2018

RESILIENT RESPONSE IN AN AGE OF CHANGE: EMERGENCY RESPONSE ORGANIZATIONS' RESILIENCE IN TIMES OF DISASTER

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EMERGENCY RESPONSE ORGANIZATIONS' RESILIENCE IN TIMES OF DISASTER

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DEPARTMENT OF MARINE AFFAIRS

A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE

REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN

MARINE AFFAIRS

UNIVERSITY OF RHODE ISLAND

2018

DOCTOR OF PHILOSOPHY DISSERTATION

OF

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UNIVERSITY OF RHODE ISLAND

2018

ABSTRACT

Impacts from major storms, floods, hurricanes, and heavy precipitation events disturb the lives of millions of people around the world every year, causing billions of dollars of damages and economic losses. As the number and destructiveness of natural disasters increase, the study of resilience offers possible solutions for minimizing loss of life and damage from disasters. Resiliency of communities and organizations in the face of global climate change is attracting increasing attention as a way to slow or reverse the increasing costliness and disruption of natural disasters. Despite the growing interest in resilience, no research focuses on the particular resilience challenges facing emergency response organizations (EROs), police, fire, emergency medical service, emergency management agencies, and departments of public work, which communities rely on for critical life-safety services during and after disasters.

The first portion of this study uses the Delphi method to build a list of expert-derived factors contributing to emergency response organization (ERO) resilience, including ranking and rating the factors to develop an expert consensus-based set of factors composing the ERO Resiliency Framework. This framework supports decision making and planning priorities to develop stronger, more resilient, emergency response agencies. The second stage of this research uses the ERO Resiliency Framework to develop a reference mental model of ERO resilience and compares 41 ERO leaders in three coastal municipalities to the reference model and each other. The gaps in the ERO leaders' mental models revealed by this assessment provide insights into how ERO leaders understand resilience in their organizations and highlight opportunities for tailored education and outreach efforts, as well as suggesting future research areas.

The third portion of this research focuses on the role of social capital in ERO resilience, analyzing the ERO leaders' levels and types of social capital. Social networks of relationships between individuals within the same organization form more resilient teams, while strong network relationships between organizations provide essential resources, support, and information during times of crisis.

This research provides key insights into the factors contributing to ERO resilience, ERO leaders' mental models of resilience, and how social capital can contribute to building strong, more resilient response organizations. Building resilient EROs is an essential component in the development of resilient communities, and the results of this research highlight key areas to focus future education and planning efforts as well as suggesting areas for future research.

ACKNOWLEDGMENT

This dissertation would not have been possible without the help and encouragement of so many people, and its existence is due to their financial, academic, and personal support. Most importantly I wish to thank my advisor, Dr. Rob Thompson, for his guidance, mentorship, and patience in letting me take an unconventional approach to my degree with many adventures along the way. My path may have wandered away from academia, but it has led to my dream career. Thank you for all your help getting to where I am today.

I am grateful to my committee members who have shared their insights, knowledge, and experience over the years: Tiffany Smythe, Austin Becker, Carlos Garcia-Quijano, and Timothy George. I am deeply indebted to Alan Desbonnet and Rhode Island Sea Grant for their support throughout my Masters and PhD. None of this would have been possible without you.

I am lucky to have the most wonderful friends and family who always made time to lend a helping hand or an ear in the midst of their own lives and degrees, you are my strength and inspiration every day.

Finally, I am grateful beyond words to Paul, for standing by me through the late nights and stressful hours and always believing in me. This is yours as much as it is mine.

PREFACE

This dissertation is written in the manuscript format containing a brief introduction, three independent chapters, and a conclusion. The three chapters form three articles that are in preparation for submission for publication. The goal of this dissertation is to identify the factors contributing to emergency response organizations' (EROs) resilience, assess ERO leaders' mental models of resilience to identify comprehensiveness and balance, and analyze ERO leaders' levels of social capital.

The first article consists of a Delphi study of emergency response experts to determine the key factors contributing to ERO resilience. Eleven key factors are identified, forming the Emergency Response Organization Resiliency Framework, and providing a foundation for further research on ERO resilience.

The second article applies mental model assessment methods to ERO leaders to assess and compare their mental models of resilience in their organizations to the reference model. Mental model comprehensiveness and balance are analyzed to identify gaps in ERO leaders' default and complete models to inform future research, planning, and education efforts.

The third article measures ERO leaders' levels and types of social capital to describe social capital's contributions to ERO resilience. Despite having overall high levels of social capital, it is important for EROs to focus on developing and maintaining strong relationships and networks between organizations prior to disasters.

The three chapters are followed by a conclusion chapter that summarizes all three manuscripts and highlights areas for future research.

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INTRODUCTION

Emergency response organizations (EROs) are a critical component of communities' disaster response, emergency preparedness, and resilience planning efforts; yet they are not included in current research efforts focusing on community and organizational resilience. As increasing academic and popular attention is applied to the topic of resilience, it is essential that EROs are included in the research. Local EROs are uniquely positioned to increase resiliency to climate-related disasters through emergency preparedness and response. In addition, EROs have extensive experience in emergency planning and response and provide critical public safety functions. Due to the importance of community-level adaptation, local emergency planning and disaster preparedness efforts must include a focus on local-level EROs in order to increase community resilience. Identifying essential factors contributing to emergency response organization resilience provides a dual benefit of improving current organizational resilience while establishing a framework for long-term community resilience growth. Emergency preparedness, disaster risk reduction, and climate change adaptation are all aspects of a central goal: increasing communities' capacity to successfully survive and overcome increasingly intense and frequent climate-related natural disasters.

This study, building off of previous research in the organizational resilience field and proposing a model of ERO resilience factors, provides recommendations for improvements in the resilience of emergency response organizations that will ultimately result in enhanced community resilience to current disasters and projected climate change impacts in the future. Using the Delphi method, this research developed a list of expert-derived factors contributing to Emergency Response Organization (ERO) resilience, then

ranked and rated the factors to develop an expert consensus-based set of ERO resilience factors forming the Emergency Response Organization (ERO) Resiliency Framework. The factors ranked by the expert panel as most important with high levels of consensus provide a framework to apply organizational resilience principals to emergency response organizations.

The development of the reference mental model of resilience in EROs derived from the ERO Resiliency Framework demonstrates one application of the expert-consensus driven resiliency framework. Assessing ERO leaders' mental models of resilience in their organizations reveals key gaps in comprehensiveness and balance. Although the ERO leaders had relatively well balanced default mental models, the significant increase in comprehensiveness between the default and complete models indicates that ERO leaders are focusing on a narrower aspect of resilience and would benefit from additional trainings and education. As ERO leaders build a greater comfort level and knowledge of the nuances of ERO resilience core components, they will be better prepared to incorporate resiliency-building strategies in their plans, procedures, and trainings.

In addition to examining their mental models of resilience, this study explores ERO leaders' levels and types of social capital to develop a better understanding of how EROs approach relationships and social network building. Strong networks of relationships between members of a team and between individuals in different organizations can contribute to organizations' social capital, thus providing the organization with better access to information, resources, and support during times of crisis. All of these aspects contribute to building stronger, more resilient EROs that are better able to withstand impacts and continue providing essential services to their

communities when disasters strike. In order to continue fulfilling their critical function in a rapidly changing world, emergency response organizations must incorporate resiliency-building actions and strategies in their daily operating policies and procedures as well as their disaster plans.

MANUSCRIPT 1

Emergency Response Organization Resilience: Identifying Factors for Success

(To be submitted to Natural Hazard Review)

By

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Abstract

As the frequency and destructiveness of natural disasters increases due to climatic changes and expanding development in vulnerable areas, the study of resilience offers possible solutions for minimizing losses from disasters. Much academic attention in the literature on resilience focuses on community and organizational resilience generally; however, the specific resilience factors essential to emergency response organizations have not been identified in previous research. This study used the Delphi method to build a list of expert-derived factors contributing to emergency response organization (ERO) resilience, including ranking and rating the factors to develop an expert consensus-based set of factors composing the ERO Resiliency Framework. This framework supports decision making and planning priorities to develop stronger, more resilient, emergency response agencies. Resilience of emergency response organizations directly contributes to community resilience, leading to stronger communities and organizations that are better able to survive and thrive in an age of increasing threats and natural disasters.

1.1 Introduction

Impacts from major storms, floods, hurricanes, and heavy precipitation events disturb the lives of millions across the globe every year, causing billions of dollars of damages and economic losses (Paton and Johnston, 2017). Three times as many natural disasters were recorded in the nine years between 2000 and 2009 compared to between 1980 and 1989 (Leaning and Guha-Sapir, 2013). As the number and destructiveness of natural disasters increases, the field of resilience and organizational resilience is also gaining academic attention (Somers, 2009; Lee et al., 2013, Keim, 2008; Tsai, 2013).

Resiliency of communities and organizations can slow or reverse the increasing costliness and disruption caused by natural disasters. However, a review of literature conducted for this study found no scholarship focused on the particular resilience challenges facing emergency response organizations (EROs), including police, fire, emergency medical service, emergency management agencies, and departments of public works, which are relied upon for assisting communities through these disasters.

When natural disasters occur, EROs must provide critical services in challenging and often dangerous environments, and disasters place increased demand on emergency services and their resources and personnel. For the purposes of this study, "emergency response organizations" (EROs) will be defined to include fire departments, emergency medical services, police departments, public works departments, and Emergency Management Agency (EMA) departments (Thompson, J. and Durkovich, 2015). The critical functions provided by EROs are essential for community resiliency, and hence must be addressed in order to minimize and mitigate the costs of impacts from disasters. The concept of organizational resilience, defined by Lee et al. (2013) as "the ability of organizations to continue to operate and to provide goods [and] services," is directly applicable to EROs as their services are required throughout natural disasters and major emergencies. The resilience of EROs is also a critical component of community resilience due to their provision of key life-safety services including medical, fire and rescue, and emergency response (Lee et al., 2013). This study, building off of previous research in the organizational resilience field and proposing a model of ERO resilience factors, provides recommendations for improvements in the resilience of emergency response organizations that will ultimately result in enhanced community resilience to

current disasters and projected climate change impacts in the future. Using the Delphi method, this research developed a list of expert-derived factors contributing to Emergency Response Organization (ERO) resilience, then ranked and rated the factors to develop an expert consensus-based set of ERO resilience factors. The factors ranked by the expert panel as most important with high levels of consensus provide a framework to apply organizational resilience principles to emergency response organizations forming the Emergency Response Organization Resiliency Framework.

Current organizational resilience literature emphasizes the increasing importance of resilience to all organizations and examines case studies of non-profit organizations, retailers, manufacturers, technology suppliers, public utilities, and private contractors (Sutcliffe and Vogus, 2003; Lee et al., 2013; McManus, 2008). EROs face unique circumstances, however, because they must face disasters directly while performing critical services. If EROs are incapacitated or unable to perform their roles during a disaster there may be severe, possibly life-threatening, consequences for members of the community. This study: 1) investigates how an ERO resiliency framework differs from existing frameworks and, 2) identifies factors that mitigate the unique hazard challenges facing EROs, including climate change related disasters. The resulting framework of factors contributing to organizational resilience for EROs provides a foundation for recommendations and guidelines that EROs may implement to improve their resilience.

As climate change impacts become progressively more visible and climate-related events affect more people, EROs must be resilient in order to continue to operate successfully and provide critical services (Leaning and Guha-Sapir 2013). Emergency responders play a key role during natural disasters since these organizations, agencies,

and individuals are responsible for protecting life and property during extreme weather events and the recovery period following major disasters. Local EROs are uniquely positioned to increase resiliency to climate-related disasters through emergency preparedness and response because EROs have extensive experience in emergency planning and response and provide critical public safety functions (Keim, 2008; Tsai, 2013). Due to the importance of community-level adaptation, local emergency planning and disaster preparedness, efforts to build resilience must focus on local-level EROs (Yamin et al., 2005; National Academies, 2006). Emergency preparedness, disaster risk reduction, and climate change adaptation are all aspects of a central goal: increasing communities' resilience in order to survive and overcome increasingly intense and frequent climate-related natural disasters.

1.2 Background

Defining Resilience

The topic of resilience has gained much attention and research interest in the wake of increasingly frequent and costly natural disasters experienced across the U.S. and around the world (McManus, 2008; Lee et al., 2013; Rodin, 2014). Resiliency of communities and organizations in the face of global climate change and large scale disasters is attracting focus as a way to slow or reverse the increasing costliness and disruption of natural disasters (Keim, 2008; Yamin et al., 2005; Lee et al., 2013; Rodin, 2014; Somers, 2009). However, resilience is a complex and multi-faceted concept encompassing a wide range of disciplinary fields and research methodologies, as well as many facets of societies, from individuals and organizations to cities, states, and countries. The

definition of "resilience" varies greatly in the literature based on the discipline and scale at which resiliency is considered.

While resilience is a broad and complex concept with a wide variety of definitions and conceptualizations applied to a diversity of disciplines, there are three main approaches to resiliency thought: engineering resilience, ecological/ecosystem resilience, and social-ecological resilience. These schools are rooted in the foundation and development of resiliency theory, from the relatively narrow definition of engineering resilience of bouncing back to a 'normal' condition following a shock or disturbance, to the ecological resilience understanding of the magnitude of disturbance that can be experienced before a system moves into a different state, and broadening to include the variety of definitions discussed in social-ecological resilience literature (Holling, 1973, Comfort, 2010, Adger et al., 2005, Folke et al., 2002, Aldrich, 2012, Berkes, 2007).This variety of definitions illustrates the complexity of resiliency as applied in multiple fields and demonstrates the theoretical development of the concept, from the "bounce back to normal" component of ecological resiliency (Holling, 1973), to "active resilience" including the idea of "bouncing forward" incorporating adaptive actions (Somers, 2009), and even the conceptualization of resilience as a "continuum of experiences" and "state of becoming" suggested by Walklate et al. (2013).

