare industry, Mallak (1998b) developed six factors that effectively measure organizational resilience. The construction of these factors was based on the concepts discussed by Weick (1993): bricolage and improvisation, an attitude of wisdom, and virtual role system. These items "provide measurement methods for the complex construct of resilience" (Mallak, 1998b, p. 151). They also have face validity (Babbie, 2005; Schutt, 2004) in their ability to address the structural, material, and cognitive dimensions of resilience identified in Chapter 2.

Each of these six factors is operationalized by a single question. Respondents were asked to rate their organization along a seven-point visual analog scale (VAS). The VAS was constructed with three anchor points: one at each end and a third in the center of the scale marking a midpoint between two extremes. Respondents were instructed to describe their organization's operations along that continuum.

The first item – goal directed solution seeking – "brings together the need for goals and a vision to guide creative processes in seeking solutions to problems" (Mallak, 1998a, p. 151). The VAS for this factor begins with a statement that work teams are provided with a set of standard operating procedures for dealing with problems. Increasingly resilient organizations are theorized to move away from this rigid standard toward the empowerment of members to adjust procedures with supervisory input and

ultimately the ability to improvise solutions in the field with little or no managerial control. The question used is shown below:

Please indicate (along the continuum below) how your Departments operations flow during a crisis. To meet Department goals and objectives:

1----------2----------3----------4----------5----------6----------7

Work teams are expected to follow a set of standard operating procedures for dealing with problems	Work teams are empowered to adjust procedures within established guidelines or consultation with supervisors	Work teams are systematically trained to improvise solutions to problems in the field

Next, source resilience requires multiple sources of information and the ability to construct a reality "based on richer information" (p. 152). Some organizations have policies to withhold information from personnel in the field, limiting their knowledge to make informed decisions. Training employees to put problems into context is an improvement, but ultimately an organization that encourages its members to consider the consequences of alternative fixes and implement those actions may prove most resilient. Source resilience was assessed with the following question:

How is information provided to Department members?

1----------2----------3----------4----------5----------6----------7

System and process information is access protected to reduce the chances of employee mistakes in the field	Employees are given access to the information required to put problems into context when devising solutions	Employees are expected to gather information from all sources in order to consider the consequences of alternative fixes for problems

Avoidance or skepticism involves "approaching new situations with skepticism, an item associated with the attitude of wisdom concept" (p. 151). Employees trained to avoid taking risks will be unlikely to exhibit creativity or improvisation. Supervisory

direction may improve adaptive behaviors although those members who routinely and effectively operate with minimal or no supervision may develop more traits of a bricoleur. To gage how employees might tackle problems – either actively through empowerment, or passively through avoidance – respondents were asked:

When faced with a complex problem or new situation:

1----------2----------3----------4----------5----------6----------7

Employees are expected to avoid taking any significant risks on their own	Employees are directed to seek specific direction from supervisors	Employees empowered to address problems with minimal supervisor intervention

Effective use of information that leads to a critical understanding of the situation in times of chaos is the next factor associated with resilience. Critical understanding is measured in the VAS beginning with supervisors defining direction and making decisions about work priority, process and methods. Greater resilience is achieved by providing structured decision making tools and techniques and ultimately training employees to consider as much information as possible before making unstructured decisions. This resilience factor was measured with the following question on the VAS:

With regard to how employees are expected to operate in the field:

1----------2----------3----------4----------5----------6----------7

Supervisors alone define direction and make decisions about crisis response priority, process and methods	Employees are expected to use structured decision-making tools to participate in supervisor setting of priority, processes and methods	Employees are expected to have the knowledge to make decisions in crises with minimum intervention by supervisors

Role dependence "is the ability to fill in for missing team member" (p. 152). This is aligned with Weick's virtual role system. The ability to occupy key positions requires

an organization to establish the structure and processes to educate, train, and test members in those roles. Organizations have the most difficulty in filling key positions, even temporarily, when roles require a high degree of specialization. Some organizations improved resilience by cross-training personnel in multiple roles to maintain high operational reliability. Ultimately, however, organizations that utilize generalists often prove the most resilient because each member could fill-in for another with little or no advanced warning. Personnel are constantly training and operating in multiple roles within the organization. Public works directors rated role dependence with this statement:

With regard to job specification in the Department:

1----------2----------3----------4----------5----------6----------7

Key positions in public works are highly specialized and make it impossible for completely effective cross-training	Cross training and/or job rotation are systematically used for incumbents of all critical positions	Key position holders are generalists and can be filled readily from within employee ranks

Finally, resilience requires access to the resources necessary to do the job. Many organizations have signed on to the notion of the just-in-time supply chain. Others maintain a central cache of materials and equipment. These systems tend to be susceptible to disruption when their single-source supply is interrupted or inaccessible to personnel. More flexible supply systems include multiple sources either through redundancy of stock or multiple suppliers. The greatest level of resilience can be achieved by authorizing employees to access private sources of limited materials needed to improvise solutions during crisis and to utilize tools and supplies for purposes other than what they were originally intended. The final statement on the VAS asked:

Which best describes your Department's resource system?

1----------2----------3----------4----------5----------6----------7

Work teams have access to a central cashe of equipment and materials to use for job-specific purposes	Work teams have access to multiple sources of materials and equipment; redundancy is build into the system	Work teams have authority to purchase materials as necessary and utilize tools for other than their intended purpose to accomplish a task

Measuring continuity of operations planning. The primary objective of a COOP is to establish plans and procedures to be used in the event of an interruption of service. Responding to an unanticipated event, restoring time-sensitive essential services, and eventually, reestablishing normal operational capacity are goals that are encompassed in COOP. COOP is not a step-by-step emergency procedure, rather it is a guide for establishing a emergent structure and lines of authority that enable organizations to carry out their mission during a crisis. To measure the eleven elements of a COOP, a scale was designed using a summated rating scale with several ordered-category variables. Each of the eleven elements of a COOP was captured by a single question. Five choices were given for each question: "preliminary," "partial," "substantial," "detailed," and "completed." Each response is followed by a brief description of the extent of completion for each planning area. A rating of "preliminary" states that management has engaged in some discussion of the planning item, but no explicit planning had been conducted. A department that reports an item of COOP as being "completed" must have exercised their COOP in a full-scale exercise.

Item 1 To what extent has your Department **developed written plans** to facilitate your continuing operations in the event of a crisis in your community or your physical structures? (The crisis could be a flood in

your community, a major water pipe leak that requires your headquarters to close or even a terrorist attack that prevents you from using normal processes and buildings to delivery services).

Item 2 Has your Department **identified and prioritized essential functions** that must be performed within 12 hours of an unexpected event or disaster?

Item 3 Has your Department identified personnel who have the **authority to make key decisions in crises**?

Item 4 To what extent has the Department **established orders of succession** for key positions and granted written authority for successors to make critical decisions?

Item 5 Is there an existing plan for maintaining your essential operations from **alternate facilities** if one or more of the structures housing your organization becomes dysfunctional or cannot be occupied?

Item 6 Does your Department have redundant communications systems and **interoperable communications** with emergency response agencies, elected officials, City leaders, suppliers, and essential partners?

Item 7 Have you identified, protected, duplicated, and do you have ready access to electronic and hardcopy documents, references, records, and **information systems** needed to support essential functions during an unexpected event or disaster?

Item 8 Does your plan address how you will assist nonessential employees and **activate key personnel** in the event of a crisis?

Item 9 To what extent have you **exercised or tested your COOP plan**?

Item 10 Is there a current inventory of personnel, equipment and materials as well as operating procedures to address how your Department will seamlessly **begin executing essential functions during a crisis**?

Item 11 Does your Department have an executable plan to smoothly **transition from temporary emergency operations back to normal operations status** once a threat or disruption has passed?

Exploring Correlates of Organizational Resilience

The overall purpose of any dissertation is to contribute to the growth of knowledge (White, 1994) and build upon the theoretical foundation in the student's academic field. From a practitioner's standpoint, theories are not to be constructed independent of practice, rather it is important to know "how to locate or to construct theories that might provide useful guides for action" (Denhardt, 2004, p. 188). Along these lines, methods in disaster research – here considered from a public administration perspective – are often focused on applying social science or political theory to identifying useful managerial strategies that improve preparedness or response capacity. Certainly, one thrust of this research is to provide useful information – based on a sound theoretical foundation and supported by valid methodological design – a variety of managerially influenced variables that should be correlated with organizational resilience and test those relationships in the dataset.

There are a number of individual, organizational, and community variables that have been demonstrated to impact the level of disaster preparedness. However, to keep the measurement within this study consistent, all correlates of organizational resilience

potential will be measured at the organizational unit of analysis. These correlates were further limited to only those items that could be substantially influenced by managers. In creating their model for predicting earthquake preparedness among municipal and county departments, Perry and Lindell (1997) utilize three factors including the level of perceived risk among managers and managerial information seeking. These variables were found to explain about two-thirds of the variance. Other research has similarly demonstrated the correlation between preparedness and the variables of managerial information seeking (Drabek, 1990; Mileti, 1983; Mileti & Sorensen, 1987) and level of perceived risk (M. Lindell, D. Whitney, C. Futch, & C. Clause, 1996). The question is: how will these variables correlate with resilience potential?

A review of the literature has identified three additional variables appropriate for this study. The first deals with organizational structure with regard to the degree of centralization. Managers need to have control, but case studies related to organizational resilience suggest that highly bureaucratic, command-and-control style structures impede creativity and adaptive behaviors by employees. Centralization is the degree to which decision-making is centered at the top of an organization. The debate over centralization versus decentralization of operations is an age-old battle of standardization versus local autonomy, control versus empowerment, and efficiency versus responsiveness. With respect to decentralization in predicting danger and preparing for the unexpected, Wildavsky (1988) notes:

> The larger and more centralized the organization that seeks to predict the future, the longer it will take to get agreement, the fewer hypothesis it can try, and the

> more costly each probe is likely to be . . . . Decentralized anticipation (numerous independent probes of an uncertain future) can achieve a greater degree of safety. (p. 8)

As far as responding to unanticipated events, high-reliability theorists observe that HROs vacillate between strong centralization during normal operating status and decentralized decision-making in times of crises (Weick & Sutclife, 2001). This adaptive structure allows for greater flexibility in the field and facilitates rapid response to changing conditions. It is anticipated that more decentralized organizational structures will demonstrate greater resilience potential.

Participation in community organizations had been proven to increase resilience at the individual level. Karapetian-Alord and Johnson-Grados (2005) cite involvement in clubs, teams, groups, and even religious organizations as one of the factors that fosters resilience in children. In disaster research, Jang (2005) found that wide social support networks positively correlated to a survivor's "posttraumatic growth." For organizations, the importance of interpersonal relationships to successful multi-agency coordination during crisis has been demonstrated (Drabek, 2003). This research will explore whether the frequency of contact with organizations with emergency missions (police and fire) or crisis planning groups (Local Emergency Planning Committee) positively correlates with resilience potential in organizations.

The extent of continuity of operations planning has a unique role in this study in that it serves as both a dependent and independent variable. While this research seeks to report on the prevalence of COOP, it also proposes to use COOP as an independent variable to determine if organizations that complete continuity planning have a higher

level of measured resilience potential. The questions related to COOP will be grouped using a "summated rating" (Alreck & Settle, 1985; Edwards, 1957) so that a resultant continuum identifies five levels of planning progress. It is predicted that public works organizations with a more complete COOP will demonstrate higher levels of resilience potential.

A final variable involves department accreditation by the American Public Works Association, or other professional accrediting organization. The examination of agency accreditation has yet to be studied in the context of resilience. In order to receive accreditation, agencies must demonstrate "full or substantial compliance" with a list of established practices (American Public Works Association, 2006, p. 3-26). The Fifth Edition of *Public Works Management Practices Manual* contains more than 500 standards and termed practice statements that a DPW agency must be able to perform to be considered a full-service agency. The Manual includes a chapter on Emergency Management that covers comprehensive multi-hazard emergency planning; use of private resources; training and exercising; emergency supplies and equipment lists; community lifeline facility restoration; emergency facilities location; emergency personnel policies and procedures; and others. These standards are congruent with many of the concepts found in high-reliability organizations. The practices are also reflected in the literature on building organizational resilience. It can be posited, therefore, that agencies accredited by the American Public Works Association would have a higher level of measured resilience potential.

Data Analysis

Two statistical techniques are appropriate for examining the probable strength and direction of the bi-variate relationships posed in the research questions. First, Karl Pearson's product-moment correlation coefficient (r) was used to assess the relationship between two variables. When squared (r^2), the Coefficient indicates the presence or absence of a relationship and explains the proportion of the variance in the dependent variable that is "explained" by the independent variable. The second technique was the one-way Analysis of Variance (or ANOVA). This common statistical procedure allowed for the analysis of the mean values of the Organizational Resilience Potential Scale across categories of different ordinal variables. This technique has been found to be statistically acceptable with the condition that ordinal variables have five or more categories so that they behave as interval scales (Boyle, 1970), as was done in this analysis.

Additionally, the theoretical objective of this dissertation is to examine the correlates of organizational resilience potential. In situations such as this, where the research focus is examining the impact of several independent variables on a single dependent, multiple regression is the appropriate analysis technique. This approach is used as a means of quantifying both the amount of variance in organizational resilience potential explained by all of the independent variables acting together and the relative importance of each independent variable in the study (Blalock, 1979). In this instance, the Coefficient of Multiple Determination (R^2) reports the relative predictive power of the model and the standardized partial regression coefficient (β) serves as an index of the relative importance of predictors. In the context of fitting a multi-variate model, it is

important to remember that the predictors used here are selected to be those over which a manager has influence; that is, those that could be modified by a concerted planning process. Clearly organizational resilience is also affected by other variables that a given manager in a given jurisdiction cannot manipulate: population size, jurisdiction budget, and others (Perry & Lindell, 2007, p. 259). Because the predictors in the model are restricted, within the analysis it is not expected that all, or even most, of the variance in resilience will be explained.

Chapter 4 – Results

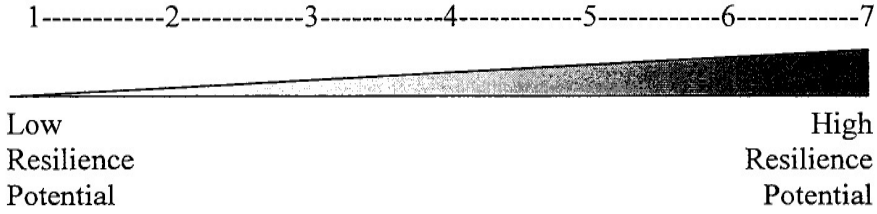
The purpose of this chapter is to present the results from the data analysis guided by the research questions posed in Chapter 3. This dissertation undertakes two empirical tasks. First, data were collected to obtain an overall picture of the level of continuity planning efforts in public works departments, as well as document the prevalence of measured organizational resilience potential. The latter objective is predicated on the ability of the scale devised for this dissertation to accurately measure latent resilience. The empirical performance of this measure as an indicator of organizational resilience potential is described herein. Second, a conceptual model of six primary correlates (predictors) of organizational resilience potential was devised. The correlates were confined to those that could be influenced by department managers. These expectations were tested on a population of municipal public works departments in Arizona, New Mexico, Oklahoma, and Texas; these four states constitute Region VII of the American Public Works Association. All of the variables were measured using the organization as the unit of analysis, thereby representing the characteristics of public works departments.

A total of 142 full-service, municipal public works departments were mailed a questionnaire. In most instances, the public works director was asked to complete and return the questionnaire on behalf of the organization. After three follow-up mailings – two using e-mail and one by direct mail – 96 directors returned the questionnaire achieving a 67.6% return rate. This completion rate is above 60%, the level specified by Babbie (2005) as required to meaningfully analyze probability sample data. The cases selected here were all of the elements of a specified population and there is a lack of consensus on general guidelines for acceptable return rates (Hutcheson &

Sofroniou,1999; Wallach, 1977). In the absence of guidelines, the research practice is to describe the organizations that completed and did not complete, acknowledging that the results apply only to those who participated in the research. Given the theoretical orientation of the dissertation – with no interest in making point population estimates – these qualifiers do not pose an interpretive problem. The organization of this chapter is structured around (1) a presentation of the analysis of the scales developed for this study, and (2) the results of the findings for each of the research questions.

Results of the Organizational Resilience Potential Scale

A key challenge for this research was the conceptualization and creation of a simple but reliable scale to accurately measure latent resilience in organizations; one based on the concepts of high-reliability organizations and resilience theory. The Organizational Resilience Potential Scale (ORPS) constructed in Chapter 3 is a seven-point visual analog scale consisting of an anchor point on each end of the scale and a third in the center of the scale marking a midpoint between two extremes. Each point is intended to imply a specific metric relation between the response levels (Uebersax, 2006) and respondents must mark one of the seven pre-specified points. Responses were coded such that the lowest level of resilience potential corresponds with the lower numerical anchor of the scale, while the highest level of resilience potential is observed at the upper end anchor point. One can think of the scales, calculated on items ranging from one through seven, as having anchor points as follows:



Each question tapped an important factor of organizational resilience potential as identified by Mallak (1998b) and based on the concepts discussed by Weick (1993): goal directed solution seeking, avoidance/skepticism, critical understanding, role dependence, source resilience, and access to resources.

The director or other senior manager in 96 full-service, municipal public works departments completed this scale acting as an informant about the practice of the department. Senior management was selected to complete the survey to ensure that the person completing the questionnaire had an organization-wide perspective as well as some years of experience in dealing with public works challenges. Obviously, this means that senior management was asked to assess and rate the resilience of his or her own organization. Critics may point out that this could lead to positive bias since managers may tend to over-estimate their own organization's resilience potential. This means that all reports by respondents regarding resilience are subjective in that the ratings may be colored or simply reflect the perceptual capacity of the person completing the survey. However, if a positive bias exists, it is likely constant across all of the organizations in this study. This provides the opportunity for future study of latent organizational resilience with multiple levels of management participating in the survey. For example, the senior manager of each operational division (water, wastewater, streets, etc.) could complete the ORPS; the results could then be compared to that of the public works director. Finally, the results of the study demonstrate that department directors tended to rate their organization somewhere along the conceptual center of the ORPS scale, with more "extreme" ratings actually falling at the lower end of the scale rather than the higher end.

Prior to using the questionnaire, a "test-retest" technique was used to examine the reliability of the ORPS. The pre-test demonstrated an impressive r^2 of .97 indicating that the scale was well above the .80 cutting point for minimum reliability. Detailed results of the pre-test are provided in Chapter 3. It is also important to note that, while scale construction may have differed, the factors that comprise the ORPS are the same as those identified and extracted via factor analysis by Mallak (1998). Mallak reported a factor analysis showing that these factors accounted for 56.8% of the variance in the instrument tested. Mallak also tested the factor-formed scale for internal consistency using Cronbach's Alpha; each yielded alphas between .70 and .89, meeting or exceeding the .70 level that Nunnaly (1978) has indicated to be an acceptable alpha reliability coefficient.

Following data collection, a Scale Item Analysis (Edwards, 1957) was performed on the ORPS to verify that it contained statistically additive items; that is, the items are not inter-correlated with each other, and therefore are in fact measuring different scale dimensions. Since the ORPS was constructed using a formal theoretical scaling approach – and not a significance test-based factor analysis technique – this outcome was expected (Hanushek & Jackson, 1977). An accepted statistical standard is that bi-variate inter-correlations amongst independent variables are additive if they are below a coefficient size of .80 (Berry & Feldman, 1985; Lewis-Beck, 1980). No pair of items in the ORPS shows a correlation coefficient higher than .51. Based on these findings, the ORPS items were determined to be additive.

Table 1 shows the distribution of public works departments by grouped scale values on the ORPS. The lowest observed was 2.50 indicating that on the whole the

Table 1.

ORPS Score Summary

Scale Value	Frequency	Percent
< 3.00	5	5.2
3.00-3.50	14	14.6
3.67-4.00	20	20.8
4.17-4.50	21	21.9
4.67-5.00	18	18.8
5.17-5.50	10	10.4
5.67-6.00	7	7.3
> 6.00	1	1.0
Totals	130	100.0

Note. Range was 2.50-7.00. The mean was 4.33. The Standard Deviation was 0.88.

organization engaged in practices that may not be conducive to resilience in crisis, while the highest score was 7.00 suggesting that the organization adopts policies that, theoretically, should result in higher levels of organizational resilience. The mean and median scores were both 4.33 with a standard deviation of 0.88, indicating that the average public works department is slightly above the conceptual center of the organizational resilience potential scale. However, the modal score for public works departments fell slightly below the conceptual center of the scale at 3.83, with 10 departments (10.4%) scoring at this level. There were only a handful of departments (5) at the lowest extremes of the scale showing a scale value less than 3.00. Even fewer organizations scored at the highest extremes of the scale; in fact, only one organization

scored above 6.00 on the ORPS. The remaining public works departments were well distributed between the 3.00 and 6.00.

These findings provide support for the assumptions that the public works departments presented in this dataset will have varying levels of resilience potential as measured for both overall organizational scores, as well as scores for the six concepts of resilience themselves. The question, therefore, is to what extent managers can directly – and positively – impact their organization's level of resilience potential. This question will be addressed in the examination of the six managerially influenced variables identified in Chapter 3.

The Continuity of Operations Scale

The second scale constructed for this dissertation was designed to (1) document the level of continuity of operations planning (COOP) among public works departments, and (2) serve as an independent variable in examining the impact of operational continuity planning upon organizational resilience potential. A summated ratings scale was devised comprising several ordered-category items that asked the respondent to disclose to what extent their organization had undertaken each of the eleven components of the COOP. Each item provided five possible responses: preliminary, partial, substantial, detailed, and completed. For the COOP scale, a score of 1.00 indicates that the department had engaged in "preliminary" planning activities, while to achieve a score of 5.00 a department would have to have "completed" all elements of that component of the COOP and tested them in a full-scale exercise. Table 2 shows the distribution of participating departments across levels of compliance with COOP recommended practices. The lowest score for completeness of all COOP elements was 1.09 reflecting

Table 2

COOP Score Summary

Scale Value	Frequency	Percent
1.09-2.00	11	11.6
2.09-2.50	13	13.8
2.55-3.00	18	18.9
3.09-3.50	14	14.7
3.55-4.00	18	18.9
4.09-4.50	11	11.6
4.55-5.00	10	10.5
Totals	95	100.0

Note. Range of scores was 1.09-5.00. The mean score was 3.23. The median was 3.27. The Standard Deviation was 0.98.

that the department had undertaken very little continuity planning efforts. The highest score was 5.00 indicating that all eleven elements of the continuity of operations plan were completed and exercised. The mean score on the COOP scale is 3.23, with a standard deviation of 0.97. Details of the relationship between COOP as an independent variable and the ORPS are discussed later in this chapter.

The progress local government agencies have made in their continuity of operations planning efforts, particularly since 9/11, is not well documented. This represents a first attempt to document COOP efforts among public works departments. Responses to each of the eleven items in the COOP scale are detailed below.

Plans. To assess the level of continuity planning in public works organizations, directors were first asked: "To what extent has your Department developed written plans

to facilitate your continuing operations in the event of a crisis in your community or in your physical structures?" It was suggested to respondents that a crisis could be a flood in the community, a major water pipe leak that requires a facility to close, or a terrorist attack that prevents the department from using normal processes or buildings to deliver services. The mean score for this question was 3.28, with a standard deviation of 1.17. More than half of the public works directors (56.2%) indicated that their department had undertaken either "partial" or "substantial" planning efforts. Based on the descriptive terms provided for these two response levels on the COOP scale, these departments have identified at least five planning areas including (1) identifying and prioritizing mission essential functions, (2) locating possible alternate operating facilities, (3) securing vital records, databases, and systems, (4) establishing written orders of succession, and (5) installing delegation of authority. However, few departments engaged in efforts to disseminate this information to lower levels of management or field employees are incomplete. Over one-third of public works departments (37.7%) in this population report having completed detailed planning efforts and 20 of these agencies have tested their plans in a full scale exercise.