Many definitions of resilience include references to "bouncing back," "learning and adapting," "absorbing disturbances," and "capacity to cope" with unexpected disturbances, sudden changes, or disasters (Masten and Obradovic, 2008; Walkate et al., 2013; Wildavsky, 1988; Folke et al., 2004; Folke et al., 2002). Despite the breadth of

possible definitions, some common themes emerge: resilience entails the ability to adapt to and overcome the unknown and unexpected while retaining essential functions.

The previously discussed definitions of resilience may be considered descriptions of "passive resilience," focusing on the ability of organizations to "bounce back" from "unanticipated dangers" (Wildavsky, 1988). Framed in this manner, passive resilience is a reaction to an event and *reactive* in nature (Somers, 2009). In contrast, "active resilience" can be differentiated as "a deliberate effort to become better able to cope with surprise" (Lovins and Lovins, 1982; Wildavsky, 1988; Somers, 2009), and thus may be considered *proactive* in nature. While passive resilience is discussed more frequently in the literature and is generally demonstrated after a major disaster or crisis (Wildavsky, 1988), active resilience may be more useful to EROs given the challenges and demands of their services.

In her book *The Resilience Dividend*, Rodin defines "resilience" as the "capacity of any entity – an individual, a community, and organization, or a natural system – to prepare for disruptions, to recover from shocks and stresses, and to adapt and grow from a disruptive experience" (Rodin 2014, p. 3). Rodin's characterization of "resilience" summarizes many of the components of resilience as defined in the literature and served as the definition used for the purposes of this study because it is particularly well suited for application to emergency response organizations. Due to the increasing demands on emergency response organizations during the response to and recovery from large scale natural disasters, such as Harvey, Irma, and Maria in 2017, these organizations must be able to rapidly recover from impacts while continuing to provide essential services to their communities.

Climate Resilience

The strategic, conceptual perspective of *climate resilience* contains multiple types of resilience including community, organizational, economic, social, and ecological (Comfort, 2010). Thus, on a strategic theoretical level, *organizational resilience* is a contributing sub-category of community resilience to climate impacts. Society's capacity to adapt to climate change is a key component of climate resilience (Adger, 2003). Assessing, measuring, and increasing adaptive capacity is a central focus of current organizational and community resilience literature, resulting in a variety of suggested methods for quantifying potential and latent resilience (Somers, 2009, Mallak, 1998, McManus, 2008). These frameworks and assessments provide suggestions and recommendations for improving organizational and community resilience, thus increasing the capacity for climate resilience in the larger field of disaster and hazard resilience to climate change. Networks, institutions, and organizations that promote resilience to current hazards and vulnerabilities will simultaneously be engaged in building resilience to climate change in the future (Adger et al., 2005).

Organizational Resilience

Organizational resilience is a complex blend of behaviors, perspectives and interactions that contribute significantly to the resilience of communities (Somers, 2009, McManus et al., 2008, Mallak, 1998). Community resilience and organizational resilience are interdependent concepts; hence, organizational resilience is an important component of communities' ability to plan for, respond to, and recover from emergencies and crises (Lee et al., 2013, McManus et al., 2008, Aldrich, 2012). Organizational "restoration," the ability of organizations to regain their essential function, is identified as

one of five "dimensions of resilience" following a disaster, supporting the linkage between organizational resilience and wider community resilience (Aldrich, 2012).

Resilience of EROs as Organizations

There is a diverse literature that discusses measuring and quantifying organizational resilience and resilience potential. Key studies by Somers (2009), McManus (2008), and Lee et al. (2013) address measuring organizational resilience potential and measuring and comparing organizations' resilience. Somers identified six factors, while McManus proposed a model consisting of three factors and 15 indicators of organizational resilience (McManus, 2008; Lee et al., 2013). Lee et al.'s (2013) study expanded on McManus's (2008) model, proposing an adjusted model consisting of four factors (Lee et al., 2013, p. 33). Together these studies identify situation awareness, adaptive capacity, planning, and resilience ethos as key resiliency factors with multiple related indicators including organizational connectivity, culture of informed decision-making, and transparent communication within an organization (Somers, 2009; McManus, 2008; Lee et al., 2013). Although these models of organizational resilience provide a foundation in the literature, none of the 73 studies reviewed for this research address the specific resilience challenges facing emergency response organizations (EROs). As the providers of critical response services during times of major disasters, EROs are vital to the well-being, survival, and resilience of the communities they serve. Elements of resiliency for EROs include being able to continue providing essential life-safety and security functions during any kind of impact or disaster, whether natural or human-caused. Emergency response organizations are expected to respond to emergency situations in all conditions

and circumstances, thus resiliency for these organizations must include factors that allow them to retain essential capabilities and continue providing critical services.

Local EROs are uniquely positioned to increase community resilience through emergency preparedness and response. In addition, EROs have extensive experience in emergency planning and response and provide critical public safety functions (Keim, 2008; Tsai, 2013). Due to the importance of community-level adaptation, local emergency planning and disaster preparedness efforts must include a focus on local-level EROs in order to increase community resilience (Yamin et al., 2005; National Academies, 2006). Identifying essential factors contributing to emergency response organization resilience provides a dual benefit of improving current organizational resilience while supporting a framework for long-term community resilience growth. Emergency preparedness, disaster risk reduction, and climate change adaptation are all aspects of a central goal: increasing communities' capacity to successfully survive and overcome increasingly intense and frequent climate-related natural disasters.

1.3 Methodology

The Delphi Process

The Delphi process is a widely-accepted method of achieving expert consensus concerning a specific problem or issue from a group of individuals with identified expertise in the topic area. Originally developed in the 1950's by Dalkey and Helmer (1963) at the RAND Corporation for use in U.S. military projects, the Delphi method has been used to build consensus and solve problems in diverse fields such as coastal management, business management, and nursing (Hsu and Sandford, 2007). The Delphi

method is particularly useful when there is incomplete knowledge about a problem (Delbeq et al., 1975; Skulmoski, et al., 2007) and the method's flexibility has resulted in its use in many sectors including climate change adaptation, vulnerability analysis, health care, defense, business, education, information technology, community resilience and recovery, and construction engineering (Webster et al., 2003; Mastrandrea and Schneider, 2004; Arnell, Tompkins, and Adger, 2005; Morgan, Adams, and Keith, 2006; de Franca Doria et al., 2009; Hallowell and Gambatese, 2010; Skulmoski, et al., 2007; Okoli and Pawlowski, 2004; Alshehri, Rezgui, and Li, 2015; Jordan and Javernick-Will, 2013).

This study used the Delphi method to build a list of expert-derived factors contributing to Emergency Response Organization (ERO) resilience, then rank and rate the factors to develop an expert consensus-based set of ERO resilience factors. The Delphi method was selected for this research based on its rigorous methodology for obtaining expert consensus from individuals across a wide geographical area (Sillars and Hallowell, 2009; Jordan and Javernick-Will, 2013).

Emergency Management and Response Expert Panel Selection

In order to begin the Delphi process, a panel of experts were recruited from emergency management and response professionals using professional organization membership lists, lead researchers in the field, and emergency management associations. Previous Delphi studies have used panels of varying sizes, from as low as three to as high as 80 members, however most studies include eight to 16 panelists (Hallowell and Gambatese, 2010). For the purposes of this research, 30 experts were initially recruited for the study from the East Coast region with 20 completing all three rounds. The East Coast region reaching from Maine to the mid-Atlantic was chosen for the purposes of this

study in order to reduce variability regarding the structure of emergency response organizations and the types of hazards expected. The selected panelists included experts in the fields of emergency response, emergency planning, organizational resilience, and emergency and disaster management.

Experts were intentionally selected from multiple backgrounds and disciplines in order to provide diverse insights in identifying factors contributing to resilience of EROs. The initial panel of 30 experts were collected through a review of current published literature in the field of emergency management and response, identification of leading academic researchers, directors and managers of agencies and departments at the local, state, and regional level, and experienced leaders of emergency response departments in the East Coast region. During the expert recruitment process, potential panelists were divided into three categories, Academic/Research, Administrative/Policy, and Field Practitioner, to ensure the various aspects of emergency management, response, resilience, and planning were represented in the final expert panel (Table 1.1). Panelists in the Academic/Research category primarily served in professor or lecturer positions in universities and focused their work on teaching and researching emergency response and management related topics. Individuals in the Administrative/Policy category worked in management and oversight agencies such as the Federal Emergency Management Agency (FEMA), Rhode Island Emergency Management Agency (RIEMA), the Department of Health (DOH), and Department of Homeland Security (DHS). Field Practitioner panelists served in their primary capacity as emergency responders in fire departments, emergency medical service departments, police departments, and municipal emergency management agencies.

Table 1.1. Expert panel composition.

Category	Initial n	Final n	Average # of years' experience	Examples of agencies and organizations
Academic/Research	10	6	24	Professors/lecturers in academic institutions
Administrative/Policy	10	7	22	Management/oversight agencies, FEMA, RIEMA, DOH, DHS
Field Practitioner	10	7	28	Fire departments, emergency medical services, police departments, municipal emergency management agencies

The criteria required to participate as an expert in a Delphi study vary based on the research topic; however, it is essential that clear criteria are identified prior to expert recruitment to ensure all panelist meet the determined criteria (Delbecq et al., 1975; Okoli and Pawlowski, 2004; Jordan and Javernick-Will, 2013). All experts selected for the Delphi expert panel in this study met the minimum requirements of (1) at least 5 years' experience working in emergency management, response, or planning, (2) current leadership or management position in their organization or agency, (3) field experience in at least one emergency response or recovery, (4) knowledge/expertise concerning emergency management, response, planning, and/or resilience verified through publications in peer reviewed journals or presentations and lectures as appropriate to the field. All panelists selected in the Academic/Research category met the additional requirements of holding an advanced degree (Masters or PhD) in a relevant field[1] and

[1] Relevant fields included fire science, emergency management, disaster management and response, and emergency medicine.

authored a minimum of three peer reviewed journal articles. The majority of the experts selected far exceeded these minimum criteria, many panelists having worked in their fields for over 20 years and a mean of 13.5 years.

Delphi Survey Administration

Following the selection of the expert panel, online surveys were conducted using SurveyMonkey. The three rounds of questionnaires followed the "ranking-type" Delphi procedures outlined by Schmidt et al. (2001) consisting of three steps: (1) brainstorming of important factors and characteristics, (2) narrowing down initial list of factors to the most important ones, (3) ranking or grading the list of important factors (Okoli and Pawlowski, 2004). Following this procedure, the first-round open-ended questionnaire was circulated requesting that the panelists identify and list as many factors and characteristics contributing to the organizational resilience of EROs as possible (Hsu and Sandford, 2007). The results of the first questionnaire were collected and assembled into a complete list of expert-suggested ERO resilience factors. Responses that contained the same factors with different wording were condensed into one factor in the compiled list. For example, the responses "being trained in incident command system," and "conducting incident command system training" were condensed to "incident command system training" in the second-round survey. The compiled list was recirculated to the panel in the second questionnaire in order to determine which of the listed factors were most important and eliminate factors determined by the experts to be unrelated to ERO resilience or unimportant (Hsu and Sandford, 2007). Factors' importance to emergency response organization resilience were ranked using a five-point Likert scale with one equaling "not important" and five equaling "very important." Factors that were

determined to be “not important” to ERO resilience by 90% or more of the expert panel were removed following the second-round survey.

Consensus began to develop in the results of the second-round questionnaire and was evaluated using criteria determined prior to data collection based on recommendations from relevant Delphi literature (Hsu and Sandford, 2007; Mcleod et al., 2015; Hasson, Keeney, and McKenna, 2000; Keeney, Hasson, and McKenna, 2006). Based on the research conducted by Hsu and Sandford (2007) and Mcleod et al. (2015), the criteria for consensus were defined as: high (80-100% of panelists ranked the factor as “very important” and “important” or 70%-100 of panelists ranking the factor as “very important”); medium (70-80% of panelists ranking as “very important” and “important” or 60-80% ranking as “very important”); low (55-70% ranking “very important” and “important” or 50-70% ranking “very important”); and none (<55% of ranking “very important and important”) (Mcleod et al., 2015; Hsu and Sandford, 2007).

Following the second-round questionnaire all factors ranked as “not important” or “of little importance” with medium and high levels of expert panel consensus were discarded from the third-round questionnaire. In the third and final questionnaire panelists were asked to rank the remaining factors again using the same Likert scale. Prior to evaluating and ranking the factors panelists reviewed the median and mode of the previous rankings and summarized notes regarding justification for rankings that panelists were encouraged to make in the previous round.

The results of the third-round questionnaire were analyzed using the consensus criteria previously discussed. Each factors’ mean, median, and mode, minimum and maximum ranking, and level of consensus were evaluated (Hsu and Sandford, 2007). The

outcome of this multi-round consensus-based methodology is an expert-produced, verified, and ranked list of factors critical to emergency response organization resilience.

1.4 Results

Thirty experts were contacted and asked to participate in the Delphi expert panel, with twenty experts agreeing to contribute to the study. After the first-round survey, the expert panel produced a list of 36 factors contributing to emergency response organization resilience. Following the second-round survey during which the panel ranked the factors' importance on a five-point Likert scale, seven factors from the original list were discarded based on low rankings of importance from the panel. The remaining 29 factors were re-evaluated by the expert panel in the third round of surveys. Following the final round, 11 factors ranked as highly important with a high level of expert consensus, summarized in Table 1.2. An additional eight factors ranked as highly important with a medium level of consensus (Table 1.3), and 10 factors ranked as moderately important with low levels of expert consensus (Table 1.4).