Essential Functions. A key component of continuity planning is the identification and prioritization of the organization's time-sensitive, mission-essential functions. Essential functions are generally defined as those that must be executed within the first 12 hours of a disaster otherwise there is a significant risk to life safety, a decline in the confidence in government, or a loss of economic integrity. Examples of critical public works services included maintenance of urban drainage and flood control systems, provision of potable water, collection of solid waste, treatment of sewage, and the supply

of water for fire control, among others. The mean score for this question was 3.29, with a standard deviation of 1.22. This highest number of respondents (53.1%) reported having either completed "substantial" or "detailed" lists that identified essential functions and prioritized them based on time-critical sensitivity. Of this group, 24 of 51 respondents claim to have allocated resources toward accomplishing these tasks in time of crises. Nineteen departments report fully completing this portion of their continuity plan.

Delegation of authority. Delegations of authority specify who is authorized to make decisions and act on behalf of the organization in the absence of more senior management or supervisory personnel. Lines of authority within public works departments seem very clearly defined based on the results of the survey. Looking across the scales from low (1.0) to high (5.0), the number of departments in each category increases at each level; this result is not demonstrated in any other item in the COOP scale. Indeed, this item had the highest mean (3.6), median (4.0), and modal score (5.0) than any other item. Fifty-five departments (57.3%) report that key programs have been identified, documented to whom authority is to be delegated, and have trained subordinate personnel to perform their emergency duties. More than half of this group also reports that these personnel have acted in these roles in a training scenario. It cannot be determined by this study, however, whether these lines are the result of purposive continuity planning efforts or simply a consequence of a paramilitary-style organizational structure. However, based on the descriptors included in the question, we can conclude that at least some level of planning activity accounts for this finding.

Orders of succession. On the other hand, a paramilitary-style organizational structure is characterized by rank-in-job career systems where authority is vested in one's

position in the hierarchy, rather than on the duties performed (Cayer, 1996). In local governments, police and fire departments largely subscribe to this organizational model. Such systems have a clear chain of command, division of labor, and orders of succession based on rank. For example, the fire department rank structure begins with the field firefighter and progresses through company officer (lieutenant/captain), battalion chief, deputy chief, and fire chief. In the absence of the fire chief, the senior deputy chief would be in charge by virtue of rank.

Public works departments may be arranged by rank-in-job, but are often organized around a dual-track or multi-track system due to the technical proficiencies required in the various divisions of the organization. Such systems may create confusion without clearly established orders of succession created through continuity planning. This component of COOP was addressed with the question: "To what extent has the Department established orders of success for key positions and granted written authority for successors to make critical decisions?" The mean response to this question was 3.34, with a standard deviation of 1.20. Twenty-three (24.0%) of respondents reported only "preliminary" or "partial" succession planning. The bulk of public works departments (56.3%) report "substantial" or "detailed" plans with roughly half of this number (23 out of 50) actually training personnel to assume key leadership positions during a crisis. Nineteen (19.8%) departments have completed this component of COOP.

Alternate operating facilities. In the event that an emergency forces the closure of a work area, key operations should relocate to an alternate operating facility that has the capabilities to allow the organization to carry out its essential functions. The identification of alternate operating facilities demonstrated the second lowest mean score

at 2.99 (SD = 1.2). A fair portion of public works departments (14.6%) in this sample had not identified any facilities that could be used for impromptu workspace should their primary facility become untenable. However, most agencies had addressed this issue to some extent. Twenty departments (20.8%) report that they had identified potential sites, but these sites would require improvements to become operational. Obviously, the extent of "improvements" will vary depending upon the facility, and work efforts to upgrade the new location to operational status will take time and possible redirect efforts away from the provision of essential services to the community. The highest percentage of this population (28.1%) falls into the "substantial" category, which indicates that these departments have secured locations that would have to be equipped to become operational, but that they have developed written plans or procedures for relocating. Slightly more than one-third (36.5%) have fully equipped secondary operating facilities, although only 12 of these 35 public works agencies have actually tested their ability to operate effectively from these facilities.

Interoperable communications. The events of September 11, 2001 at the World Trade Center in New York City illustrated the importance of interoperable communications. Public Works departments are an essential component of a municipality's emergency response system and must be able to communicate effectively with other organizations – such as police and fire departments, administrative leaders, suppliers and essential partners – as well as within the internal sub-divisions of the department – water, wastewater, streets, engineering, and others – in order to work in an effective, coordinated way toward hazard mitigation, response, and recovery. The mean score achieved by this population was. 3.20 with a standard deviation of 1.14.

Individually, nearly one-third (29.2%) of public works departments in this study acknowledge that significant communications challenges exist in their community or that no action had been take to address this issue. Twenty-nine percent 29.2% of the agencies have established backup communications procedures with key partners. Twenty-six (27.1%) departments report having established a redundant, multi-modal, interoperable communications system with key partners and twelve (12.5%) more agencies have the same level of planning completeness but have also tested these systems in a full-scale exercise.

Vital records and databases. Vital records and databases are those departmental documents, references and records that are needed to support information flow in the provision of mission essential functions. These may be in written form, kept in electronic databases, or on microfilm. COOP should address systems protection as well as the restoration and recovery of vital records. This element had the lowest overall mean of any of the 11 components of a COOP at 2.87 (SD = 1.35) indicating that much work still needs to be done in this area. One-fifth of departments (20.8%) indicate that they have yet to identify any of their vital records or develop a plan to protect or recover them. The four remaining levels of measure indicate increasing levels of attention to vital record protection. Al most twenty-two percent (21.9%) report at least identifying important records and databases that are vital to their department; 20.8% have duplicated these records; and 22.9% have duplicated important records, databases, and systems and placed backup documents in their alternate operating facility. Finally, 13 departments (13.5%) have utilized these backup records and information systems in a full-scale exercise.

Key personnel. While most managers would argue that every member of their organization plays an important role in providing good service to the agency's customers, each mission essential function has key personnel that are absolutely vital to the continuity of operations. It is important to conceptualize "key personnel" as key *positions*, not individual workers; although this may be the case in a select few education-intensive, highly specialized skill sets. Key positions need to be identified and the organization must maintain information about these positions including current occupants, work requirements of the position, and the location of the key position in the organizational structure. The public works departments studied have not done as well in identifying key positions (mean = 3.31, SD = 1.21) as they have delegating authority (mean = 3.64) or lines of succession (mean = 3.34), casting at least some shadow over exactly how well COOP plans have addressed human capital issues. Fortunately, only a small percent of public works departments (7.3%) report no progress toward this effort. In addition, 37.9% have only general guidelines describing what a key position in their organization is or having some preliminary roster available. Forty-two percent (42.7%) of departments, however, have made significant end roads in this important aspect of COOP by developing rosters and disseminating this information along to managers and employees within the organization. Twenty departments (2.8%) have exercised the activation of key employees.

Testing, training, and exercises. Exercises serve a number of purposes including identifying weaknesses in the plan, revealing gaps in resource needs, clarifying roles and responsibilities, testing communications systems and networks, and improving readiness for a real event (Perry, 2004). "To what extent have you exercised or tested your

departmental plans?" was the one question on the COOP scale not measured using the five ordinal levels of "preliminary," "partial," "substantial," "detailed," or "completed." Instead, public works directors were asked to specifically identify the highest level of training and exercising their department had participated in. The highest percentage of responses (27.1%) is in the tabletop exercise category. A tabletop exercise typically involves senior department personnel and is intended to introduce participants to the COOP plan and their role in it. A functional exercise is usually more complex involving a combination of tasks played out in "real time." Nineteen public works departments (19.8%) stated that they had participated in such a test of their COOP or emergency operations plan.

The full-scale exercise is a community-wide test of multiple functions of an emergency plans. These exercises involve multiple agencies with actual players in the field. Thus, full-scale exercises test the coordination and interoperability among agencies. Twenty-three departments (24.0%) report having played a role in just such a test of emergency plans. On the other hand, a good number of public works agencies (17 departments, 17.7% of the departments studied) have not participated or executed *any* testing of emergency plans on any level. It is unclear – given the scope of this dissertation and the questions asked – why this is the case. Seventeen other departments (17.7%) have also not participated in any testing, but have attended an orientation seminar on COOP that includes discussions on the role of public works agencies in maintaining continuity of local government operations.

Devolution of control and direction. According to Department of Homeland Security publications on COOP, devolution is the capability to transfer statutory authority

for mission essential functions from an agency's primary operating facility to alternate facilities. This also requires training alternate personnel to coordinate agency functions from alternate sites in the event that the department's leadership is unavailable or incapacitated. Devolution was measured with the question: "Is there a current inventory of personnel, equipment and materials as well as operating procedures to address how your Department will seamlessly begin executing essential functions during a crisis?" The mean response to this question was 3.37 (SD = 1.20). Nearly a quarter of public works departments (24.0%) state that they have specific lists and procedures for emergency use in place and that they have been tested in a full-scale exercise; a further 19.8% report that these plans are complete but have yet to be tested. Twenty-five more departments (26%) indicate that they have begun to plan for devolution. However, 24.2% of this population have inventory lists appropriate only for routine operations (16 departments) or have no detailed inventory at all (7 departments).

Reconstruction. The final element of a complete COOP addresses the issue of reconstituting agency leadership and transitioning back to normal operations once a crisis has waned. As a whole, public works departments in the population studied scored mean values below the center of the scale (3.0) at 2.95, although the standard deviation was 1.14. Seventeen departments have no explicit plans for the resumption of normal operations. In addition, fifteen departments (15.6%) rely on general guidelines, although even these have not been disseminated to key operations personnel raising questions on how effective these guidelines might be during a crisis. However, the majority of the agencies surveyed have addressed this challenge to varying degrees. The highest proportion of departments (31.3%) fall into the "substantial" category indicating that

procedures for transition have been outlined, and there has been some dissemination of this information among management. The remaining departments are reporting in the "detailed" (22.9%) or "completed" (11.5%) categories where reconstruction plans have been pre-planned, documented, and passed down through the organization. Again, only those public works departments reporting a "completed" plan element have actually tested it in a full-scale exercise.

Findings from the Research Questions

Based on the review of the literature presented in Chapter 2, six factors were identified that may affect organizational resilience potential. They include (1) the perception of risk by department directors, (2) the extent to which management seeks information about environmental hazards, (3) the structure of the organization, (4) the extent of participation in community emergency planning efforts, (5) the level of compliance with COOP recommended practices, and (6) whether the department was accredited by a professional organization or seeking accreditation. These correlates were posed as variables of the third research question to be explored as part of this dissertation. Findings for each of these variables are discussed below.

Pearson's product-moment correlation coefficient (r) was used to assess the strength and direction of the relationship of these correlates (independent variables) and organizational resilience potential, as well as the inter-correlations among the independent variables. The Pearson's r is a descriptive statistic that measures the strength of simple bi-variate linear associations. It is among the most commonly used measures of the relationship between two ordinal or interval level variables (Mueller, Schussler, & Costner, 1977). Pearson's r has a value that varies between -1.0 and 1.0 where the larger

value, ignoring the sign, indicates stronger association between the independent and dependent variables. An r of zero reflects statistical independence (no relationship), while an r of ± 1.0 means there is a perfect linear relationship (Sirkin, 2006). The sign indicates the direction of the association (Abdi, 2007a). A positive relationship means that as the independent variable increases, so does the dependent variable; a negative sign indicates an inverse relationship. When squared (r^2), the product-moment correlation coefficient is interpreted as showing the percent of variance in the dependent variable that is explained by the independent variable. All of the values of the correlation coefficient reported here are squared values. The Pearson's product-moment correlation coefficient is tested for statistical significance using a sampling distribution of rho; a traditional level of .05 is used throughout these analyses as indicating statistical significance, and a level of .10 indicating marginal significance (Healey, 2007).

Level of perceived risk by management. According to Tierney et al. (2001), "Hazards have low salience for most organizations except when there is an imminent threat" (p. 46). Past disaster research has demonstrated a correlation between the extent to which managers themselves recognize environmental risk and the extent they encourage preparedness activities. This relationship is expected to translate similarly to organizational resilience potential. Directors were asked to convey management's position on the likelihood that their organization would experience any type of crisis over the next 5 years that might require the activation of all or part of an internal emergency operations plan or other crisis management measures. In order to keep the focus of the unit of analysis on the organization and not the individual, "management" is defined as the senior managerial division of the organization, not simply the director. The Likert-

type item provided five responses that were evenly spaced gradations: highly unlikely (less than 1 chance in 4), unlikely (up to 1 chance in 4), even odds (up to 2 chances in 4), likely (up to 3 chances in 4), and highly likely (up to 4 chances in 4).