Expert Panel Ranking of Resilience Factors with High Consensus

Consensus was determined based on the criteria implemented by Hsu and Sandford (2007) and Mcleod et al. (2015), with high consensus defined as 80-100% of panelists ranking a particular factor as "very important" and "important." Factors were also determined to have a high consensus of agreement when 70-100% of panelists identified the factor as "very important" to ERO resilience. Based on these criteria, the 11 factors summarized in Table 1.2 were determined to be important to ERO resilience with a high level of consensus. The mean importance level of these factors range from 3.82 to

4.45 on a 5-point Likert scale with 4 equivalent to "important" and 5 equivalent to "very important."

Table 1.2. Ranking of 11 high-consensus resilience factors using a 5-point Likert scale (1 = "not important," 2 = "of little importance," 3 = "somewhat important," 4 = "important," 5 = "very important"; n=20).

ERO resilience factors identified by expert panel	Consensus Level of Importance	Mean
Ability to effectively identify organizational needs	High (95%)	4.2
Establishment and maintenance of clear communication within organization and externally	High (90%)	4.4
Ability to adapt to changing conditions	High (90%)	4.45
Ability to establish and maintain clear objectives	High (85%)	4.15
Preparedness of organization for disasters and/or impacts	High (85%)	4.05
Effective management of available capital (financial, human, social)	High (83%)	3.94
Engage in relationship building activities prior to an incident	High (83%)	4.18
Availability of and/or access to adequate personnel and staffing	High (83%)	3.82
Knowledge of and access to available resources	High (83%)	3.94
Implementation of efficient logistics within organization	High (80%)	4.15
Conduct regular exercises and trainings, providing opportunity to exercise plans, determine gaps and opportunities to improve plans	High (80%)	3.95

Expert Panel Ranking of Resilience Factors with Medium Consensus

The seven factors ranked by the expert panel as high importance with a medium degree of consensus (70-79% agreement) include two resilience factors identified in previous organizational resilience studies and five factors suggested by the Delphi

experts (see Table 1.3). Rodin (2014) discusses redundant systems as an organization having different sources of capacity so that it may continue operations even when elements or assets are missing. The expert panel also identified redundant systems as important components of resilient organizations, especially redundancy within operations and logistics so that emergency response organizations can maintain operational effectiveness and logistical continuity during and immediately after an impact. Rodin (2014), Somers (2009), and Lee et al. (2013) all include aspects of awareness, analysis, and understanding of locally relevant risks and hazards as key to organizational resilience. The expert panelists supported the importance of situational awareness, including awareness of local hazards. Through the Delphi survey, the experts also reached a 72% consensus level on the importance of personal preparedness of emergency responders, including preparedness of family members.

Table 1.3. Ranking of 7 medium-consensus resilience factors using a 5-point Likert scale (1 = "not important," 2 = "of little importance," 3 = "somewhat important," 4 = "important," 5 = "very important").

ERO resilience factors identified by expert panel	Consensus Level of Importance	Mean
Availability of and/or access to adequate equipment to carry out assignments	Medium (78%)	3.76
Redundant systems, redundant operations and logistics	Medium (75%)	3.9
Standardized operating procedures	Medium (75%)	3.9
Personal preparedness of emergency responders, including preparedness of family members	Medium (72%)	3.76
Situational awareness to successes, challenges, lessons learned within organization	Medium (70%)	3.95
Ability to anticipate the "what if" scenarios; determining proactive actions and decisions	Medium (70%)	3.65
Awareness of locally relevant risks and hazards	Medium (70%)	3.75

Expert Panel Ranking of Resilience Factors with Lower and No Consensus

After the third round of surveys were complete, the expert panel had reached no consensus on seven of the original 36 factors and had reached low consensus on an additional 11 factors (see Table 1.4 and Table 1.5). All of the no consensus factors were ranked between 2.6 and 3.29 in importance, indicating that while the experts did not agree on the factors' overall ranking, the mean scale of importance was notably lower than the factors with higher levels of consensus with no panelist giving any factor a ranking higher than "somewhat important." The 11 factors that achieved low levels of consensus from the expert panel had mean rankings of importance higher than the no consensus group, with mean rankings of importance between 3.47 and 3.84. All of these low consensus factors displayed widely differing rankings of importance from the expert panel that did not narrow to closer agreement after three rounds of surveys. These results indicate that the expert panelists were firmly attached to their original rankings of importance and were largely unwilling to change their rankings to either higher or lower levels of importance.

ERO resilience factors identified by expert panel	**Consensus Level of Importance**	**Mean**
Access to political and/or jurisdictional support	Low (67%)	3.47
Participation in mitigation activities to reduce risk prior to a disaster	Low (65%)	3.7
Planning (for example: establishment of pre-incident action plans, pre-plans in place, ability to understand the steps and procedures required to address likely incidents)	Low (63%)	3.79
Development and/or implementation of best practices within organization	Low (63%)	3.84

Motivation, integrity, pride of emergency responders in organization	Low (61%)	3.53
Active information and intelligence gathering, seeking latest information pertaining to training, equipment, operations	Low (60%)	3.6
Situational awareness to ongoing risks, hazards, events outside organization	Low (60%)	3.8
Maintain current relationships through joint exercises or trainings, maintain current mutual aid agreements	Low (56%)	3.65
Emotional stability of emergency responders	Low (56%)	3.65
Overall health and fitness of emergency responders	Low (56%)	3.53
Access to financial resources to support emergency response activities	Low (56%)	3.47

Table 1.4. Ranking of 11 lower-consensus resilience factors using a 5-point Likert scale (1 = "not important," 2 = "of little importance," 3 = "somewhat important," 4 = "important," 5 = "very important").

Table 1.5. Ranking of 7 no-consensus resilience factors using a 5-point Likert scale (1 = "not important," 2 = "of little importance," 3 = "somewhat important," 4 = "important," 5 = "very important").

ERO resilience factors identified by expert panel	**Consensus Level of Importance**	**Mean**
Access to subject matter experts	None (39%)	3.06
Effective engagement with all domains of society - for profit, non-profit, religious organizations, and social service organizations	None (39%)	3.29
Ability to utilize and follow the principles of emergency management	None (37%)	3.16
ICS training and adherence to NIMS	None (37%)	3.05
Previous experience with disaster response	None (33%)	2.82
Cross training of staff between different sections/departments of organization	None (28%)	3.12
Use of decentralized command in leadership	None (25%)	2.6

1.5 Discussion

The 11 factors ranked by the expert panel as most important to ERO organizational resilience with high levels of consensus were used to develop a framework (Figure 1.1) applying organizational resilience principles to emergency response organizations. These factors highlight key elements of resilience for EROs, and many of the expert-identified factors are practices that are already included to an extent in response organization structure and operations. In addition to the 11 most important factors, the results of the expert panel surveys provide a list of secondary factors that response organizations may also consider in developing resilience plans (Table 1.3). Despite the wide variety of environments and communities served by emergency response organizations, the resiliency framework factors are relevant for many locations and situations. For example, the ability to adapt to changing conditions is applicable to all emergency response organizations, whether they are a large city fire department with 400 active firefighters or a part-time rural emergency management director reliant on volunteers during disasters. This initial checklist of resilience factors provides a starting place for response organizations to examine their resilience and identify implementable factors and practices to improve their resilience prior to the next disaster.

Emergency Response Organization Resiliency Framework

The eleven factors that emerged from the Delphi panel survey with high levels of importance and high degrees of consensus (between 80-95% agreement) provide an expert-derived list of factors contributing to ERO resilience that can inform resilience-building efforts and planning on the organizational and agency level (see Table 1.2).

These key resilience factors may be grouped into four areas of focus: resource management, operations/logistics, planning, and situational awareness (Figure 1.1). While some of the factors identified through this study support other organizational resilience research findings, several unique factors were identified that are particularly relevant to emergency response organizations. The identification of these factors allows them to be included and emphasized in revisions of plans and procedures for response organizations.

Figure 1.1. Emergency Response Organization Resiliency Framework.

The results of this study reinforce findings of previous resilience research efforts as well as contributing new factors specifically focused on ERO resilience. The Delphi expert panel identified and ranked four factors as important to emergency response organization resilience that were not identified in other organizational resilience literature

reviewed for this study. The ability to effectively identify organizational needs was ranked as important with the highest consensus rate of all factors, 95%. The other factors uniquely recognized as important for ERO resilience are the ability to establish and maintain clear objectives, implementation of efficient logistics within the organization, and effective management of available financial, human, and social capital. The critical response component of emergency response organizations necessitates the establishment of sound logistics and clear objectives, which can only be achieved through efficient management of resources. During large scale disasters resources are likely to be depleted rapidly, making resource management critically important for ERO's ability to continue response operations.

Seven ERO resiliency factors identified by the expert panel support components of resilience frameworks in existing research. McManus (2008) and Lee et al. (2013) discuss the establishment and maintenance of clear communication within an organization and externally with partners and stakeholders as a key element of resilience. The importance of this factor was supported with the Delphi expert panel who gave it a mean ranking of 4.4 with 90% consensus. McManus (2008) and Lee et al. (2013) also identified engagement in relationship building activities prior to an incident and conducting and participating in regular trainings and exercises as key resilience factors. The expert panel identified both of these factors as important with mean rankings of 4.18 and 3.95 respectively with high levels of consensus. Rodin (2014) noted the importance of an organization's ability to adapt to changing conditions, which the expert panel strongly agreed with. The expert panel ranked this factor as highly important (a mean ranking of 4.45) with 90% consensus on the ranking level. The high ranking and

consensus on this factor are indicative of the expert-acknowledged need for emergency response organizations to remain flexible, adaptable, and resilient in the face of changes due to environmental factors, such as climate change, and to human-related factors, such as changing response types and community needs.

Mallack (1998) identified access to appropriate resources as a key element of resilience, similar to the expert panels identification of knowledge of and access to available resources as important with a consensus level of 83%. The resources that are appropriate to a particular response, and their availability, is likely to vary considerably based on the type and degree of impact for a disaster, however maintaining the awareness of and accessibility to resources contributes to organizational preparedness and hence resilience. Lee et al. (2013) discusses the importance of staff engagement and involvement, with similarities to the Delphi panel's identification of availability of and access to adequate personnel and staffing as a key resilience factor. Personnel and staff must be engaged in the organization with involvement in organizational activities and trainings in order to be adequately prepared for serving in an emergency response capacity during an incident or disaster. The expert panel ranked preparedness of the organization for disasters and/or impacts as important with a consensus of 85%, echoing Hollnagel et al.'s (2007) discussion of the ability to respond to various disturbances and to regular and irregular threats as key to organizational resilience.

Implementing ERO Resiliency Factors

One challenge to implementing improved resiliency measures and practices is the scarcity of available financial resources to support such efforts. However, the resiliency factors ranked highest in importance by the expert panelists may be incorporated into

emergency response organizations' operations with minimal financial support. Identification of organizational needs and implementation of efficient logistics are achievable through improved planning and training of organizations' leaders. Most emergency response organizations engage in regular training and exercises both internally and with exterior mutual aid organizations. These trainings may be intentionally designed to incorporate resiliency building measures, such as reviewing and revising disaster response plans, engaging in mutual aid and large scale exercises with neighboring organizations, reviewing available resources, and practicing clear inter- and intra-organizational communications. One of the factors with a medium level of consensus (72%) was the importance of personal preparedness of emergency responders, including preparedness of family members. As noted by one panelist, emergency response personnel need to be confident that their homes and families will be safe during a disaster in order for them to be fully committed to working during an event and not using vacation or sick time to stay home and care for their families. If organizations implement personal preparedness training as a component of regular drills and exercises, they can develop a well-prepared staff whose homes and families will be ready for the next disaster. Through the development of resiliency-focused and preparedness oriented trainings and operating procedures, emergency response organizations can take steps to improve their organizational resiliency and become more prepared for future impacts.

Differences Between ERO Resiliency Framework and Previous Frameworks

Although some factors overlap with previous organizational resilience research findings, the marked differences in the additional factors address the multitude of challenges and responsibilities faced by emergency responders during disasters that other

organizations do not have to cope with. It is especially noteworthy that several of the low and no consensus factors are aspects of organizational resilience that have been identified as highly important to resilience in non-emergency response organizations. Access to subject matter experts was identified by Lee et al. (2013) as a key element in organizational resilience, however the Delphi expert panel ranked this factor with a mean of 3.06 (somewhat important) with no consensus, with one panelist recording they thought the factor was "not at all important" and two experts ranking the factor as "very important." Similarly, training in Incident Command Systems (ICS) and adherence to the National Incident Management System (NIMS) was ranked a mean of 3.05 (somewhat important) with no consensus and expert panelist rankings from "not at all important" to "very important." Training in ICS and NIMS is required for the majority of fire department, police, emergency medical services, and emergency management personnel and has been suggested as a key component of improving these organizations' resilience during disasters (Waugh 2009).While training in ICS and NIMS may improve organizations' interoperability and effective management on emergency scenes, the expert panelists in this study do not support the importance of this factor in improving emergency response organizations' resilience.

Use of decentralized command and cross training staff between different sections within an organization are identified as key organizational resilience factors in non-emergency response organizations (McManus, 2008; Lee et al., 2013; Mallak, 1998). However, the expert panel did not reach any consensus regarding their importance to emergency response organizations with rankings ranging from "not at all important" to "very important." The expert panelists' intentionally diverse backgrounds may contribute

to their lack of consensus on these factors and future research may focus on identifying how experts' backgrounds relate to these factors' rankings of importance.