Table 3 shows the distribution of managerial attributions of risk likelihood. Twenty-seven public works departments have determined that there is at least a 50-50 chance of a service disruption in the next five years. Of the remaining departments, thirty-three felt that the likelihood of a disaster affecting their organization was greater than 50%, while thirty-five felt that this likelihood was lower than 50%.

The mean ORPS scores demonstrate a rise in organizational resilience potential as the managerial perception of the likelihood of service disruption increases. This finding is consistent with both the hypothesized relationship and other disaster research. Those managers that felt that some form of crises requiring an activation of all or part of their department's internal emergency plan was "highly unlikely" or "unlikely" scored a mean of 4.00 and 4.16 on the ORPS, respectively. Public works directors who report a sense in Table 3.

ORPS Score Compared to the Level of Perceived Risk

			Scale Values[a]	
Perceived Risk	Number	Percent	Mean	Standard Deviation
Highly Unlikely	11	11.6	4.0	.97
Unlikely	22	23.2	4.2	.88
Even Odds	27	28.4	4.6	.78
Likely	29	30.5	4.3	.83
Highly Likely	6	6.3	4.6	1.32

Note. [a]F=1.354, P=.256

their management that such an occurrence was "likely" showed an increased mean of 4.28, and those that believe a disaster was "highly likely" show a mean of 4.58. A one-way analysis of variance indicates that the observed differences do not reach statistical significance ($F = 1.35$, $p = .256$). Clearly, the pattern of the relationship – increasing risk perception produces higher levels of resilience – follows the hypothesis, but the spread of these differences (from 4.0 through 4.58) do not represent a definitive difference. As a result, the finding of a positive relationship between the perception of risk and organizational resilience potential should be cautiously interpreted pending further research.

Of course, one explanation for the low statistical significance is that even at the organizational unit of analysis perception of risk is purely a subjective term. Two respondents provided unsolicited comments on their questionnaire indicating that they were in "tornado alley" and that "tornadic activity remains a possibility." Yet, one director felt that his organization was highly likely (5.0) to be subject to some form of operational disruption, while the other only felt that there was only a 50-50 chance (3.0) of such an occurrence. Zhang, Prater and Lindell (2004) also found that individuals typically have an extremely difficult time placing a probability on disaster events that can be consistently and accurately communicated to others.

Another possible explanation is that as planning increases, the perception of risk among management decreases. This supposition is supported by a longitudinal study published in the *Annals of Behavioral Medicine* that examined how risk perceptions and risk behaviors affect one another (Brewer, Weinstein, Cuite, & Herrington, 2004). Results of this study support three hypothesis: (1) behavior motivates people to take

protective action against risk, (2) when people take protective actions they deem to be effective, the perception of risk decreases, and (3) the perception of risk accurately reflects risk behavior. Translated into organizational terms, high levels of perceived risk are related to the early planning stages. However, as planning is completed and exercised successfully, perception of risk decreases. Replication of these results has yet to appear in the disaster planning literature.

Managerial information seeking. Based on a simple information hypotheses (Perry & Lindell, 2004) one would expect to observe a positive relationship between managerial information seeking and resilience potential. There is much guidance available to public works departments to aid in the development of continuity of operations plans and other types of emergency plans. Federal authorities such as the U.S. Department of Homeland Security (DHS) and the Federal Emergency Management Agency (FEMA) publish guides for preparedness for a myriad of natural, technological, and human-caused disasters. Similarly, state emergency management agencies as well as local police, fire departments, and the Local Emergency Planning Committee (LEPC) offer opportunities for public works directors to become involved in regional, inter-organizational planning efforts and access experts in the field of emergency management. Planning assistance is also available from private sector consultants, professional associations, and academia. Public works directors were asked to indicate all of the sources of emergency planning information their organization had used to develop its continuity or emergency operations plan.

The median number of sources used by public works directors was 6, indicating that most public works directors sought multiple sources of information in developing

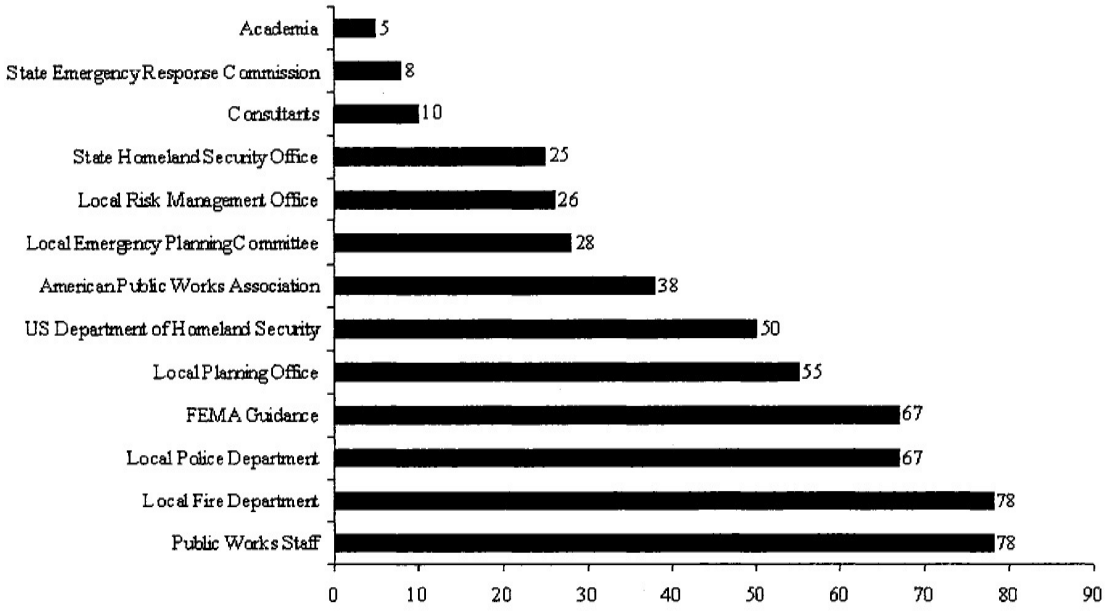


Figure 1. Sources of Information Used by Management

emergency plans. Seven department directors used only a single source of information in creating their emergency response plans. The largest number of sources accessed was twelve, with only two departments using this many. Figure 1 enumerates the frequency of use for each source. Internal public works department staff (83.8%) and the local fire department (83.8%) were equally reported as the most frequently utilized source of emergency planning information. Local police (72.0%), the U.S. Federal Emergency Management Agency (72.0), and the emergency management coordinator or emergency planning office (58.1%) round out the top five sources. More than half of public works directors (53.8%) also report accessing information from the Department of Homeland Security. Conversely, few departments tapped academia (5.4%) for assistance and state emergency response commissions (8.6%) went largely unutilized. Private sector

consultants (10.9%) were rarely involved in creating emergency or continuity plans, possibly due to the costs involved with hiring outside experts.

Respondents were also given the opportunity to identify "other" sources of information with an open-ended question. Two public works directors indicated that the county provided emergency planning assistance; the same number received assistance from the American Water Works Association. Additional sources named included the Arizona Department of Environmental Quality, the Texas Rural Water Association, the Water Environmental Federation, and the Solid Waste Association of North America. One department mentioned consulting peers in neighboring public works departments.

For the purpose of analysis, the number of sources used were grouped into four evenly-distributed interval categories such that 1 to 3 sources used was placed in level 1, 4 to 6 sources in level 2, 7 to 9 sources in level 3, and 10 to 12 sources in level four (Table 4). The correlation between number of sources and organizational resilience potential was $r^2 = .10$ and is statistically significant at $p = .018$ level ($F = 3.52$). The

Table 4.

ORPS Score Compared to Managerial Information Seeking

			Scale Values[a]	
Number of Sources	Number	Percent	Mean	Standard Deviation
1 – 3 Sources	21	21.9	4.1	.81
4 – 6 Sources	38	40.0	4.1	.82
7 – 9 Sources	27	28.1	4.5	.98
> 9 Sources	10	10.0	4.9	.49

Note. [a]F=3.521, P=.018

positive relationship is reflected when one looks at size of the mean organizational resilience scores. These increase from 4.11 for public works departments utilizing one to three sources, to a high of 4.95 for those using ten or more. The greatest change in magnitude comes between using four to six sources (mean = 4.13) and those using seven to nine sources (mean = 4.54). This difference could be the result of the difference between using sources to reference or duplicate a plan for one's organization, and that of actually researching the process of continuity planning thereby building resilience. This finding is consistent with the relationship predicted in Chapter 3.

Organizational structure. It was postulated that fewer levels of management would be positively correlated with scores on the ORPS. Hutchins' (1995) illustration of structural flexibility in U.S. Navy operations demonstrates how even tightly-coupled, strict hierarchal organizations such as the military must decentralize decision-making in times of crisis in order to avert catastrophe. According to Dynes (2002), the very nature of emergencies requires that organizations adopt decentralized decision-making structures, rather than relying on centralization of authority. For this study, organizational structure was examined by inquiring about the number of levels of management between field employees and the public works director. It was postulated that an inverse relationship would exist between these variables. Thus, as the number of levels of management decreased, the level of organizational resilience potential also would increase. As shown in Table 5, more than half of public works organizations (51%) report only one or two levels of management existing between the director and field crews. The number of organizations reporting in each category declines sharply from category to category as the number of levels of management increases. Twenty-four departments

Table 5.

ORPS Score Compared to Organizational Structure

Levels of Management	Number	Percent	Scale Values[a] Mean	Standard Deviation
<3	49	51.0	4.3	.83
3	24	25.0	4.5	1.09
4	16	16.7	3.9	.67
5	5	5.2	4.6	.77
>6	2	2.1	4.1	.59

Note. [a]F=1.216, P=.310

(25%) report three levels of management, sixteen (17%) report four, five (5.2%) report five, and only two (2.1%) departments claim to have six or more levels of management.

The concentration of public works departments in the smaller categories of "organizational levels" produces statistical restriction of range (Belsley, Kuh, & Welsch, 1985). This means that there is not enough variation in the levels among the departments studied to obtain statistical coefficients that can be interpreted without ambiguity. In this case, we would expect correlations of this "low variation" predictor with any other variable to be low, but we are unable to say if the low correlation is caused by statistical independence (no causal relationship) or because there was not enough variance available in "organizational levels" to statistically explain variation in resilience (Neter, Wasserman, & Kutner, 1985). Seventy-five percent of departments are located in the two lowest "organizational level" categories; there is a lack of cases in the organizations with high numbers of levels to make any statement at all.

Indeed, a one-way analysis of variance does indicate that the mean organizational resilience potential values are not statistically different across categories of "organizational level" ($F = 1.21$, $p = .31$). Yet, these results do provide an opportunity to briefly examine for new suppositions for future consideration. For example, when considering two, three, and six levels of management, we find mean scores of 4.3, 4.5, and 4.0, respectively. In other words, the level of resilience begins a moderate level then climbs slightly before beginning to drop off with its lowest level reached at the most levels of management, as predicted. It could be posited, therefore, that too few levels of management create a highly centralized decision-making structure that is not conducive to resilience. Resilience potential improves as decentralization takes place, but then declines as the organization becomes too "top-heavy". Again, it must be emphasized that this is merely an alternative hypothesis to the one posed in this dissertation, and that the evidence collected here does not support any conclusion.

Participation in community planning organizations. The fourth variable investigates the relationship between organizational resilience potential and the extent of participation by public works managers in community planning efforts. Organizational involvement in community planning activities has been shown to positively correlate with effective disaster response (Drabek, 2003, 2005) and this positive relationship was expected to replicate between participation in planning organizations and scores on the ORPS. It was posited that public works departments with no contact or only rare or periodic contact with agencies in the planning process would have fewer opportunities to access planning assistance, be less apt to identify and understand hazards that could affect the organization, limited capacity to create interoperable communications systems, and

lack the ability to establish relationships with key outside organizations. Conversely, public works departments that are full partners on jurisdictional planning teams would be expected to demonstrate higher resilience.

Only two public works departments (2.1%) reported that they had no contact with other agencies in the jurisdictional planning process and three (3.1%) rarely get requests from planning teams for information or for participation. Fifteen agencies (15.6%) reported periodic contact. The bulk of agencies claim to have greater levels of participation in community planning. Thirty public works departments (31.2%) in this population get regular requests from jurisdictional planning teams for information or participation and forty-five departments (47.9%) are full partners in the jurisdictional planning process.

The mean ORPS scores show a general increase as the levels of participation in community planning teams increases (Table 6). Public works departments claiming no contact with planning teams produced a mean of 3.33, whereas departments that are full

Table 6.

ORPS Score Compared to Participation in Planning Organizations

Levels of Involvement	Number	Percent	Scale Values[a] Mean	Standard Deviation
No Contact	2	2.1	3.3	1.17
Rare Contact	3	3.1	3.8	.59
Periodically Contacted	15	15.6	4.5	.94
Regular Requests	30	31.3	4.4	.81
Full Partner	46	47.9	4.3	.90

Note. [a]F=1.193, P=.319

partners in the planning process scored a mean of 4.29. However, there is a spike mean score of 4.50 for agencies that have periodic contact. Ultimately, the differences in ORPS score for different levels of participation are not statistically significant ($F = 1.19$, $p = .32$).

It is possible that there is no relationship between involvement in the community planning process and organizational resilience potential. Instead, it may be that involvement in the community planning process is really correlated with continuity of operations planning, which is itself connected with organizational resilience. Thus, the apparent logical relationship between immersion in the planning process and resilience is really spurious; these two variables are in fact only related through the intermediate variable of continuity of operations planning (Duncan, 1975). To test this conclusion, one-way analysis of variance was conducted for continuity planning with involvement serving as the dependent variable. For categories of continuity of operations planning, an increase in planning involvement generated higher means for continuity planning ranging from 1.64 for "no contact" to 3.47 for "full partner." This finding was significant to $p < .05$ ($F = 2.87$, $p = .03$). Therefore, it does appear that there is a spurious relationship between planning involvement and organizational resilience potential. The null hypothesis that there is no relationship between involvement and organizational resilience potential cannot be rejected.

Extent of continuity of operations planning. Continuity of operations planning holds a unique position in this dissertation in that it serves as both a dependent variable and an independent variable. That is, there is interest in knowing the extent of COOP planning and also interest in how it impacts organizational resilience potential. One might

speculate that a public works department with a more complete continuity plan would demonstrate higher levels of resilience potential given COOP elements' commonality with characteristics of high-reliability organizations. However, there is currently no literature to suggest a relationship between COOP and organizational resilience. Consequently, no prediction regarding the implication of COOP preparation on ORPS scores was made. As indicated in Chapter 3, COOP planning was measured with an eleven-item scale representing the minimum standards for COOP elements. These formed a summated ratings Continuity of Operations Planning Scale ranging from 1 through 5 (each score is the number of COOP elements the department has completed).

Table 7 shows the relationship between COOP completion categories and organizational resilience potential. Only ten (10.5%) public works departments' scores place them in the "completed" category indicating that nearly all COOP elements are completed and that COOP has been tested in a full-scale exercise. Twenty-eight agencies (29.5%) scored in the "detailed" category indicating completion of nearly all

Table 7.

ORPS Score Compared to Extent of Continuity of Operations Planning

COOP Categories	Number	Percent	Scale Values[a]	
			Mean	Standard Deviation
Preliminary	4	4.2	3.1	.73
Partial	20	21.1	3.9	.70
Substantial	33	34.7	4.5	.83
Detailed	28	29.5	4.6	.79
Completed	10	10.5	4.3	1.10

Note. [a]F=4.787, P=.002

elements of the COOP but that no exercise had yet been conducted to test the ability of the organization to execute the plan. Thirty-three departments (34.7%) have made some strides toward developing a COOP. However, twenty-four agencies in this population (25.3%) have made little (n = 20) or no (n = 4) progress on COOP planning.

When ORPS mean scores are compared across COOP categories, the magnitude of the mean steadily increases from low completion of COOP to higher levels of compliance. This pattern confirms the relationship pattern predicted in Chapter 3. In these data, the smallest mean score is 3.13 produced by departments with little COOP planning, and the highest level is 4.59 at the "detailed" category. Public works departments who have exercised their plan score somewhat lower means (4.33) although the standard deviation is higher than any other category (SD = 1.10) and the number of agencies in this category is fairly small (n = 10). Ultimately, an analysis of variance indicates that these mean differences are statistically significant ($F = 4.79$, $p < .01$). Pearson's r2 indicates that 10-percent of the variance in ORPS scores can be attributed to continuity planning ($r^2 = .102$).

Department accreditation. The sixth and final variable explores the correlation between whether a public works department has sought accreditation by a professional organization – most notably, the American Public Works Association – and organizational resilience potential. The APWA accreditation program provides a means for departments to objectively evaluate and demonstrate their compliance with acceptable professional standards and recommended practices. Department accreditation was measured on five levels: not accredited, preparing to accredit, self-assessment phase, evaluation phase, and accredited. Each response choice included a brief description of its

meaning. A sixth category – "other" – provided an open-ended response for public works departments that may be accredited by a professional organization other than the APWA. A single department indicated accreditation by the American Water Works Association (AWWA) "QualServe" program. A review of this program indicates that it is a voluntary accrediting process that involves a peer-review of an agency's compliance with benchmark standards that include: strategic planning, long-term financial planning, risk management planning, continuous improvement, and training hours per employee, among others. Considering the scope of the AWWA's QualServe accreditation program, a score of 5 was assigned to this to classify its performance.

In looking simply at the non-accredited (n = 74) and accredited (n = 6) categories, the observed mean raises from 4.23 to 4.89. However, upon closer examination of categories that make up the "in-progress" responses (Preparing to Accredit, Self-Assessment Phase, and Evaluation Phase) the means do not follow the predicted path from low to high. Still, one-way analysis demonstrates that the differences among the mean scores across accreditation categories is statistically significant ($F = 2.43$, $p = .05$). Although Pearson's r is small ($r^2 = .035$) indicating very little of the variance in ORPS scores is accounted for by department accreditation. Table 8 enumerates these findings. As was the case with organizational structure, the responses for this variable are not well distributed. The difference, however, is that the relationship between accreditation and ORPS scores was statistically significant, whereas organizational structure is not. This positive relationship must be cautiously interpreted until additional empirical study can be conducted that demonstrates greater distribution of responses on the accreditation

Table 8.

ORPS Score Compared to Department Accreditation

Level of Accreditation	Number	Percent	Scale Values[a] Mean	Standard Deviation
Not Accredited	74	78.7	4.2	.88
Preparing to Accredit	8	8.5	5.0	.50
Self-Assessment Phase	5	5.4	4.2	.63
Evaluation Phase	1	1.0	3.8	--
Accredited	6	6.4	4.9	.88

Note. [a]F=2.430, P=.053

scale. Ultimately, one cannot meaningfully attribute relationships when there are only six accredited agencies in the dataset.

Multiple Regression Analysis

We now begin the process of fitting the model developed in Chapter 3 to the data from public works departments by examining how the independent variables collectively relate to the dependent variable, as well as exploring their relationship to each other. Until this point the analysis coefficients have been bi-variate. Relationships have been examined serially, pairing one independent variable (level of perceived risk, managerial information seeking, organizational structure, participation in community planning organizations, extent of continuity of operations planning, and department accreditation) with a dependent variable (organizational resilience potential and COOP) for the purpose of determining the empirical relationship between them. These analyses display and interpret the uni-variate data and document each predictor variable's zero-order correlation with the dependent variable. In the real world of research and practice,

however, variables are not isolated pairs; rather, one must deal with multiple causes that simultaneously affect the same collective relationship. Multiple regression, therefore, is the appropriate statistical technique for these analyses (Mosteller & Tukey, 1977).

Multiple regression is a statistical technique used to explore linear relationships and develop predictive equations when there are multiple independent variables present. Lewis-Beck (1980) notes two ways in which multiple regression is useful. "First, it almost inevitably offers a fuller explanation of the dependent variable, since few phenomena are products of a single cause. Second, the effect of a particular independent variable is made more certain, for the possibility of distorting influences from the other independent variables is removed" (p. 47). Thus, multiple regression answers questions about the relative importance of each independent variable in causing changes in the dependent variable, and describes how much variance is explained by all of the independent variables acting together (Mosteller & Tukey, 1977).

The Beta (ß) coefficient is the "standardized partial regression coefficient" used to measure the relative importance of the independent variables (Matlack, 1993). The differences in magnitude of the Beta coefficients provides an estimate of the relative importance of the predictor variables (Matlack, 1993). For example, a beta value of 1.5 indicates that a one standard deviation change in the independent variable causes a mean increase of 1.5 in the dependent variable. The higher the Beta value, the greater the impact of the independent variable on the dependent variable (Brace, Kemp, & Snelgar, 2000). Beta coefficients range in values between –1.0 and 1.0, with the valence indicating the direction of the relationship. The beta coefficient allows such comparisons across variables from the same regression equation.

The magnitude of Beta coefficients can be affected by factors that distort the "true" relationship between variables (Lewis-Beck, 1980), including multicollinearity, specification error, and scale unreliability. However, if researchers carefully construct their conceptual models to avoid these problems, then beta coefficients can be meaningfully interpreted (Blalock, 1979). Furthermore, each beta coefficient may be tested for statistical significance using the t statistic (Knoke, Bohrnstedt, & Mee, 2002). A t statistic is calculated to assess the probability the observed beta coefficient is not statistically significant from a value of zero. Beta measures how many standard deviation units of the dependent variable will change when the independent variable associated with the beta weight changes by one of its standard deviation units while holding all other independent variables constant (Sirkin, 2006). A beta of zero indicates statistical independence. Since the probability distribution of t is known, the probability of independence can be assessed for all values of that statistic. Thus, it is appropriate to conclude that beta values that are not statistically significant are probably not producing enough change in the dependent variable to be substantively important.

Unlike Beta, the multiple correlation coefficient (R) is a measure of explained variance between the observed value of cases and their predicted value (Brace et al., 2000; Neter et al., 1985). As described by Sirkin (2006), the "concept of the multiple correlation, R, and the coefficient of multiple determination R^2, is an extension of the Pearson's r and r^2 to more than two variables" (p. 516). While R can be difficult to interpret, Mueller, Schussler and Costner (1977) developed a proportional reduction in error interpretation for R that involves focusing on the squared value of the coefficient. R Square (R^2) – referred to as the coefficient of multiple determination – indicates the

proportion of variance in the dependent variable that is attributed to the model of all predictor variables acting together. Values for R^2 range between zero meaning that none of the variation is explained, to 1.0 indicating 100% of the variance is explained. The multiple correlation coefficient squared can also be tested for statistical significance using the F-ratio (Abdi, 2007b). This test allows a means of assessing the difference between the observed explained variance (R^2) and the value of zero.

As previously discussed, there are a number of assumptions and inferences that are made about the nature of the data being analyzed in the application of regression (both bi-variate and multiple) analysis (Lewis-Beck, 1980). The first assumption is the absence of specification error. In sum, it asserts that no variables have been erroneously included or excluded, and that the relationships among the variables in the theoretical model are actually in a straight line – a linear relationship. On this latter point, statistics generally are capable of detecting only linear relationships. Because of this, bi-variate regression analyses between each independent variable and the dependent variable are run in an effort to detect evidence of non-linear, or curvilinear, relationships. If this is found to be the case, regression analysis is either eliminated as a technique, or the predictor variable must be transformed into a linear predictor (Blalock, 1979) by taking a log of the values. Upon inspection of the bi-variate analyses described in this Chapter, there is no empirical evidence that would suggest the possibility of curvilinear relationships.