One factor's lack of consensus is particularly notable: the expert panel reached no consensus on the importance of previous experience with disaster response, with respondents' rankings varying from "not at all important" to "very important." Previous studies on disaster response cite previous response experience as an important contributor to resilience to future disasters (McDaniels, 2008), however the expert panel was unable to reach consensus regarding the factor's importance for emergency response organizations. The expert panel's lack of agreement on these low-consensus factors, many of which are acknowledged as important to non-response organizations, indicate the importance of identifying resilience factors applicable to emergency response organizations, taking into consideration their unique responsibilities and challenges during a disaster event.

ERO Resilience Contribution to Community Resilience

The ample literature on community-level adaptive capacity, collective action, organizational resilience, and social capital testifies to the importance of building resilience, from the local community and organizational level up to the national level (Adger et al., 2005, Adger, 2003, Keim, 2008, Aldrich, 2012). From an operational perspective, building resilience and increasing adaptive capacity requires engagement with organizations, groups, and individuals on a community level in order to promote and enable collective action focused on resiliency (Adger, 2003, Keim, 2008). Hence, implementation of strategies and objectives designed to improve organizational resilience can result in improved community resilience and climate resilience. One example of the

operationalized concept of organizational resilience contributing to overall disaster/climate resilience is the case of restoring port function in the Port of New York following Superstorm Sandy. The organizational resilience and utilization of social capital displayed during the activation of the Marine Transportation System Recovery Unit (MTS-RU) significantly enhanced the Port's response and recovery capabilities and contributed to overall community resilience to a climate change-related hazard through minimization of Port closure time and rapid restoration of full services (Sturgis et al., 2014, Smythe, 2015).

Limitations of the Study

This study's geographic focus on the East Coast region was selected in order to reduce variability in the structure of emergency response organizations, however the geographic location results in some limitations in the applicability of the study findings. Given that the expert panel were all selected from the same region, from Maine to the mid-Atlantic coastal area, the type of hazards considered are limited. Hurricanes, severe winter storms, and flooding are the primary natural hazards of concern in this region, while hazards such as earthquakes, tsunamis, and large wildfires are less of a risk. The focus on certain hazard types and the exclusion of others may lead to bias in the resiliency factors identified. For example, the expert panel may consider factors contributing to resiliency to hurricane impacts of greater importance than factors that would mitigate the damage of wildfires. Thus, the results of this study may be limited in their applicability to regions with different expected hazards and impacts.

1.6 Conclusion

The emergency response organizational resilience factors identified through the Delphi expert panel form a framework on which to build stronger, more resilient response organizations. The ERO Resiliency Framework identifies factors that are missing in prior studies focused on non-emergency organizations, demonstrating the importance of considering the unique resiliency challenges and criteria facing emergency response organizations. Resiliency frameworks and factors developed for organizations such as manufacturers and retailers have some applicability to EROs, as demonstrated by the overlapping factors identified by the expert panel. However, in order to withstand future impacts and continue providing critical services during and after disaster events, emergency response organizations need to consider additional resiliency factors as well. When a large storm is anticipated a retailer or manufacturer can close their business or move operations to a different site while the affected area sustains the impact and recovers. Emergency response personnel, in contrast, must report for work during and after the event, providing critical services to the affected community while their own homes and families may be at risk. In order to continue delivering emergency services during and immediately after large events, response organizations must have resilient plans and operations already implemented. The development of resilience-focused trainings, engagement in mutual-aid and neighboring agency exercises, and promoting an organizational emphasis on building resiliency and preparedness will help EROs become more resilient to the next disaster or disturbance they face. Incorporating the ERO Resiliency Framework in training, planning, and organizational development can help

emergency response organizations grow into strong, resilient organizations better prepared to serve and protect their communities in an age of increasing change.

References

Adger, W.N. (2003). Social capital, collective action, and adaptation to climate change. *Economic Geography, 79*, 387-404.

Adger, W. N., Hughes, T. P., Folke, C., Carpenter, S. R., & Rockström, J. (2005). Social-ecological resilience to coastal disasters. *Science*, *309*(5737), 1036-1039.

Aldrich, D.P. (2012) *Building Resilience: Social capital in post-disaster recovery*, University of Chicago Press, Chicago.

Alshehri, S. A., Rezgui, Y., & Li, H. (2015). Disaster community resilience assessment method: a consensus-based Delphi and AHP approach. *Natural Hazards*, *78*(1), 395-416.

Arnell, N. W., Tompkins, E. L., and Adger, W. N., (2005). "Eliciting information from experts on the likelihood of rapid climate change". *Risk Analysis,* 25, 1419–1431.

Berkes, F., J. Colding, and C. Folke. 2003. Introduction. In: Berkes, Colding, and Folke 2003, eds. *Navigating Social-Ecological Systems: Building Resilience of Complexity and Change*. Cambridge: Cambridge University Press.

Comfort, L. K., Boin, A., & Demchak, C. C. (Eds.). (2010). *Designing Resilience: Preparing for Extreme Events*. Pittsburg, PA: University of Pittsburg Press.

Dalkey, N., and O. Helmer, 1963. An experimental application of the Delphi method to the use of experts. *Management Science*, 9 (3), 458-467.

Delbecq, A., A. Van de Van, and D.H. Gustafson, (1975). *Group techniques for program planning: A guide to nominal group and Delphi processes*. Glenview, USA: Scott, Foresman and Company.

de Franca Doria, M., Boyd E., Tompkins, E. L., and Adger, W. N., (2009). "Using expert elicitation to define successful adaptation to climate change." *Environmental Science and Policy,* 12, 810–819.

Folk, C., J. Colding, and F. Berkes (eds.), 2002. Synthesis: building resilience and adaptive capacity in social-ecological systems. In: *Navigating Social-Ecological Systems: Building Resilience of Complexity and Change*. Cambridge, UK: Cambridge University Press.

Folk, C., S. Carpenter, B. Walker, M. Scheffer, T. Elmqvist, L. Gunderson, and C.S. Holling, 2004. Regime shifts, resilience, and biodiversity in ecosystem management. *Annual Review of Ecology, Evolution, and Systematics*, 35, 557-581.

Hasson, F., Keeney, S., and McKenna, H., (2000). "Research guidelines for the Delphi survey technique." *Journal of Advanced Nursing,* 32, 1008–1015.

Hallowell, M. R., and Gambatese, J. A. (2010). Population and initial validation of a formal model for construction safety risk management. *Journal of Construction Engineering and Management*, *136*(9), 981-990.

Holling, C. S. (1973). Resilience and stability of ecological systems. *Annual Review of Ecology and Systematics*, 4: 1-23.

Hollnagel, E., Woods, D. D., & Leveson, N. (2007). *Resilience engineering: Concepts and precepts*, Ashgate, Burlington, VT

Hsu, C. C., and Sandford, B. A. (2007). *The Delphi technique: making sense of consensus. Practical assessment, research & evaluation*, 12(10), 1-8.

Jordan, E., & Javernick-Will, A. (2013). Indicators of community recovery: Content analysis and Delphi approach. *Natural hazards review*, *14*(1), 21-28.

Jordan, E., & Javernick-Will, A. (2013). Indicators of community recovery: Content analysis and Delphi approach. *Natural hazards review*, *14*(1), 21-28.

Keeney, S., Hasson, F., and McKenna, H., (2006). "Consulting the oracle: Ten lessons from using the Delphi technique in nursing research." *Journal of Advanced Nursing,* 53:205–212.

Keim, M. E. (2008). Building human resilience: the role of public health preparedness and response as an adaptation to climate change. *American journal of preventive medicine*, *35*(5), 508-516.

Leaning, J., and Guha-Sapir, D. (2013). Natural disasters, armed conflict, and public health. *New England journal of medicine*, *369*(19), 1836-1842.

Lee, A.V., Vargo, J., and Seville, E., (2013). "Developing a tool to measure and compare organizations' resilience." *Natural Hazards Review*, 15, 29-41.

Lovins, A. and L.H. Lovins, 1982. *Brittle Power: Energy Strategy for National Security*. Andover, MA: Brick House Publishing CO.

McDaniels, T., Chang, S., Cole, D., Mikawoz, J., and Longstaff, H. (2008). "Fostering resilience to extreme events within infrastructure systems: Characterizing decision contexts for mitigation and adaptation." *Global Environmental Change*, 18(2), 310-318.

Mallak, L.A., (1998). "Measuring resilience in health care provider organizations." *Health Manpower Management*, 24 (4), 148-152.

Mastrandrea, M. D., and Schneider, S. H., (2004). "Probabilistic integrated assessment of dangerous climate change." *Science,* 304, 571–575.

Masten, A.S., and J. Obradovic, (2008). Disaster preparation and recovery: Lessons from research on resilience in human development. *Ecology and Society*, 13 (1), 9.

McManus, S., (2008). "Organizational resilience in New Zealand." Ph.D. thesis, University of Canterbury, Christchurch, New Zealand.

Mcleod, E., Szuster, B., Tompkins, E. L., Marshall, N., Downing, T., Wongbusarakum, S., ... and Hansen, L. (2015). "Using expert knowledge to develop a vulnerability and adaptation framework and methodology for application in tropical island communities." *Coastal Management*, 43(4), 365-382.

Morgan, G. M., Adams, P. J., and Keith, D. W., (2006). "Elicitation of expert judgments of aerosol forcing." *Climatic Change,* 75, 195–214.

Okoli, C., and S.D. Pawlowski, (2004). The Delphi method as a research tool: An example, design considerations and applications. *Information and Management*, 42 (1), 15-29.

Paton, D., & Johnston, D. (2017). *Disaster resilience: an integrated approach*. Charles C Thomas Publisher.

Rodin, J., (2014). "The Resilience Dividend: Being Strong in a World Where Things Go Wrong." New York, NY, PublicAffairs.

Schmidt, R., Lyytinen, K., Keil, M., & Cule, P. (2001). Identifying software project risks: An international Delphi study. *Journal of management information systems*, *17*(4), 5-36.

Sillars, D. N., & Hallowell, M. R. (2009). Opinion-based research: Lessons learned from four approaches. In *Construction Research Congress 2009: Building a Sustainable Future* (pp. 1499-1508).

Skulmoski, G. J., Hartman, F. T., & Krahn, J. (2007). The Delphi method for graduate research. *Journal of Information Technology Education: Research*, *6*, 1-21.

Smythe, T. C. (2015). The impacts of hurricane Sandy on the port of New York and New Jersey: lessons learned for port recovery and resilience. In *Climate Change and Adaptation Planning for Ports* (pp. 106-120). Routledge.

Somers, S., (2009). "Measuring resilience potential: An adaptive strategy for organizational crisis planning." *Journal of Contingencies and Crisis Management*, 17 (1), 12-23.

Sturgis, L., T. Smythe and A. Tucci. 2014. Port Recovery in the Aftermath of Hurricane Sandy: Improving Port Resiliency in the Era of Climate Change. Voices in the Field Report, Center for a New American Security. Available online at www.cnas.org.

Sutcliffe, K.M. and Vogus, T.J., (2003). "Organizing for resilience." *Positive Organizational Scholarship*, 94-110.

Thompson, J. and Durkovich, C.A. (2015). "Emergency Services Sector-Specific Plan: An Annex to the NIPP 2013". *U.S. Department of Homeland Security.* https://www.dhs.gov/sites/default/files/publications/nipp-ssp-emergency-services-2015-508.pdf. (Dec. 13, 2017).

Tsai, P., (2013). *Launching a National Conversation on Disaster Resilience in America: Workshop Summary*. Washington, DC: The National Academies Press.

Walkate, S., R. McGarry, and G. Mythen, (2013). Searching for resilience: A conceptual excavation. *Armed Forces and Society*, 1-20.

Waugh Jr, W. L. (2009). "Mechanisms for collaboration in emergency management: ICS, NIMS, and the problem with command and control." *The collaborative public manager: New ideas for the twenty-first century*, 157-175.

Webster, M., Forest, C. E., Reilly, J., Babiker, M., Kicklighter, D., Mayer, M., Prinn, R., et al. (2003). "Uncertainty analysis of climate change and policy response." *Climatic Change,* 61, 295–320.

Wildavsky, A., (1988). *Searching for Safety*. New Brunswick, NJ: Transaction Press.

Yamin, F., Rahman, A., and Huq, S., (2005). Vulnerability, adaptation and climate disasters: A conceptual overview. *Institute of Development Studies Bulletin*, 36 (4), 1-1.

MANUSCRIPT 2

Responder Resilience: A Case Study Analysis of Emergency Response Organization Leaders' Mental Models of Resilience

(To be submitted to Disaster Prevention and Management)

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Abstract

Purpose: As community and organizational resilience become increasingly important elements of disaster response and emergency preparedness, examining emergency response organizations (ERO) leaders' mental models of resilience provides essential insights into what they know and value with respect to key resiliency concepts and approaches to resiliency planning.

Design/methodology: This study examines ERO resilience knowledge and awareness through the application of mental model analysis of ERO leaders in three coastal New England municipalities. 41 ERO leaders were interviewed and their default and complete mental models were assessed for comprehensiveness and balance in comparison to an expert derived reference model.

Findings: Comparisons of the participants' default and complete mental models revealed low default model comprehensiveness scores in all three sites (45%-51%) that increase notably during researcher-prompted structured questions (84%-90%). In contrast, participants' mental model balance scores showed little change between prompted and unprompted portions of the interview.

Research limitations: The research was limited by the focus on three case study sites. Future research may expand to a wider scope to include more study areas in a variety of risk environments, such as tornado-prone regions and areas vulnerable to wildfires.

Practical implications: The identification and description of ERO leaders' mental models highlights the gaps and inaccuracies in the participant's mental models. Additionally, the results indicate the large shifts that can occur in ERO leader's mental

models concerning resilience due to discussion and input from others. The results of this mental model assessment provide insights that can inform future emergency response resilience education and planning initiatives in addition to suggesting areas for future research.

Originality: This research applies mental model methods to the study of ERO resilience in order to address the current gap in academic literature. The study results also suggest new areas for research and inquiry pertaining to successful application of resiliency initiatives in the emergency response community.

Key words: emergency response organization, resilience, mental model methods

Paper type: Research paper

2.1 Introduction

Emergency response organizations (EROs) are a critical component of communities' disaster response, emergency preparedness, and resilience planning efforts. Although there are many current research efforts focusing on community and organizational resilience (Somers, 2009; Rodin, 2014; Lee *et al.*, 2013; Mallak, 1998; McManus *et al.*, 2008), little research focuses specifically on resilience in EROs. In order to build communities that are ready to face the challenges of a rapidly changing world with increasing climate-related risks and hazards, EROs must become fully involved in resiliency-building and planning initiatives. This study focuses on the five EROs identified by the U.S. Department of Homeland Security in the Emergency Services Sector-Specific Plan: fire, police and law enforcement, emergency medical services, emergency management agencies, and public works departments (Thompson, J. and Durkovich, 2015). These five key response organizations provide essential emergency and routine life-safety services to their communities in day-to-day operations, and serve as first responders during large scale incidents or disasters such as hurricanes, blizzards, or terrorist attacks. Due to their roles in routine operations as well as disaster events, incorporating EROs in resiliency planning initiatives can contribute to community resilience by ensuring the continued provision of essential life-safety services during any incident or impact (Lee *et al*., 2013). This study focuses on identifying and describing ERO leaders' mental models of resiliency within their organizations and identifies the components of resilience they value most.

This study examines ERO resilience understanding and awareness through the application of mental model analysis of ERO leaders in three coastal New England

towns, Westerly, Rhode Island, West Haven, Connecticut, and Stratford, Connecticut. Mental models are an "individual's internal representation of an external problem or phenomenon," and as such offer a unique perspective on the world view and understanding each person brings to their decision-making, behavior, and attitudes (Smythe and Thompson, 2015; Gentner and Stevens, 1983). As community and organizational resilience become increasingly important elements of disaster response and emergency preparedness, understanding ERO leaders' mental models of resilience provide important insights into their knowledge of key resiliency concepts and approach to resiliency planning. This study defines resilience as the "capacity of any entity – an individual, a community, or an organization – to prepare for disruptions, to recover from shocks and stresses, and to adapt and grow from a disruptive experience" (Rodin, 2014). Current literature provides a wide variety of definitions for "resilience," however Rodin's definition was selected based on a thorough literature review. This article forms one section of a larger mixed-methods study that developed an expert derived and verified ERO Resiliency Framework (see Manuscript 1), applied information developed from the Framework to build an expert mental model of ERO resilience, and analyzed mental models of ERO leaders in the field to identify gaps and differences in leaders' mental models compared to the expert mental model.

The mental models of ERO leaders were analyzed using the concepts of mental model "comprehensiveness" and "balance" developed by Smythe and Thompson (2015) in order to develop an understanding of the leaders' primary focuses and knowledge areas. Moreover, this study examined the discrepancies between the ERO leaders' models and the expert model. The results of this analysis provide important insights into ERO

leaders' current understanding and approach to resilience, which may inform future resiliency education, policy, and planning efforts.

2.2 Resilience in Emergency Response Organizations

As the field of community and organizational resilience attracts increasing academic and governmental attention, the lack of research focusing on ERO resilience is notable. Current organizational resilience literature emphasizes the increasing importance of resilience to all organizations and examines case studies of non-profit organizations, retailers, manufacturers, technology suppliers, public utilities, and private contractors (Sutcliffe and Vogus, 2003; Lee et al., 2013; McManus et al., 2008). Although these studies provide recommendations and guidelines for multiple types of organizations, none of them provide guidance for emergency response organizations. Defining the roles EROs play in communities and their responsibilities is essential to understanding their importance in resiliency efforts. Fire departments are responsible for providing fire suppression, rescue operations, hazardous material response, and incident command in addition to other functions. Police departments serve as the law enforcement agency, responsible for maintaining security, managing people and traffic, and responding to critical violent incidents. Emergency medical services may be provided by fire departments, private companies, or municipal departments and are responsible for providing medical response in the out-of-hospital setting. Emergency management agencies serve a key function as the management organization responsible for planning, preparing, mitigating, and responding to natural disasters or human-caused incidents. Public works departments also serve an essential emergency response function by clearing roads of snow, fallen trees, or debris, securing water, gas, and electrical utilities

that may be damaged, and working in coordination with the previously listed response organizations to access individuals in need of assistance. Communities rely on the critical life-safety services provided by EROs on a daily basis as well as during extreme disaster events; thus, the resilience of EROs within a community are an essential component of improved community resilience. However, EROs face unique challenges in improving resilience that other organizations such as retailers and manufacturers do not encounter. For example, emergency responders cannot move personnel and equipment and relocate to areas outside the impact zone until the disaster has passed as is recommended for organizations such as manufacturers and non-profits (Sutcliffe and Vogus, 2003). Nor can emergency response personnel work remotely from home or other secure locations. Due to the nature of the critical services provided, emergency responders must report for duty when other employees may be advised to shelter at home or in emergency shelters. Thus, resilience-building factors applicable to EROs must take into consideration the unique situations and challenges facing emergency responders during disaster events and their fundamental role in daily emergency operations.

The ERO Resiliency Framework was developed to address the lack of ERO-specific resiliency strategies in current literature and to produce recommendations directly applicable and translatable to ERO practitioners working in communities (see Manuscript 1). The Framework outlines the eleven key resilience factors in four areas of focus: resource management, operations/logistics, planning, and situational awareness.

The Framework was developed through a Delphi-method survey of emergency response experts including highly experienced field practitioners, academic researchers, and administrative and policy professionals. Manuscript 1 describes the complete Delphi

study and findings resulting in the development of the ERO Resiliency Framework. Identifying key factors contributing to ERO resilience is essential to creating translatable and actionable resilience-building recommendations that EROs may apply to their plans, procedures, and training to begin the process of improving their resilience. In order to be most effective in developing ERO resilience-building initiatives and plans, it is essential to understand ERO leaders' mental models of their organizations' resilience.

2.3 Mental Models Applied to EROs

A mental model is "an individual's internal cognitive representation of a real-world or hypothetical domain, problem, or phenomenon" and forms the basis of the individual's world view, impacting their behavior, decision making, communication, and reasoning (Gentner and Stevens, 1983; Smythe and Thompson, 2015; Jones *et al.*, 2011; Ladosz, 2015). The concept of mental models was originally proposed by the psychologist Kenneth Craik (1943), who suggested that the nature of human thought was the manipulation of internal representations and understanding of the world. Craik's theory was expanded by Johnson-Laird (1980) in work proposing that mental models carried important lessons for cognitive science, processing, and reasoning. Mental models are highly dynamic and although they do not change easily, models may adapt to changing circumstances and evolve over time (Jones *et al.*, 2011). The introduction of new information, further training, or exposure to new experiences may alter individuals' mental models, reshaping them or adding additional details. Mental model analysis, a method that extracts participants' cognitive conceptualizations about a specific subject, form a key component of research into individuals' knowledge, beliefs, values, and perceptions of the world and is especially applicable to research focused on

understanding how individuals approach and solve problems, make decisions, and perceive their surroundings (Hulst, 2012; Smythe and Thompson, 2015; Ladosz, 2015). Use of mental model analysis allows researchers to gain important insight into how individuals "internally represent complex, dynamic systems and how these representations change over time" (Jones *et al.,* 2011). Better understanding of how individuals conceive of and view particular practices, concepts, and problems may be used in a wide variety of ways, including enhanced decision making, development of better management policies, and improved communication (Zaksek and Arvai, 2004; Stone-Jovicich *et al*., 2011, Jones *et al*., 2011). Mental model analysis methods have been successfully applied to a variety of disciplines including coastal zone and coastal ecosystem management (Hulst, 2012; Smythe and Thompson, 2015), water use and management (Mathevet *et al.*, 2011, Stone-Jovicich *et al*., 2011, Kolkman and van der Veen, 2005), flood risk management (Wood *et al.*, 2012), natural resource management (Zaksek and Arvai, 2004), risk communication (Morgan *et al.*, 2002), and volunteer tourism (Ladosz, 2015).

Although mental model analysis provides unique insights into individuals' understandings and perceptions, it also presents challenges. It may be difficult to differentiate and elicit the mental models that subjects genuinely rely on to make decisions and take actions rather than the mental models that they may externally "espouse" but not actually use in their internal decision making and conceptualization process (Jones *et al.*, 2011). It is also possible that the mental models elicited during the study may be inaccurate and/or incomplete due to the exclusion of some stakeholders or incomplete or inaccurate mental models of individuals interviewed (Jones *et al.,* 2011).

Mental models must be viewed as "functional rather than complete or accurate representations of reality" due to the fact that by nature mental models are a simplified representation of reality (Jones *et al.*, 2011). Additionally, due to cognitive limitations, it may not be "possible nor desirable to represent in a mental model every detail that may be found in reality" (Jones *et al.*, 2011; Smythe and Thompson, 2015; Ladosz, 2015). In spite of the incomplete representation of reality obtained through mental model research, it remains a valuable methodological tool for assessing individuals' internal understandings and cognitive representations of the outside world (Jones *et al.*, 2011).

Implementing resilience in EROs is an inherently complex goal involving identifying and changing outdated attitudes and traditions, developing new habits and methods of approaching organizational responsibilities, and engaging diverse stakeholders in new approaches to daily activities as well as disaster events. The use of mental model analysis is particularly appropriate for the purposes of this research. The identification of ERO leaders' mental models is essential to fully understanding their current comprehension and knowledge of resilience prior to implementing resilience-building initiatives. Understanding the mental models of the numerous different individuals involved in community emergency response helps identify gaps in knowledge, responders' varying levels of understanding pertaining to resilience and risk, and their attitudes, preferences, and values (Mathevet *et al*., 2011; Smythe and Thompson, 2015; Jones *et al.*, 2011). Identifying mental models and making them explicit can help both trainers and planners adapt and adjust existing plans and education programs and develop new trainings designed to respond to EROs current mental models.

Emergency response leaders' ability to understand the multiple components of ERO resilience is essential in order for them to implement resilience as an organizational goal and incorporate resiliency factors in trainings, planning, and operations. Hence, assessing ERO leaders' current mental models of resilience and identifying gaps in knowledge and understanding contributes to the success of their department's education, trainings, and planning efforts. Through the use of mental model interviews and analysis, a comprehensive view of ERO leaders' varying mental models regarding their organizations' resilience emerge.

2.4 Methodology

This study applied a comparative case study approach using mental model methodology to assess ERO leaders' conceptualization and understanding of resilience in three case study sites in coastal southern New England: Westerly, Rhode Island, West Haven, Connecticut, and Stratford, Connecticut. These sites were selected based on their similarities and thus comparability. Specifically, each site is a mid-sized (population 23,000-54,500 according to the U.S. Census Bureau, 2011)) coastal community that sustained impact and damages from Superstorm Sandy (2012), has taken identifiable steps towards reducing future impacts of major storms, and has municipal-based emergency services including fire departments, police departments, emergency medical services (EMS), emergency management agencies (EMA), and public works departments. Interview subjects were recruited from each ERO based on their leadership role within the organizations. A total of 41 ERO leaders were interviewed for this research, 15 in Westerly, 10 in West Haven, and 16 in Stratford, providing a total population sample of ERO leaders' mental models of resilience in the three study sites.

The methods used in this study are based on the mental model methodology outlined by Morgan et al. (2002) consisting of four steps: (1) developing the "reference model," an expert model of ERO resilience, (2) conducting mental model interviews with leaders in each of the five identified EROs in the selected study locations, (3) transcribing, coding, and analyzing the interview transcripts, and (4) comparing interviewees' mental models with the reference model (Smythe and Thompson, 2015; Morgan *et al*., 2002). This methodological framework provides the foundation in the application of previously tested and verified methods to a new area of inquiry, emergency response leaders' mental models of resilience.