Another assumption is that scales of all variables in the analysis can be treated as if they were interval. Three variables examined in this dissertation – level of perceived risk, participation in community planning organizations, and department accreditation –

are ordinal measures meaning that the intervals between adjacent scale values are indeterminate. However, Blalock (1964) holds that the use of ordinal variables as if they were interval is acceptable for regression analysis. In addition, Boyle (1970) used simulation methods to demonstrate that regression analysis is robust even in the presence of violations of the interval measurement assumption. Given the findings of these authors, the ordinal variables for this research were mixed with the interval ones in the analysis of the organizational resilience potential scale.

The final assumption in regression analysis that requires discussion here is that there is no inter-correlation among the predictor variables. Multicollinearity violates a Classical Assumption of econometrics required for Ordinary Least Squares to be the "best estimator" for regression models; that is, no explanatory variable is a perfect linear function of another predictor or combination of predictors. Studenmund (2001) notes that in the presence of multicollinearity estimates will remain unbiased, variances and standard errors will increase, computed t-scores will fail, and estimates become sensitive to changes in specification. Ultimately, since high inter-correlation can cause Beta coefficients and the multiple regression coefficient to exceed their upper limits, meaningful interpretation is impossible (Neter et al., 1985). There are many ways to detect the presence of multicollinearity. One warning sign is if none of the *t* statistics for the independent variables meets significance at the .05 level, yet the F-statistic for the model is significant (Berry & Feldman, 1985). Perhaps the most commonly used test for multicollinearity is the inspection of the observed inter-correlations of a matrix of predictors to ensure none are too high, and insuring that the beta and *R* values are within prescribed range (Lewis-Beck, 1980).

Detection of any inter-correlations among predictor variables in this study was measured using Pearson's product-moment correlation coefficient squared (r^2). An inspection of these correlations shows that all are well below the .80 threshold for multicollinearity set by Lewis-Beck (1980). Also, following Lewis-Beck, an inspection of the Betas and R^2 show all of these coefficients to be within the acceptable range. Taken together, these three conditions confirm that the presence of multicollinearity is unlikely. Indeed, the highest observed correlation was between management perception of risk and managerial information seeking, producing an r^2 of .28.

Brace et al., (2000) indicate that multiple regression analysis requires a substantial number of observations (cases) in comparison to the number of independent variables. The absolute minimum ratio is five to one, but 10:1 is generally considered more acceptable. For this study, 96 public works directors returned surveys that will be used to measure the impact of six independent variables on the ORPS dependent variable. Thus, a 16:1 ratio was achieved for this analysis.

Table 9 summarizes the results of the multiple regression analysis of six independent variables acting upon the dependent variable of organizational resilience potential. The R^2 value indicates that 20-percent of the variance in the ORPS is explained by these six predictors, and that this value is statistically significant ($F = 3.56$, $p < .01$). Therefore, we may conclude that the model developed in this dissertation has a "good fit" to the data. Of course, there is a significant portion of variance left unexplained by this model. As argued in Chapter 3, the principal concern here was with variables that were under the control of managers. Hence variables that would be expected to explain large amounts of variance – but uncontrollable – were left out of the equation, such as budget,

Table 9.

Regression Summary

Predictor	Beta (β)	t Statistic	Sig.
Continuity of Operations Planning	.28	2.6	.01
Managerial Information Seeking	.24	2.3	.02
Department Accreditation	.17	1.7	.09
Perceptions of Risk	.06	.61	.54
Involvement in Planning Community	-.09	-.90	.37
Organizational Structure	-.11	-1.07	.28

Note. P < .01

population served, form of local government, and federally assigned planning support. However, it is clear that certain managerially influenced organizational variables have a positive impact on latent organizational resilience.

Table 9 also reports the Beta (ß) values in descending order. Two of these items – continuity of operations planning and managerial information seeking – are statistically significant at the $p < .05$ level, with COOP being significant to the $p = .01$ level. These two items, therefore, are the principal determinants of positive changes in the values of the ORPS. In addition, department accreditation reaches a point of statistical significance above the 90th percentile or $p < .10$ level. While this may be considered "marginal" by social science standards, it is worth noting that accreditation of public works departments is a relatively new endeavor, and that as the number of departments that reach accreditation increases, the level of statistical significance of this finding may increase as well. The remaining three predictors – organizational structure, participation in

community planning efforts, and levels of perceived risk by management – did not test to a level of statistical significance, and therefore cause small changes in the dependent variable. It is also worth noting that two of these predictors demonstrate a negative correlation to the ORPS. However, the impact approaches zero and thus the relationship (if one exists at all) may prove to be positive as predicted in this study, once further research is conducted on these variables.

Chapter 5 – Discussion and Implications

The preceding chapter has presented the findings of this research in statistical terms. That is, concern focused upon the extent a predictor variable influenced the dependent variable at a particular level of statistical significance. While this is important from a methodological standpoint, statistical analyses do not elaborate or interpret findings or place them in academic and applied context. As Kirk (1996) has written, "Statistical significance is concerned with whether a research result is due to change or sampling variability; practical significance is concerned with whether the result is useful in the real world" (p. 746). Thus, the conclusion to this dissertation is presented through a discussion of the key findings with an emphasis placed on presenting practical and theoretical implications. Recommendations for future research on organizational resilience potential are also presented.

While past research on the concept of resilience in the face of crisis has been focused largely on the individual or community, this research approached resilience from the organizational unit of analysis. The basic objective of this dissertation was to theoretically and empirically connect the characteristics of high-reliability organizations to the idea of how continuity of operations planning may build resilience in municipal organizations. Recent literature has qualitatively documented the resilience of organizations in the wake of the 9/11 terrorist attacks on the World Trade Center. At the same time, some scholars have begun to question whether there is a causal connection between pre-disaster planning and effective response to crisis. Their questions go to the very core of the theoretical assumptions upon which emergency managers and disaster

academicians base recommendations for good planning practices and upon which expectations for successful disaster response are based.

The data examined here on public works departments begins to build a critical foundation of knowledge with which to decide whether a move toward a new paradigm in disaster planning – one based on building organizational resilience potential – is worthy of serious academic consideration. Overall, the results of the study are encouraging. The Organizational Resilience Potential Scale (ORPS) was found to be a meaningful measure of resilience and many of the research hypotheses posed in Chapter 3 were supported, at least within the population of public works departments used here. While it is not statistically appropriate to generalize these results beyond the population in this study, the findings do suggest that further research in the area of organizational resilience potential could yield planning recommendations that create organizational environments that are more conducive to enabling post-disaster adaptive behaviors and, when necessary, appropriate improvisation.

The literature pertaining to organizational resilience and high reliability organizational theory provided the conceptual framework with which to construct the ORPS. Data were collected through a brief questionnaire and 96 public works directors completed and returned the survey on behalf of their organization. These responses provided important information on resilience potential, actions managers had taken to ensure continuity in a post-disaster environment, and basic background information about the department, managerial perceptions of threat, and involvement in community planning activities. This information was coded into numerical form for statistical analyses using SPSS®. The ORPS was used to assess the relationship between six

managerially influenced variables hypothesized to be predictive of organizational resilience. Bi-variate analyses were conducted to determine the strength and direction of these relationships; multiple regression analysis was then used to obtain a fuller explanation of the relationship of the predictor variables acting collectively on the dependent variable. These results are discussed in detail in Chapter 4. It is now appropriate to turn this examination to an interpretation and discussion of the key findings.

Key Findings

Information obtained through the questionnaire provided a database that yielded numerous descriptive findings and enabled the development of a multivariate model. Interpretation of the statistical findings is presented here with an eye toward theoretical impact, practical application, and recommendations for further study.

Measured latent resilience in public works. Creation of the Organizational Resilience Potential Scale (ORPS) sought to replicate the work of Mallak (1998) by providing a simple tool with which to measure latent resilience in organizations. Six questions reflective of high reliability organizational theory and the literature on organizational resilience comprised the scale. Mallak previously examined these factors for internal consistency and found that they indeed met a level indicated to be an acceptable reliability coefficient. Further, several standard statistical measures of reliability were performed on the ORPS for this study. A test-retest technique produced an exceptional score for reliability, and a Scale Item Analysis verified that the ORPS contained statistically additive items. Ultimately, these tests support the reliability of the ORPS as a measure of resilience potential.

One research question focused on the observed range on the ORPS among the public works departments studied. The concern was to describe the distribution of departments by grouped scale values on the scale and the measure of central tendency in respect for their capacity for organizational resilience. The results of the analysis show good dispersion across the ORPS with a low score of 2.50 and the highest score was 7.00. While the average public works departments score slightly above the conceptual middle of the scale (3.5), the greatest number of departments actually fell slightly below this mid-range. This indicated that there were likely many bureaucratic processes and organizational structures in place that could inhibit resilience in crises.

It is possible that public works departments tend to constrain operations personnel – foremen, crew chiefs, and individual workers – to programmed decision-making that follows an established pattern. Characteristics of programmed decision-making would include a concern for performing operational tasks in general isolation of the greater influence of that task on a system; a decision process defined by rules and procedures with problems identified at higher levels; highly repetitive specialized tasks; a restriction of field-made decisions to those with low levels of complexity; a culture that imbues a risk-free or risk-adverse environment; and a source of data that is provided through instructions given from the managerial level. Additionally, many managerial policies encourage internal control of inventory and resource allocation in terms of materials, supplies, parts and equipment. Other managers advocate the use of a just-in-time supply chain that minimizes on-hand inventory thereby reducing costs for storage. These controls are meant to promote efficiency in economic terms, but also severely limit the

ability of field personnel to effectively address emergent needs in a timely manner. Such delays can exacerbate tenuous conditions leading to failure of a system under stress.

Orthodox public administration theory supports the criterion of efficiency as a preeminent value in the field. The quest for operational efficiency has been largely sought through unified, hierarchal structures with a strict division of labor and unity of command. The work of early organizational theorists such as Frederick Taylor, Leonard White, and W.F. Willoughby reflect this preoccupation with efficiency and many organizations, even today, are structure around this value. However, efficiency in the face of crisis is not always the preferred value; rather, effectiveness and timeliness may prove more important than pure cost-benefit economic assessments of value. The literature on high-reliability organizations demonstrates a series of exceedingly reliable, failure-free systems that function in high-risk environments relatively free from failure. The processes that create these organizations have been demonstrated to be lacking in non-HROs where managers tend to focus on efficiency, rather than on reliability. To operate during times of crisis, the value of economic efficiency must become secondary to reliability, which demands having the right resources, in the right place, at the right time.

A cluster of contemporary strategies and practices has sought to restructure bureaucratic agencies, streamline organizational processes, and decentralize decision-making (Osborne & Plastrik, 1998). Advances in information technology and communications systems have allowed more flexible, team-based approaches to problem solving. Decision-making has been pushed downward throughout the organization placing decisions in the hands of employees in the best position to determine the appropriate course of action in a timely manner. Public works directors may be able to

create organizations that build higher levels of organizational resilience potential by adapting these strategies. Examples include shifting control over resources and daily operational decisions from a central administration to frontline managers; temporarily lifting rules and standard procedures on a case-by-case basis to enable field personnel to deal with rapidly changing conditions as commonly experienced during disasters; rotating employees through different jobs within the department having them take full responsibility for the work and stay in each position to learn the intricacies; and getting field employees to engage in dialogue with workers from other units or departments in order to learn about domain responsibilities and interdependencies.

Caution must be exercised in undertaking these recommendations, however, since the central thesis of this dissertation remains entirely conceptual until future research can demonstrate that resilience potential – as measured here – positively correlates with post-disaster adaptive behavior. Yet, the findings of this research are intriguing and hopefully will create the impetus for future study on the notion of latent resilience, as well as provide some direction on how to proceed toward establishing a new paradigm for disaster planning. Additional qualitative work in the form of intensive field studies of post-disaster organizational environments, structured observations of crisis operations, detailed interviews, and similar methods, are needed to explore other aspects of resilience potential that were not identified and measured in this study. Such efforts can help build a grounded theory of latent resilience and provide better measures for future quantitative application.

In this vein, quantitative research such as this study of public works organizations is appropriate for testing hypotheses about theoretically defined variables. It is not

particularly well suited for identifying new variables that may *cause* latent resilience to be manifest. It is important to identify variables that shape organizational resilience potential, as well as capture organizational processes that create resilience. Such research will help construct a more thorough theoretical model that increases the accuracy of measurements of resilience in organizations and more aptly fits resilience processes in the practical world.