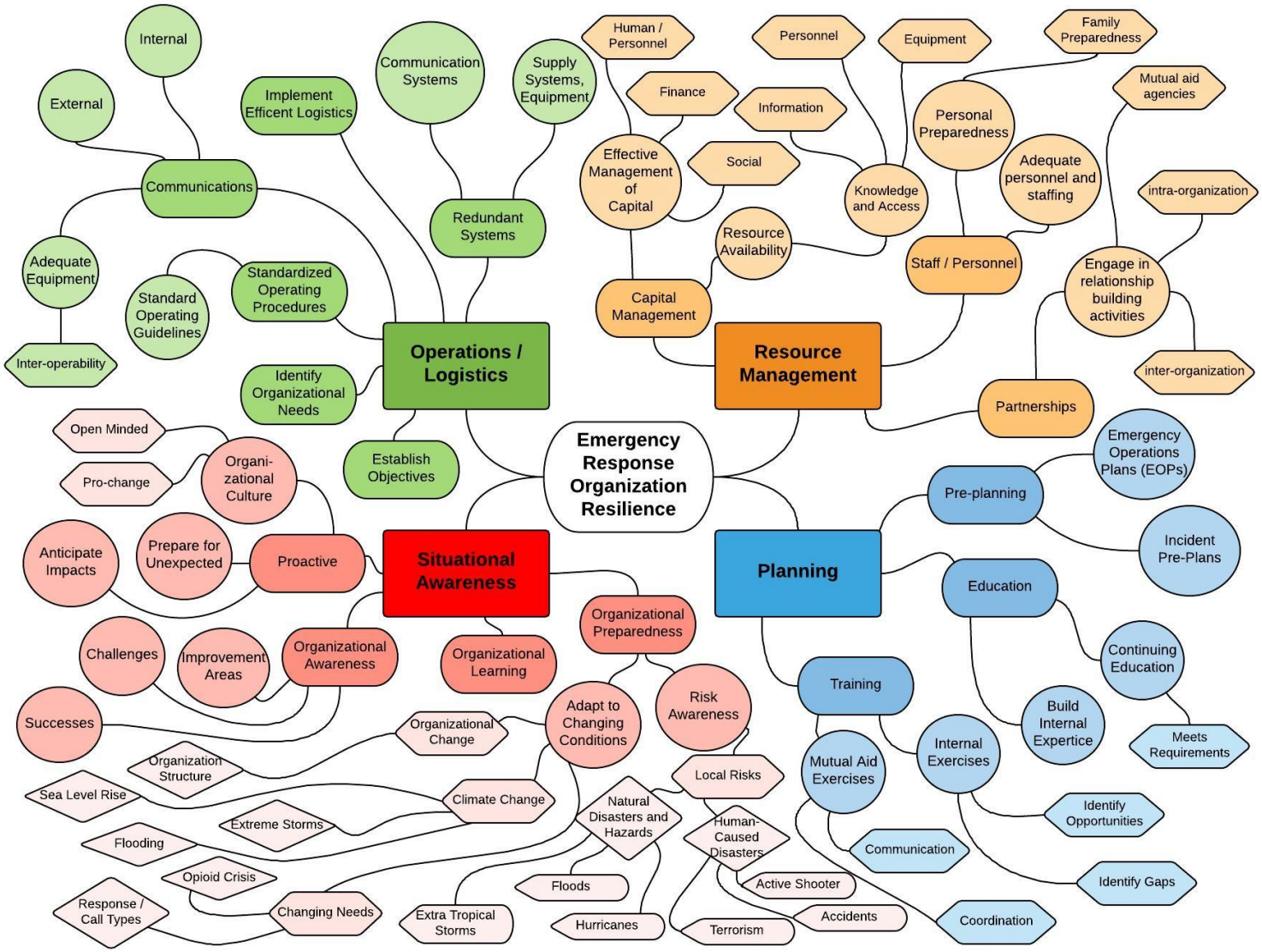

Figure 2.1. Reference ERO resilience model.

The development of the reference model, the expert model of ERO resilience, was based on the key components of organizational resilience identified through a review of current academic literature and expanded based on the results of the Delphi study of emergency response experts described in Manuscript 1. The core components of the reference model (planning, resource management, situational awareness, and operations/logistics, see Figure 2.1) are identified as essential aspects of organizational resilience in multiple studies and their relevance to EROs was confirmed through the Delphi study described in Manuscript 1 (Rodin, 2014; Mallak, 1998; Somers, 2009; Lee *et al.*, 2013; McManus *et al.*, 2008). The Delphi study also contributed additional details to the reference model that focused on emergency response organizations' resilience. The literature reviewed in this study does not address the specific factors relevant to ERO resilience, hence the expert insights obtained through the Delphi portion of this research add depth to the expert model. The combination of literature-derived and expert-derived components in the development of the expert model provides a more comprehensive reference model including both the academic literature and expert practitioner input (see Figure 2.1). The reference model formed the basis for the development of the interview instrument and was reviewed for comprehensiveness by two resilience experts and two ERO leaders who were excluded from study inclusion based on their geographic location.

Figure 2.2: The Emergency Response Organizational (ERO) Resiliency Framework, including the core components of ERO resilience.

Mental model interviews were conducted using the "funnel design" and "prompting" approach outlined by Morgan et al. (2002) and applied by Smythe and Thompson (2015). Each interview began with broad open-ended questions and then narrowed to a series of researcher-prompted questions. The initial questions were designed to be intentionally broad in order to elicit the participants' unprompted thoughts regarding resilience in their organizations with minimal influence from the interviewer. This approach allows a researcher to learn what is most salient to the interviewee. Initial phase questions such as "Could you tell me about resilience in your organization?" were followed up with questions such as "Could you tell me more about ____?" or "Could you explain that?" with the intention of the participant leading the direction and focus of the conversation.

After the broad participant-led phase of the interview, the interviewer led the conversation with focus area-specific questions such as "What can you tell me about partnerships in your organization?" and "Does your organization engage in mutual aid exercises?" The core component-specific questions were worded the same in each interview and addressed all primary components of the reference model. Importantly, prompted questions were only used to bring up topics that had not been addressed by the interviewee in the first participant-led stage of the interview. Answers were coded to indicate whether the information was provided without prompting or only after prompting. All 41 interviews were conducted in person by the lead researcher in a consistent manner utilizing the same interview instrument to ensure comprehensiveness and consistency of each interview. Each interview was recorded with the participants' written permission for subsequent transcription.

Following the completion of the interview stage, transcribed interviews were coded and analyzed using NVivo qualitative data analysis software to assist in comparisons of mental models between individual participants and with the reference model (Smythe and Thompson, 2015; Thompson, 2005). Using methods outlined by Morgan et al. (2002), the code book was developed based on the reference model with each model node, a word or phrase summarizing the concept or subject being discussed, included in the code book (Morgan et al., 2002; Hulst, 2012; Smythe and Thompson, 2015). The developed code book was tested with a researcher familiar with the subject area and a professional in the emergency response and management field to ensure consistency in coding and all transcribed interviews were then coded by the lead researcher.

Coding was conducted based on the "fracturing" approach (Bazeley and Jackson, 2013) such that individual topics or concepts were coded each time they were raised during the interview in order to ensure accurate quantitative analysis of the subjects' mental models. Coding also included recording whether the content was discussed during the initial "unprompted" or second "prompted" phases of the interview (Smythe and Thompson, 2015). The resulting interview coding was analyzed using the methodology developed by Smythe and Thompson (2015) to visualize and compare participants' mental model comprehensiveness and balance. In order to assess and compare mental model comprehensiveness and balance, each interviewees' responses were summarized to identify the presence or absence (whether the participant had identified each of the possible nodes in the reference model) and repetition (the number of times a participant mentioned each node) (Smythe and Thompson, 2015). The number of prompted and unprompted mentions of each node were also recorded in each participant summary. The results of all 41 participant summaries were aggregated within the four main focus areas of the reference model: planning, resource management, situational awareness, and operations/logistics.

In order to assess the mental model comprehensiveness and balance of each participant and identify participants' "default" and "complete" models, the analysis methods developed by Smythe and Thompson (2015) were applied to the results of the interview coding summaries (Table 2.1). Mental model comprehensiveness was measured by comparing the percentage of nodes, corresponding to concepts, in the reference model the participants identified with and without prompting, forming their "default" (unprompted) and "complete" (prompted) mental models. Participants' mental

model balance was determined based on the number of times a node in the reference model was mentioned during the interview, both in the unprompted and prompted portions of the interview (Smythe and Thompson, 2015). Thus, participants' default (unprompted) model provides important insights into the aspects and components of resilience with which they are most familiar or most comfortable, or the areas that they feel are most important and the top priority. The complete (prompted) model is larger and includes topics or content that the participant feels are correct or valid but that they may be less knowledgeable about or believe to be less important and thus not think of until prompted by the researcher (Smythe and Thompson, 2015).

Table 2.1. Mental model measure definitions (Smythe and Thompson, 2015).

Mental model measure	**Definition**
Default model	Model derived from unprompted open-ended section of interview
Complete model	Model derived from complete interview (prompted and unprompted)
Mental model comprehensiveness	Extent to which interviewees' mental models included reference model components
Mental model balance	Extent to which interviewees' mental model focuses equally across four reference model focus areas

This research focused on identifying and describing ERO leaders' mental models brings to light the gaps in the participant's mental models as well as the wide variety of mental models held by individuals within the same department and the same community. Assessment of the comprehensiveness and balance of individuals' mental models highlights areas of strength as well as gaps in knowledge and understanding. In addition, the results of this study show the shifts that can occur in mental models due to discussion and input from others, such as the prompting questions of the researcher. The results of

this mental model assessment provide insights to inform future emergency response resilience education and planning initiatives in addition to suggesting areas for future research.

2.5 Results

The mental models of 41 ERO leaders were analyzed to identify the components, comprehensiveness, and balance of their mental models of resilience within their organizations. The results of the interview coding analysis were compared between the three case study sites and between organizations to fully understand the differences and similarities between individuals' and organizations' mental model comprehensiveness and balance. The findings of this study provide important insights into the application of resiliency concepts within the emergency response field.

The average complete comprehensiveness scores for all ERO leaders across all three case study sites were very similar with West Haven having the lowest (84%), and Stratford (89%) and Westerly (90%). Similarly, the sites' default comprehensiveness scores were also close: (West Haven 45%, Westerly 49%, and Stratford 51%). As can be seen, however, there was a large difference between all locations' default and complete scores (see Table 2.2). Westerly participants had the lowest complete model comprehensiveness scores for situational awareness (81%) and resource management (89%) with higher scores in planning (94%) and operations/logistics (95%). Stratford participants had similar complete model comprehensiveness scores with lower scores in situational awareness (78%) and resource management (87%) and higher scores in planning (92%) and operations/logistics (97%). West Haven participants had the lowest scores of the three sites across all focus areas with situational awareness (70%) and

resource management (84%) lower than operations/logistics (89%) and planning (90%). All three sites had low default model comprehensiveness scores ranging from 36% (West Haven, situational awareness) to 57% (Stratford, resource management). As Table 2.2 illustrates, the average interviewee in each of the three case study sites increased their mental model comprehensiveness notably between their default and complete models, demonstrating how their focus and what they determined to be of greatest importance was far narrower than their full understanding that was revealed through prompting by the researcher-led structured questions.

Table 2.2. Summary results of mental model comprehensiveness for three case study sites (D = default, C = complete).

Site	Total Comp. Score	Resource Management		Planning		Operations / Logistics		Situational Awareness	
		D	*C*	*D*	*C*	*D*	*C*	*D*	*C*
Westerly (n=15)	90%	51%	89%	48%	94%	50%	95%	46%	81%
West Haven (n=10)	84%	54%	84%	44%	90%	35%	89%	36%	70%
Stratford (n=16)	89%	57%	87%	52%	92%	51%	97%	46%	78%

In contrast to their mental model comprehensiveness scores, most participants' mental model balance scores shifted very little between their default and complete models (see Table 2.3). The site with the greatest shift between default and complete model balance was West Haven with 1% to 3% increases in balance varying between focus areas. Both Westerly and Stratford show minor increases in model balance between default and complete models, between 1% and 2% increases depending on focus area.

Table 2.3. Summary results of mental model balance for three case study sites (D = default, C = complete).

Site	Total Balance Score	Resource Management		Planning		Operations / Logistics		Situational Awareness	
		D	*C*	*D*	*C*	*D*	*C*	*D*	*C*
Westerly (n=15)	95%	20%	22%	24%	26%	17%	18%	28%	29%
West Haven (n=10)	90%	19%	20%	17%	18%	17%	20%	30%	32%
Stratford (n=16)	95%	18%	19%	22%	24%	20%	22%	29%	30%

The results of mental model comprehensiveness and balance analysis based on type of ERO are displayed in Table 2.5 and Table 2.6. In order to simplify the comparison of mental models between locations, summarized results of mental model comprehensiveness and balance for each case study site are presented in Table 2.4. The default model comprehensiveness of the fire department leaders (53%) was very similar to the comprehensiveness of police (54%), emergency medical services (EMS) (53%), and emergency management agency staff (51%), with department of public works (DPW) personnel having the lowest default model score (33%). The complete model comprehensiveness scores are also tightly grouped for fire (89%), police (90%), EMS (91%), and EMA (91%), with DPW showing significant increase but still holding the lowest score (77%). When analyzed by ERO, participants' show similar low changes in mental model balance score ranging from increases of 1-10%. The notable exception is department of public works personnel (DPW), who improved their default model balance score of 59% to 95% following structured-interview prompting, a 36% increase.

Table 2.4. Summary results of mental model comprehensiveness and balance by case study site.

Site	Mental Model Comprehensiveness			Mental Model Balance		
	Default	*Complete*	*Change between*	*Default*	*Complete*	*Change between*
Westerly	49%	90%	41%	89%	95%	6%
West Haven	42%	83%	41%	83%	90%	7%
Stratford	51%	88%	37%	89%	95%	6%

Table 2.5. Summary results of mental model comprehensiveness and balance by ERO.

ERO	Mental Model Comprehensiveness			Mental Model Balance		
	Default	*Complete*	*Change between*	*Default*	*Complete*	*Change between*
Fire	53%	89%	36%	88%	93%	5%
Police	54%	90%	36%	84%	94%	10%
EMS	53%	91%	38%	89%	90%	1%
DPW	33%	77%	44%	59%	95%	36%
EMA	51%	91%	40%	84%	93%	9%

The varying default and complete model scores examined by core component for each ERO reveal organizational strengths and gaps in knowledge or comfort levels. Fire, police, EMS, and EMA leaders had default model scores within a similar range across all four areas of focus (47-62%). However, DPW personnel had the lowest default model scores for planning (30%), operations/logistics (23%) and situational awareness (29%). DPW also had the lowest complete model score with 61% for situational awareness. While there was notable variability within fire, police, EMS, and EMA complete model scores in different focus areas, the complete comprehensiveness scores had a much

smaller range, from 79% to 99%. The marked increases in model comprehensiveness between default and complete models are notable in all five EROs analyzed.

Table 2.6. Summary results of mental model comprehensiveness by ERO (D = default, C = complete).