Continuity planning in public works departments. One objective of this dissertation was simply to document the extent of compliance with recommended continuity of operations planning practices within a population of public works departments in the southwest United States. This dissertation has provided a discussion on the history of COOP planning, identified the elements of an effective COOP plan, and measured compliance among municipal public works agencies through a survey of department directors. Nearly six years after September 11, 2001, and more than a year after the lessons of Hurricane Katrina along the Gulf Coast, significant efforts still need to be undertaken by public works departments in preparing for operational continuity in a post-disaster environment. This is particularly disconcerting considering that the bulk of the sample came from the State of Texas, which in 2006 received more Presidential Major Disaster or Emergency Declarations than any other state in the Union (78). Oklahoma was also well represented in this sample and received the sixth most Declarations (49).

The analysis shows that only four departments out of the 96 departments returning questionnaires report having a completed, comprehensive COOP plan. A key concern is that over 27-percent of public works agencies have not identified their essential

functions, let alone prioritized them based on time sensitivity. Out of the remaining departments, only nineteen had actually conducted an exercise to identify plan deficiencies or evaluate key personnel in their roles and responsibilities. Such recurring drills and exercises are critical to maintaining an appropriate degree of COOP capability. In addition, identification of vital records, databases, and communications systems to support the flow of critical information in a timely manner was not well addressed. Conversely, these public works departments have done more to establish lines of authority for decision-making.

It was beyond the scope of this dissertation to determine precisely *why* a department had or had not conducted a COOP, although past research has looked at correlates of disaster planning generally. Looking specifically at COOP compliance, research at the federal level has shown a lack of oversight to be a significant contributing cause of deficiencies in agency continuity plans (Government Accountability Office, 2004). GAO (2005) recommendations for improving planning include developing a short-term strategy for oversight of COOP planning activities, developing and implementing procedures that verify agency-reported data used to develop plans, and developing guidelines on the steps agencies should take to implement alternative work processes during emergency operations. These recommendations are likely to translate well to local government. The American Public Works Association could play a key role in developing continuity "best practices" for COOP in pubic works, as well as establish minimum standards for continuity planning as a condition of accreditation. Responsibility for appropriate planning, however, falls to public works management and city officials.

Another potential limitation on COOP planning is a lack of appropriate funding. Consequently, there is the possibility that budgetary decisions will limit the availability of even the minimum necessary resources needed for COOP activities. Prior to 9/11, federal programs to support local emergency planning and preparedness efforts were modest and largely targeted to specific activities such as the Metropolitan Medical Response System, created by the 1996 Nunn-Lugar-Dominechi Act, that focused on medical response to terrorist attacks. There was a surge in funding following 9/11, generating a variety of programs ranging from infrastructure protection to the Urban Areas Security Initiative. While none of these programs specifically address COOP, most permitted funding for planning and other activities that fall under the COOP umbrella. Regrettably, this funding has begun to decrease, although the decrease is difficult to measure. In 2004, FEMA folded almost all local emergency response funding into a single program that operates as a block of funding, passed through the states. The availability of funding became competitive with FEMA selecting projects it deems appropriate, but the total amount of funding available through the block of programs has continued to fluctuate (Perry & Lindell, 2007).

This study only documents the reported compliance with COOP practices. It does not detail the quality or appropriateness of plans in local public works departments. To ensure that essential local government services are available in emergencies, a more thorough examination of such plans themselves needs to be conducted. Such an examination would likely involve a review of actual plans from public works departments, comparing them against FEMA or other professional guidelines. Such a study must include evaluations to confirm that essential functions are correctly and

appropriately identified, otherwise plans would not ensure that the most vital public works functions would be maintained during a crisis. Municipalities may also undertake a similar review by examining COOP documents from all city departments, private contractors, and key suppliers and partners to ascertain the level of community-wide preparedness with regard to continuity. Partnering with the National League of Cities, the U.S. Conference of Mayors, or the Public Entity Risk Institute would aid in the efficacy of conducting such studies across cities and would provide meaningful information for policymakers as well as a provide a benchmark for local level COOP preparedness.

Level of perceived risk and resilience. Chapter 4 applied one-way analysis of variance to six variables anticipated to produce a change in the level of organizational resilience potential. The first of these examined the relationship between the level of perceived risk by management and ORPS scores. Perceived risk was defined as senior management feelings about the likelihood that some internal or external event would cause a temporary disruption of services in the public works department. It was postulated that the more likely senior management felt a service disruption could occur in the next five years, the greater the implementation of organizational processes that create organizational resilience potential. Therefore, it was anticipated that responses of "likely" or "highly likely" would score higher on the ORPS.

Indeed, these two categories accounted for higher scores on the ORPS with a mean of 4.28 and 4.58, respectively. However, while this finding meets the expectations of this study, the magnitude of the relationship was so small that it did not meet an acceptable level of statistical significance ($p = .256$). Furthermore, when considered with all six variables, multiple regression analysis shows perceived risk very low in

importance, with a beta (ß) coefficient of only .063. This means that as one considers managerial impressions of the likelihood of risk in the context of other variables, the effect is diminished by other factors. Alternatively, or additionally, this factor may have little relationship to the building of latent resilience at all. Additional study of this predictor is needed before one can accept or reject the null hypothesis to any degree of certainty.

Two possible explanations for this statistical finding were posed. First, perceptions of risk are subjective. Two respondents to the questionnaire both indicated in an unprompted answer that their organization was susceptible to tornado activity. Yet, one director indicated his organization felt it was "highly likely" to be subject to service disruption, while the other felt there was only a 50-50 change. Second, recent literature has reported an interesting finding with regard to risk perception. The results of a longitudinal survey indicate that individuals with high degree of risk perception will take greater protective actions, yet as those actions are implemented and perceived to be effective, the assessment of risk declines (Brewer, Weinstein, Cuite, & Herrington, 2004). This finding makes sense intuitively and it emphasizes that risk is a very relative concept for organizations. Given these findings, it is logical that the level of perceived risk by management will decline as their confidence in COOP elements increases.

Managerial information seeking and resilience. The second research question probed the relationship between the extent of information sought by management about COOP planning and the degree of latent organizational resilience present. The correlation between these variables was predicted to be positive in that the more sources a department utilized in constructing its continuity plan, the higher the level of observed

resilience potential. This prediction was supported by research that suggests that when senior managers request hazard or threat information from emergency managers, the level of preparedness activity increases (Drabek, 1990; Mileti, 1983; Mileti & Sorensen, 1987; Perry & Lindell, 1997). The number of sources accessed by public works directors ranged between one and twelve. As predicted, the relationship was positive with the ORPS ($r^2 = .10$, $p = .018$).

The greatest change in magnitude in the relationship occurs between organizations using four to six sources (mean ORPS = 4.13), and those using between seven and nine sources (mean ORPS = 4.54). It is possible that this change marks the delineation between mere information gathering and more thorough "research" on environmental hazards, mitigation methods, and continuity planning. Leedy and Ormrod (2001) wrote that, "Research is the systematic process of collecting and analyzing information (data) in order to increase our understanding of the phenomenon about which we are concerned or interested" (p. 4). Simply gathering information on or discovering facts about a subject does not constitute thorough research. Research requires that data be collected and *interpreted* in order to *extract meaning* that may then be applied to an individual's or an organization's environment. In addition, research is cyclical, building upon itself and investigating new questions as they arise from current study. As such, research continuously builds knowledge. It is posited that creating a COOP document only requires one to gather information about it; however, building resilience is far more complex and would necessitate greater ability to extract and interpret information from an ever-changing organizational environment.

In terms of building resilience as it relates to continuity planning, there are three possible conceptual explanations for the difference between information gathering and research: (1) information gathering will tell us *how not why*, (2) it is simply *replication not building* knowledge, and (3) information gathering creates a *product versus a process*. Evidence of these three concepts can be further explored by examining the types of resources that were accessed. Public works directors report accessing documents pertaining to COOP planning from FEMA or the Department of Homeland Security. These materials are readily accessible via the Internet and take little effort to retrieve. Similarly, information that can be accessed in-house from public works personnel, the fire and police departments, and the local planning office requires only a short walk down the hall. One only needs to be a little more determined to pick up a fifth or sixth source of information.

In contrast, public works managers who sought out seven or more sources had to work at it. Certainly, some of the less frequently accessed sources – such as academia, Local Emergency Planning Committees, and State Emergency Response Commissions – are not as easy to add. One might conclude, therefore, that public works managers who are really serious about building resilience, are willing to seek out sources that require a greater commitment of time. This finding is consistent with a study by Perry and Lindell (1990) who found that in connection with preparing for volcanic threats, people and organizations that reported seeking out more than six different information sources were much more likely to develop an emergency plan and implement pre-impact mitigation measures.

Organizational structure and resilience. The next research question examined the impact of organizational structure on ORPS scores. Organizational structure was determined simply by counting the number of levels of management between the public works director and the individual worker in the field. It was expected that a wide span of control would be more responsive to unstable situations as it places decision-making in the hands of field personnel rather than requiring problems to be brought up through the chain-of-command. The hypothesis for this relationship stated that as the number of levels of management increase, organizational resilience would decrease.

Bi-variate analysis of these variables indicated that the mean ORPS score did not statistically significantly change as the levels of management increased. In fact, mean scores fluctuated considerably from one level to the next making any meaningful examination of the correlations impracticable. One possible problem with this assessment was that there was very poor distribution of responses across categories. The bulk of public works departments (51%) reported having 2 or fewer levels of management, twenty- four (25%) had three levels, and sixteen (17%) had four. This problem could have been the result of either a sample that over represented small public works departments or the question itself was a cause of confusion to respondents who may have interpreted "levels of management" differently.

Chapter 4 reported on a possible pattern that is worthy of consideration for future research attention. When looking at two, three, and four levels of management, the mean ORPS scores start at a middle range of 4.3 moving higher to 4.5 with three levels of management before dropping down to a low of 4.0. The prediction here was for mean scores to gradually drop as the number of levels of management increased. Obviously,

this finding was not consistent with the stated hypothesis. Again, it must be reiterated that the results of this study support no conclusion to any statistical certainty. However, this finding creates a new question for consideration: Can too few levels of management create a highly centralized command structure subject to an autocratic leadership style that is not conducive to organizational resilience?

Obviously, the measurement of management levels requires new categories or an alternative approach. One possibility is to create a ratio of employees to managers. It would be expected that as the number of managers increases in proportion to the number of employees (that is, there is a smaller span of control), there would be a greater tendency to shift decision-making to managers and supervisors rather than allow more flexibility for field employees. Consequently, scores on the ORPS would be positively correlated to the ratio of employees to managers. It would be expected that directors would have at least some control over the number of managers in their organization; thus, defining this variable in terms of a ratio would be appropriate to this study.

What constitutes a "manager" would have to be defined within the context of the public works organization before attempting to re-examine this variable. Should line supervisors be counted among the ranks of management, or are they employees? Is a system with apprentices, journeymen, skilled tradesmen, and masters to be considered a hierarchy, or are these all subordinates that must operate under the guidance of a supervisor? Does a simple paramilitary style of rank structure translate at all to an organization such as public works that tends to be comprised of several seemingly independent (although certainly interdependent) subunits? That is, is the rank structure

similar for the water division as it is for the streets division, as would be seen throughout the divisions of a police or fire department?

A second problem in measuring levels of management as a span of control is that it stresses a one-way (downward) relationship between management and employee (Starling, 1998). But this is only part of the relationship.

> The upward relationship to overhead authority is at least equal in importance to the downward relationship to subordinates. Likewise, lateral relationships with cognate agencies and interest groups is also important. What is needed, then, is to replace the concept of span of control with a more relevant concept: the span of managerial relationships (p. 312).

Another option would be to examine the relationship between structural characteristics and organizational resilience potential. There is likely to be considerable variation in complexity of organizational structural characteristics among public works departments. There are several different structures that are applicable to various public works agencies depending upon the types of services provided, organizational objectives, and the size of the department. These would include: line, line and staff (hierarchal), the functional organization, and the matrix concept (Tomsho, 1975).