ERO	Resource Management		Planning		Operations / Logistics		Situational Awareness	
	D	*C*	*D*	*C*	*D*	*C*	*D*	*C*
Fire (n=13)	58%	87%	53%	93%	51%	96%	48%	80%
Police (n=8)	62%	88%	53%	98%	57%	96%	47%	79%
EMS (n=8)	49%	93%	52%	90%	58%	96%	54%	84%
DPW (n=5)	49%	81%	30%	82%	23%	83%	29%	61%
EMA (n=7)	49%	87%	54%	97%	46%	99%	56%	83%

In order to visualize the changes in default and complete model comprehensiveness, radar graphs were made displaying the shifts in focus and balance for each ERO (Figure 2.3). The similar mental model balance between the default and complete model is clear for fire, police, EMS, and EMA, and the notable shift in the DPW's balance between default and complete results in a balance comparable to the other EROs. The significant increase in comprehensiveness between the default and complete models are clearly visible for fire, police, EMS, and EMA with their comprehensiveness scores reaching from 89% to 91%. The DPW's default comprehensiveness started much lower than the other EROs (33%) and shows noteworthy increase to a complete model score of 77%, however the DPW complete

score remains behind the complete score of the other four EROs. The implications and potential causes of this difference will be discussed in the following section.

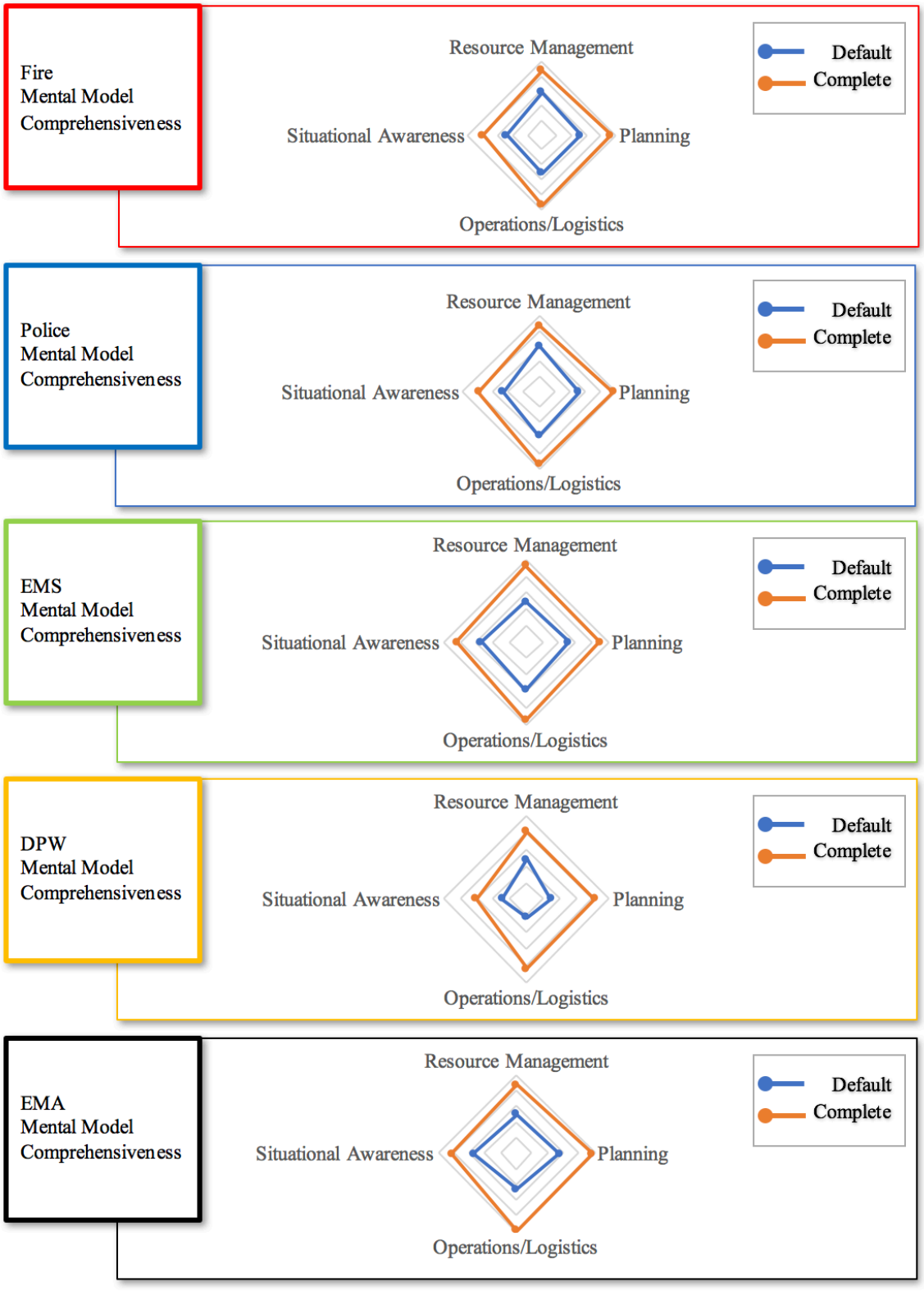

Figure 2.3. Mental model comprehensiveness compared by average of ERO participants.

2.6 Discussion

The results of this study reveal some key considerations and essential insights into ERO leaders' understanding of resilience in their organizations. Shifts and changes in the participants' mental model comprehensiveness between the unprompted default and prompted complete model illustrate differences in what the ERO leaders know on a broader scale and what they value and focus on most. Prompts, in this study the researcher's structured questions, can expand participants' mental models, highlighting the participants' areas of greatest attention and comfort through the unprompted portion of the interview and contrasting it with their wider field of knowledge. Differences between case study sites' default and complete models, as well as differences between EROs models, provide insights about current approaches to resilience as well as areas of greater value, knowledge, and comfort for the participants.

Comparing Mental Model Comprehensiveness

Results suggest that fire, police, EMS, and EMA are more familiar with the concept and details of ERO resilience, as indicated by their higher default model comprehensiveness compared with the DPW participants. The relatively high default mental model balance across the three case study sites and between EROs indicates that the four core components are all areas in which the participants have a base level of comfort or experience as they were able to address nodes of the reference model in all core component areas. One notable exception is the DPW participants, who had the lowest default model comprehensiveness and balance scores.

During interviews, DPW leaders frequently noted that they had not been included

in previous emergency planning initiatives within their communities and many did not consider themselves knowledgeable enough about resilience to speak with authority on the subject. Of the five DPW personnel interviewed, three referred the researcher to fire chiefs, EMA leaders, or police chiefs for more information about resilience in their communities. As the results indicate, the DPW participants increased their mental model comprehensiveness by 44% between the default and complete model, indicating that they had more extensive understanding when reminded about the broader view of resilience through the researcher's prompts. As previously described, DPW personnel and equipment serve a critical function in responding to natural disasters by clearing roads and providing access so fire, police, and EMS can reach individuals in need of assistance. One DPW director noted, "we are good at managing our equipment and our staff, I can tell you exactly how many trucks and plows and chainsaws I have and I know how many people I need to call in for a snowstorm, but I have no idea what the town's plan is if a hurricane is coming our way." This comfort with resource management and lack of knowledge regarding planning and operations is reflected in the mental model comprehensiveness of the DPW participants interviewed.

The DPW leaders' default comprehensiveness score was 49%, the same as EMS and EMA leaders, but their default scores for the other three core components were notably lower than their counterparts in fire, police, EMS, and EMA. While prompting from the researcher's questions resulted in large increases in their comprehensiveness levels, DPW leaders still had the lowest complete mental model comprehensiveness score with 77%. Although DPW serves as an important component of the emergency preparedness and response community, their primary daily operational focus is on

transportation and infrastructure, not the life safety and critical response work that fire, police, and EMS engage in on a daily basis. As such, some of the concepts in the reference model are less familiar to DPW personnel, but with prompting the DPW participants were willing and able to talk about the areas of focus with greater comprehensiveness and balance. DPW personnel are an essential component of communities' emergency preparedness and response resources and must be included in future planning and resilience knowledge sharing events or groups in order to bridge the gap between their daily operational focus and emergency response function.

Catalyzing Events and Changing Times Impacting Mental Models

The core component that received the highest default balance scores was situational awareness (Westerly 28%, Stratford 29%, and West Haven 30%). The situational awareness focus area included the nodes corresponding to the opioid crisis and active shooter events, impacting both the balance and comprehensiveness scores of participants. Increasing numbers of opioid overdoses place a significant demand on fire, EMS, and police departments' financial and personnel resources and 40% of participants unprompted identified the opioid crisis as a concern for their organization. Active shooter situations were also in the forefront of participants' minds due to the prevalence of mass casualty active shooter incidents in 2017-2018, with 51% of interviewees describing recent active shooter trainings or drills their organizations participated in within the past year. The prevalence and public attention drawn to both the opioid crisis and active shooter scenarios are reflected in the higher default mental model comprehensiveness and balance of ERO leaders in these case study sites. In addition to impacting the results of this research, the opioid crisis and active shooter incidents provide an example of how

highly public and catalyzing events can have an influence on individuals' unprompted default mental models and shift focus away from low probability-high consequence events such as natural disasters.

The increases in mental model comprehensiveness displayed by ERO leaders in all three case study sites suggest that the leaders are willing and able to change their mental model of resilience to be more inclusive of all core components of ERO resilience. Many participants stated that their organizations were resistant to change and old traditions and practices were difficult to alter, but 95% (38 of the 41 interviewees) said that their organizations had to keep up with changing times and new ideas and innovations. One fire chief stated, "this isn't the world we faced as firefighters 30 or 40 years ago. The world has changed and we need to change with it to keep providing our communities the best services we can." Participants across all five organizations expressed interest in engaging in additional resilience training and education and incorporating resilience principles into their plans and protocols. In addition, ERO leaders in all three case study sites invited the researcher back upon the completion of this study to share research results and recommendations for their organizations.

Mental Models Motivating Change

The large differences in mental model comprehensiveness between default and complete models in all three case study sites and across all five EROs suggests that there is an opportunity to bridge the gaps in ERO leaders' mental models of resilience in their organizations. Default mental models were relatively balanced with participants addressing nodes in all four core component areas, but participants primarily focused on the large ideas and aspects of resilience forming the central nodes of the reference model.

With prompting, the participants' mental models expanded to include more nodes in each core component area, displaying greater knowledge of details relevant to each core component. This shift of the participants' mental models indicates that with prompting, ERO leaders are more comprehensive in their approach to resiliency and thus may address resilience with greater thoroughness in planning efforts and training scenarios.

Shifts in ERO leaders' mental models of resilience may also provide opportunities for motivating change within the emergency response community. Research on cultural models, similar to mental model studies, supports the importance of cultural knowledge in motivating individuals to take action (Strauss, 1992; Holland and Quinn, 1987; Paolisso, 2002). The results of this study describing the comprehensiveness and balance of participants' mental models also provides insights on the broader cultural knowledge of resilience in emergency response organizations. An improved understanding of these critical organizations' mental and cultural models can guide future efforts to motivate action and set goals on an organizational and community level.

2.7 Conclusion

The understanding of ERO leaders' mental models of resilience gained through this research provide insights and recommendations for future applications of resiliency-building initiatives in an emergency response context. ERO leaders have notably balanced and comprehensive default models of resilience and they are familiar with the core ERO resiliency components of resource management, planning, operations/logistics, and situational awareness. In addition, the participants saw the four core components as nearly equally important with small levels of variation in comprehensiveness or balance

between components in both their default and complete models. ERO leaders are also willing and able to change their mental models of resilience with prompting regarding the various components of resilience. Thus, it is recommended that resilience initiatives actively recruit and involve leaders from emergency response organizations in planning projects and outreach efforts. Emergency responders strongly adhere to time-honored traditions and may be resistant to change, but ERO leaders acknowledge that the world is changing around them and they must proactively engage in efforts to incorporate new concepts, such as resilience, in their plans, policies, and response operations. Additional research is needed to identify the best methods for teaching resilience principles and strategies to emergency responders. A good initial step is encouraging ERO leaders to get involved with current community emergency planning initiatives and proactively discussing the role of resilience in their organizations.

One important finding of this study is the noted differences between DPW leaders and research participants from fire, police, EMS, and EMA organizations. Although DPW leaders' focus in their day-to-day operations is not on the critical life-safety scenarios and events that fire, police, and EMS face on a daily basis, they are an important resource and contributor in emergency response to large-scale events, especially natural disasters. As such, DPW needs to be included in the emergency planning process and invited to participate in trainings and educational opportunities. Incorporating DPW assets and staff during exercises serves as a way to familiarize fire, police, EMS, and EMA leaders and personnel with the capabilities and equipment of their DPW colleagues and provides an opportunity for DPW leaders to participate in emergency planning and scenario-based training. In order to provide the best possible

response and remain resilient during potential impacts from disasters, all emergency response organizations must work together and build their organizational resilience cooperatively.

Gaps in ERO leaders' mental models also provide an opportunity to tailor education, training, and outreach efforts to address aspects of resilience with which they are less familiar and comfortable. Most emergency response departments engage in regular training, drills, and continued education, thus incorporating resilience training and best practices into pre-scheduled drills or classes. In order for EROs to proactively include resilience factors and strategies in their plans and operations, it is vital to clearly demonstrate how such factors and strategies will improve their ability to safely and successfully carry out their critical life-safety missions during times of disaster. Building resilient EROs is an essential component in the development of resilient communities, and the results of this research highlight key areas to focus future education and planning efforts as well as suggesting areas for future research.

References

Bazeley, P., and Jackson, K., eds., 2013. *Qualitative data analysis with NVivo*. Sage Publications Limited.

Craik, K., 1943. The nature of explanation. Cambridge, Cambridge University Press

Gentner, D., and A.L. Stevens, eds., 1983. *Mental models*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Holland, Dorothy, and Naomi Quinn, eds., 1987. *Cultural Models in Language & Thought*. Cambridge: Cambridge University Press.