Yet, there are challenges to this type of measurement as well. Part of the complexity of this variable is that such descriptions of structural characteristics tend to be too simplistic to adequately capture the true structure of the organization. For example, Handy (1989) describes the "virtual organization" that would involve a partnership or collaborative efforts among public, private, and non-profit agencies that share resources and skills in order to achieve a specific purpose. In business terms, a virtual organization

is a company that out sources a significant portion of its functions (a popular idea the New Public Management era, generally referred to as "privatization"). A public works director, then, may simply be a contract manager. How would one measure hierarchy in such organizations?

Participation and resilience. The fourth research question inquired about the level of participation management had with regional planning efforts and their department's organizational resilience potential. Involvement was measured by asking public works directors to indicate their level of involvement in developing community emergency plans, from "no contact" with planning agencies except during emergencies, to "full partner" on jurisdictional planning teams. It was posited that a positive relationship would exist whereby departments with more involvement in the planning process would demonstrate higher resilience potential. While the results of the one-way analysis showed that departments with "no contact" scored lower on the ORPS (mean = 3.33) as compared to department that were a "full partner" (mean = 4.29), the relationship failed to meet statistical significance. Although the score difference between the extreme categories was large, it was not statistically significant because the intermediate categories of "periodically" or "regularly" involved in the planning process also showed high mean ORPS scores.

This result proved to be somewhat perplexing. Literature on resilience at the individual level of analysis had demonstrated a clear relationship between social involvement and post-crisis resilience behaviors (Jang, 2005; Karapetian-Alord & Johnson-Grados, 2005). Although no research had been conducted using the organization as the unit of analysis, this relationship was expected to translate due to previous research

showing positive correlations between participation in community planning organizations and effective disaster response (Drabek, 2003, 2005). It appeared that the assumptions and expectations about this relationship between involvement in planning efforts and organizational resilience were soundly supported by this literature. Instead, it seems that involvement in community involvement is really correlated with continuity of operations planning, which is itself correlated to organizational resilience potential as will be discussed later in this chapter.

To test this conclusion, a one-way analysis of variance was conducted between involvement in planning efforts and continuity of operations planning. The results indeed indicate a strong and statistically significant relationship between these two. Thus, it appears that the apparent logic in the relationship between active partnerships with the planning community and resilience is spurious.

Continuity planning and resilience. Research question number five explored the possibility of a relationship between the extent of continuity planning and latent organizational resilience. This study marked the first attempt to measure continuity of operations planning in local government. Chapter 2 presented the literature on high reliability organizational theory and conceptually linked the factors that create high-reliability organizations with organizational resilience. While a positive relationship may seem fairly intuitive given this effort, no literature or past research has endorsed, nor even suggested either a positive or negative relationship exists. Therefore, no formal prediction was made with regard to the direction or strength of the relationship.

As suspected, the mean ORPS scores steadily increased from low completion of COOP (3.13) to high levels of compliance (4.59). This finding tested very strongly in

one-way analysis of variance achieving statistical significance at a level of $p < .01$. This positive relationship was confirmed by an r^2 correlation of .10 indicating that 10-percent of the variance in organizational resilience potential was explained by COOP compliance.

Department accreditation and resilience. The final research question examined the relationship between department accreditation and resilience. Public sector organizations – particularly at the local level – have become increasingly interested in third-party assessments as a means of providing outside validation of the quality of programs and services offered by the department. Accreditation generally requires a department to undertake an extensive self-assessment that examines a number of performance indicators. Once this has been completed, departments may submit to a site evaluation where outside experts visit operational locations to verify material in the self-assessment document. While there may be other ways to measure the effectiveness of public services, accreditation is a comprehensive tool that provides consistent benchmarks for understanding departmental compliance with industry standards and gauging the quality of service.

The American Public Works Association administers an accreditation program for public works departments. The accreditation process involves an assessment of core competencies including strategic planning, records maintenance, communications, risk management, and others that may help build organizational resilience potential. Given a lack of a theoretical foundation upon which to base an assumption about the relationship, no prediction on the direction was made.

While the finding from the bi-variate analysis reveals a positive relationship, this conclusion must be interpreted carefully. When looking strictly at non-accredited versus

accredited public works departments, the mean ORPS scores show a positive relationship raising from 4.23 to 4.89. However, the ORPS means for the "in-progress" categories that include "preparing to accredit," " self-assessment phase," and "evaluation phase" do not follow this same low score to high score path as would be expected in order to positively identify a correlation between the variables. Still, one-way analysis demonstrates a statistically significant result that many social scientists would describe as marginal at $p = .053$, although significance is structurally unlikely because of the small number of accredited agencies (producing a restricted range on this variable). The tentative existence of a relationship was confirmed in the multiple regression analysis where the Beta (ß) was .171 with a significance of .09.

Given the interest in public sector accreditation, this finding should be explored further. Any significant conclusion is impeded in this study by the heavy concentration of non-accredited agencies ($n = 74$), and the lack of fully accredited public works departments ($n = 6$) in the population studied. A future research project could utilize the database from the American Public Works Association to compile a list of departments in various phases of the accreditation process. A survey of this population would be conducted to measure organizational resilience potential to better determine the strength of the relationship.

Multiple regression analysis. Multiple regression analysis was used in this dissertation to examine the collective impact of six independent variables acting upon the dependent variable of organizational resilience potential. It was also used to determine the relationship of the independent variables to one another. Resilience potential was measured with the Organizational Resilience Potential Scale developed for this study.

This enables the researcher to understand the unique relationship of these predictors to latent resilience in light of a constellation of causes. The regression analysis confirmed the statistical significance of two variables – continuity of operations planning and managerial information seeking – and that the directions of the relationships were positive. A third variable – department accreditation – also demonstrated a positive relationship to the dependent variable, although this finding only reached a marginal level of statistical significance ($p < .10$). These three variables, therefore, are the principal determinants of change in the values of the ORPS for the public works organizations studied here. The variables of perceived risk by management, organizational structure, and participation in community planning organizations did not reach statistical significance, thus, they only cause small incremental changes in the values on the ORPS.

In addition, the multiple regression analysis showed that these six predictor variables produced an R^2 of .201, indicating that all six predictor variables acting together account for 20-percent of the variance in organizational resilience potential. This finding is statistically significant at $p = .003$. Therefore, we may conclude that the model developed in this dissertation has a "good fit" to the data (Achen, 1982). As would be expected given the results of the analysis thus far, the Beta coefficients demonstrate that the three variables with the highest relative importance are continuity of operations planning (ß = .267), managerial information seeking (ß = .244), and department accreditation (ß = .171). While this model explains only a relatively small portion of the variance, it was articulated throughout this dissertation that the intent of this study was to determine the impact of certain managerially influenced variables on organizational

resilience potential. It is clear from these results that managers of public works organizations can help build organizational resilience.

More than three-fourths of the variation in resilience remains unexplained. There are a number of potential variables, both internal to the organization and external to it that should be explored in order to enhance the explanatory power of the model. In keeping with the idea of variables that can be controlled by managers, some possibilities include attitudes (resistance) toward planning activities and the presence of an in-house emergency manager. While the department's budget did not fit the framework of this analysis, it is within the purview of public works directors to apply for federal disaster planning grants. The extent to which managers had applied for and utilized external grants to fund continuity planning efforts would also be a variable worth inserting into this model. Furthermore, variables specific to the individual (public works director) should be explored. Examples include the level of education, past disaster training, participation in local service organizations, length of tenure, and leadership style.

Directions for Future Research

Gaps in knowledge and unanswered questions have been presented throughout this chapter. Public works departments are an important part of a community's response and recovery mechanism. However, there is very little information on how public works is organized for disaster response, what their capabilities are, how they coordinate with emergency responders during emergency response, and their level of preparedness for operational continuity. While this study marks the first attempt to document preparedness among public works departments in over thirty years, the results cannot be generalized to all departments in the United States. This clearly is an area in need of further research

attention. An obvious method for accomplishing this research objective is to take a general accounting of preparedness efforts in a random sample of public works departments across the United States. This effort would then establish a baseline of knowledge about preparedness in public works to allow for follow-up studies that document improvements over time.

Research also needs to be conducted on other government organizations without a disaster-relevant mission, but whose functions are key to continued government services. For example, Information Technology (IT) is a key department in need of study. The operations of local government and business alike have become increasingly dependent upon the services of the IT department and further research is needed on vulnerability and continuity planning activities, as well as mapping out interdependencies from IT to other organizations. Other non-disaster related organizations that provide vital services include the city attorney's office, budget and financial services, the public information office, city manager's office, and the transportation division. The methods used in this study of public works departments should be replicated on these organizations.

Crisis-relevant organizations also provide an opportunity for future study. While the preparedness activities of local emergency management agencies has been a major focus of research, the preparedness activities of local police, fire, and emergency medical services has received little attention (Tierney, Lindell, & Perry, 2001). It would be expected that, given the propensity of these organizations to have decentralized decision-making processes in place, they would score high on the ORPS. However, there is little documentation on continuity planning. Emergency medical services is particularly of interest given that there are many models of service provision including private sector,

third service municipal, and fire department-based. This provides an opportunity to compare continuity planning and resilience potential across service types.

The private sector provides even more research opportunities. The wave of privatization of government service that began in the mid-1980s has created an environment where private, for-profit companies are providing many key services of local government, or that municipal departments are dependent upon the private sector to provide services or resources so that they can continue to carry out their mission essential functions. Almost no data is available on preparedness efforts among these organizations. This question is further complicated by the fact that many private sector organizations have their own interdependencies with other businesses that may not be a direct contractor with the city. Dynamic systems theory may provide a quantitative research opportunity to examine the social dynamics of the private sector in regard to public sector provision of essential services.

Finally, the central thesis of this piece of research – that organizational resilience potential is a preferred goal of continuity or crisis planning – remains entirely conceptual until the measures of latent resilience can be verified by further study. Proving the validity of measures of latent organizational resilience will likely require cross-sectional and longitudinal studies using questionnaires or structured interviews for data collection with the intent of generalizing the results from a random sample to a larger population of departments (Babbie, 2005). The variable of department accreditation needs further attention. While it was demonstrated to be statistically significant both on one-way analysis of variance with the ORPS and in the multiple regression analysis, this finding was only marginal. In addition, organizational structure may still prove to impact

organizational resilience potential, however, the way in which this variable was measured here proved to be ineffective.

Summary

The purpose of this research was to theoretically and empirically connect the concepts of High reliability organizational theory to a study about how continuity of operations planning may build latent resilience in public works departments. It is suggested that current approaches to disaster planning that focus on creating standard operating procedures or a step-by-step contingency plan is outmoded. Rather, attention should be given to creating internal processes and organizational structures that build latent resilience within organizations so that they demonstrate positive adaptive behaviors when under stress. Such a paradigmatic shift requires the ability to quantitatively measure organizational resilience potential. A tool was devised for this purpose using the theoretical literature and past research attempts. The unit of analysis was the organization. Six variables were selected specifically for their ability to be influenced by managers. The rationale was that practitioners should be able to read this piece of research and implement organizational practices that will help create resilience within their own department.

The data presented here provide a valuable empirical and theoretical description of the levels of continuity planning and organizational resilience potential. Public works departments demonstrated a moderate degree of resilience potential. In addition, significant efforts still need to be undertaken to improve continuity planning in these organizations. The results of one-way and multiple regression analyses support the expected outcomes of two research questions. Continuity of operations planning and

managerial information seeking that leads to a greater understanding of one's organization and its operating environment both accounted for 10-percent of the variance in organization resilience. In addition, department accreditation appears to positively correlate to resilience although further research on this relationship is needed before any solid conclusions can be made. However, these findings remain entirely conceptual pending further study on organizational resilience potential Therefore, the practical and policy implications should be interpreted cautiously.

The population selected for this study was the full-service, municipal public works department. This provides ample opportunities to examine the concept of resilience potential in other crisis and non-crisis oriented departments both in the public and private sectors. Knowing what organizational processes and features build resilience potential offers the opportunity to alter them in a manner that enhances organizational continuity during crisis. Other variables at the organizational and individual unit of analysis offer significant opportunities to build the theoretical foundation of resilience potential as a new approach to crisis planning.

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