Hulst, S., 2012. Planning for shoreline retreat in Matunuck: The relevance of coastal geologic processes and climate change, Marine Affairs. University of Rhode Island, Kingston, RI.

Johnson-Laird, P. N. (1980). Mental models in cognitive science. *Cognitive science*, *4*(1), 71-115.

Jones, N.A., H. Ross, T. Lynam, P. Perez, and A. Leitch, 2011. Mental models: An interdisciplinary synthesis of theory and methods. Ecology and Society 16, 46- 59.

Keim, M.E., 2008. Building human resilience: The role of public health preparedness and response as an adaptation to climate change. *American Journal of Preventive Medicine*, 35 (5), 508-516.

Kolkman, M. J., Kok, M., & van der Veen, A. (2005). Mental model mapping as a new tool to analyse the use of information in decision-making in integrated water management. Physics and Chemistry of the Earth(30), 317-332. doi: 10.1016/j.pce.2005.01.002.

Ladosz, M. (2015). *Exploring Volunteers' Understanding of Harm in International Volunteering Projects: A Mental Models Approach* (Doctoral dissertation, University of Calgary).

Lee, A.V., J. Vargo, and E. Seville, 2013. Developing a tool to measure and compare organizations' resilience. *Natural Hazards Review*, 15, 29-41.

Mallak, L. A. (1998). Measuring resilience in health care provider organizations. *Health manpower management*, *24*(4), 148-152.

Mathevet, R., Etienne, M., Lynam, T., & Calvet, C. (2011). Water Management in the Camargue Biosphere Reserve: Insights from Comparative Mental Models Analysis. Ecology and Society, 16(1), 43 [online].

McManus, S., Seville, E., Vargo, J., & Brunsdon, D. (2008). Facilitated process for improving organizational resilience. *Natural Hazards Review*, *9*(2), 81-90.

Morgan, M.G., B. Fischhoff, and C.J. Altman, 2002. *Risk communication: A mental models approach*. Cambridge, UK: Cambridge University Press.

National Academies, 2012A. *Disaster Resilience: A National Imperative.* Washington, DC: The National Academies Press.

Paolisso, M., 2002. Blue crab and controversy on the Chesapeake Bay: A cultural model of understanding watermen's reasoning about blue crab management. *Human Organization*, 61(3), 226-238.

Rodin, J., 2014. *The Resilience Dividend: Being Strong in a World Where Things Go Wrong*. New York, NY: PublicAffairs.

Smythe, T.C. and Thompson, R., 2015. Conceptualizing coastal ecosystem-based management: a Mental Models Approach, *Society & Natural Resources*, *28*(1), 38-56.

Somers, S., 2009. Measuring resilience potential: An adaptive strategy for organizational crisis planning. Journal of Contingencies and Crisis Management, 17 (1), 12-23.

Stone-Jovicich, S., Lynam, T., Leitch, A., & Jones, N. A., 2011. Using Consensus Analysis to Assess Mental Models about Water Use and Management in the Crocodile River Catchment, South Africa. Ecology and Society, 16(1), 45 [online].

Strauss, Claudia, 1992. Models and motives. In *Human Motives and Cultural Models*, R. D'Andrade and C. Strauss, eds. Pp. 1-20. Cambridge: Cambridge University Press.

Sutcliffe, K.M. and Vogus, T.J., (2003). "Organizing for resilience." *Positive Organizational Scholarship*, 94-110.

Thompson, J. and Durkovich, C.A., 2015. "Emergency Services Sector-Specific Plan: An Annex to the NIPP 2013". U.S. Department of Homeland Security. https://www.dhs.gov/sites/default/files/publications/nipp-ssp-emergency-services-2015-508.pdf.

Thompson, R., 2005. Reporting offshore wind power: are newspapers facilitating informed debate? *Coastal Management*, *33*(3), pp. 247-262.

Tsai, P., 2013. *Launching a National Conversation on Disaster Resilience in America: Workshop Summary*. Washington, DC: The National Academies Press.

United States Census Bureau / American FactFinder. (2011). "B11001 : Household Type (Including Living Alone)." *2007 – 2011 American Community Survey*. U.S. Census Bureau's American Community Survey Office, 2011. Web. 13 January 2018 <http://factfinder2.census.gov>.

Wood, M., D. Kovacs, A. Bostrom, T. Bridges, and I. Linkov. 2012. Flood Risk Management: US Army Corps of Engineers and Layperson Perceptions. *Risk Analysis*, 32(8): 1349-1368.

Zaksek, M. and Arvai, J.L., 2004. Toward improved communication about wildland fire: mental models research to identify information needs for natural resource management. *Risk analysis*, *24*(6), pp.1503-1514.

Appendix A: Informed Consent Letter

Resilient Response in an Age of Change: Emergency Response Organizations' Resilience in Times of Disaster

CONSENT FORM FOR RESEARCH: INTERVIEW

You have been invited to take part in a research project described below. The researcher will explain the project to you in detail. You should feel free to ask questions. If you have more questions later, Clara Decerbo, the graduate researcher conducting this study, can be reached at 802-299-5339 to discuss them with you. The total maximum time required for participation in this study is 1.5 hours, the maximum duration of the interview. In order to participate in this study you must be over 18 years old and of sound mind. This research project is conducted under the supervision of Principal Investigator Dr. Robert Thompson.

Description of the project:
This research will use data obtained through this interview to evaluate the resilience of emergency response organizations (EROs) during disasters. The organizations focused on in this study include fire departments, police departments, emergency medical services, departments of public works, and emergency management agencies. The results of this study will be used to develop guidelines and recommendations for improving the resilience of EROs in the United States and internationally.

What will be done:
If you decide to take part in this study, you will be interviewed regarding your opinions and experiences relating to emergency response organizations' resilience to disasters. The interview will last 45 to 90 minutes and will be recorded with your permission. The only additional involvement that may be asked of you would be a brief follow-up conducted by the researcher within 1 year of the initial interview to clarify any responses.

Risks or discomfort:
There is minimal risk in participating in this study.

Benefits of this study:
This study will benefit emergency response organizations and emergency response personnel who must continue providing critical services during and immediately after disruptive and destructive disasters. The results of this study will also benefit communities negatively affected by disasters through improved resilience of their emergency response organizations.

Confidentiality:
Names of participants will not be used and your participation and information shared in this study is confidential. None of the information will identify you by name. All written records will be stored in a locked file cabinet in the Coastal Institute Kingston at the University of Rhode Island. Scientific reports and academic presentations of this study

will be based on group data and will not identify you or any individual as being in this project. Data will be destroyed three years after the completion of the study.

In case there is any injury to the subject:
This study is not expected to cause any injury. If this study causes you any injury, you should write or call the office of the Vice President for Research, 70 Lower College Road, University of Rhode Island, Kingston, Rhode Island, telephone: (401) 874-4328.

Decision to quit at any time:
The decision to take part in this study is completely voluntary. If you decide to take part in the study, you may decline to answer any question or you may quit at any time. If you wish to quit during the interview, please inform the interviewer immediately. If you wish to quit at a later time, please inform please inform Clara Decerbo at (802) 299-5339 of your decision.

Rights and Complaints:
If you are not satisfied with the way this study is performed, you may discuss your complaints with Robert Thompson at (401) 874-4485 or rob@uri.edu, or Clara Decerbo at (802) 299-5339 or clara.decerbo@gmail.com, anonymously, if you choose. In addition, if you have questions about your rights as a research participant, you may contact the office of the Vice President of Research and Economic Development, 70 Lower College Road, Suite 2, University of Rhode Island, Kingston, Rhode Island, telephone: (401) 874-4328.

You have read the Consent Form. Your questions have been answered. Your signature on this form means that you understand the information and you agree to participate in this study.

_____ Signature of Participant

_____ Typed/printed Name

_____ Date

_____ Signature of Researcher

_____ Typed/printed name

_____ Date

Please sign both consent forms, keeping one for yourself.

Appendix B: Interview Guide

Introductory script:

Today I would like to talk with you about resilience in your organization.

Phase 1: Interviewee-led

I would like to begin by having you tell me about your organization and what resilience means to you in the context of your work.

Follow-up Prompts

- Anything else?
- Could you tell me more about that?
- Why is _____ important?
- What's being done about that?
- What could be done about that?
- How does that work?
- Are there any actions addressing that problem?
- Can you give me an example of that?
- Why is that important?
- How was that decided?
- How does that affect your organization?
- Are there any differences of opinion about that?

Phase 2: Interviewer-led

RESOURCE MANAGEMENT

1. What can you tell me about partnerships in your organization?
2. ___What are the ways your organization engages in relationship building activities?

   *___ Inter-organizational; *___ Intra-organizational; *___ Mutual Aid

3. ___ What can you tell me about the role/importance the staff/personnel have in your organization in relation to resilience?

   *___ Adequate personnel and staffing; *___ Personal Preparedness; * ___ Family Preparedness

4. ___ Describe the role resource management has in your organization. [Management of social, financial, human resources/capital]

___ Effective management of: *___ Social; *___ Financial; * ___ Human/Personnel

___ Resource availability: *___ Knowledge of and access to: *___ Equipment; *___ Personnel; * ___ Information

PLANNING

5. ___What can you tell me about training in your organization?

6. ___What type of events does your organization train for?

*___ How intensely do you train for different types?

*___ Why do you train for these types of events and not others? How do you decide which events to train for?

7. ___What are the ways your organization engages in internal exercises?

*___ Identify gaps; *___ Identify opportunities

8. ___What are the ways your organization engages in mutual aid exercises? What are some of the benefits and challenges you encounter?

*___ Coordination *___ Communications

9. ___What can you tell me about education in your organization?

___What are the ways your organization engages in continuing education? Meeting education requirements?

___What are the ways your organization builds internal expertise?

10.___What can you tell me about disaster or incident pre-planning in your organization?

*___ Incident pre-plans *___ EOPs

OPERATIONS/LOGISTICS

11. ___What can you tell me about how your organization identifies needs?

12. ___What can you tell me about how your organization establishes objectives?

13. ___How does your organization implement logistics?

14. ___How does your organization manage communications?

*___ Internal; *___ External; *___ Adequate equipment; *___ Inter-operability

15. ___How does your organization manage standardized operating procedures?

___What are the ways your organization implements and uses standard operating guidelines?

16.___Does your organization use redundant systems? If so, how?

*___ Communication; *___ Supply systems

SITUATIONAL AWARENESS

17. ___What can you tell me about your organizational preparedness?

18. ___ Is your organization ready to adapt to changing conditions? Which conditions? How are you prepared?

*___ Organizational change; *___ Organization structure; *___Climate change; *___ Extreme Storms; *___ Flooding; *___ Sea Level Rise; *___Changing needs; *___ Response/call types

19. ___ What are the local risks your organization prepares for?

*___ Human-caused disasters; *___ Terrorism; *___Accidents; *___Natural disasters; *___Hurricanes; *___Extra Tropical Storms; *___Floods

20. ___How would you define organizational awareness?

21. ___What can you tell me about your organizational awareness?

*___ Successes; *___ Challenges; *___Improvement areas

22.___What attitude/posture does your organization take towards change?

___How does your organization anticipate impacts? How do you prepare for the unexpected?

___What is your organizational culture?

*___ Pro-change; *___ Open-minded

___What mindset do you think would be best for improving your organization's resilience?

MANUSCRIPT 3

Building Connections Before the Crisis: Assessing Social Capital in Emergency Response Organizations

(To be submitted to Journal of Emergency Management)

By

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Abstract

Social capital is widely recognized as a key component of communities' and organizations' ability to withstand and recover from impacts following a disaster. The aspects of social capital that contribute to building resilient communities also assist businesses and organizations by establishing and maintaining strong networks of relationships within teams and between individuals in different organizations. The unique challenges and functions of emergency response organizations (EROs) demand a greater focus on identifying and implementing resilience-building practices and policies designed for EROs. This article presents the findings of a social capital assessment of 41 ERO leaders in three coastal New England municipalities. The study's mixed quantitative and qualitative methods measure the EROs' levels of bonding, bridging, and linking social capital and offer recommendations for how social capital may be strengthened to improve organizational resilience and contribute to community resilience-building initiatives. While the EROs assessed in this study have high levels of social capital overall, the organizations' scores across the three forms of social capital highlight areas of strength and weakness and suggest areas for future improvement. In order to continue providing essential life-saving services to their communities during any disaster, EROs must build and maintain strong relationships and networks with other organizations and focus on developing and sustaining social capital.

3.1 Introduction

Hurricanes, floods, earthquakes, and other natural disasters impact millions of people every year, disrupting communities and causing millions of dollars in damages. A common approach to mitigating impacts and costs from large scale disasters and

increasing resilience focuses on policy changes designed to improve critical infrastructure systems. Social infrastructure also greatly affects community resilience, with elements such as social capital influencing how communities and organizations withstand and recover from impacts during and following disasters (Aldrich and Meyer, 2014). Social capital is defined in varying ways across the sociological, psychological, and behavioral literature. One commonly referenced definition is from Robert Putnam's book *Bowling Alone: The collapse and revival of American community* (2000) in which he defines social capital as the "features of social organizations, such as networks, norms, and trust that facilitate coordination and cooperation for mutual benefit" and that "enable participants to act together more effectively to pursue shared objectives" (Putnam, 2000, pg. 67). A growing body of work focuses on the impact social capital can have on communities' ability to mitigate vulnerability and recover after impacts, demonstrating the key role social capital has in building community resilience (Aldrich, 2012; Aldrich and Meyer, 2014; Aldrich, 2010; Adger, 2003; Murphy, 2007; Cox and Perry, 2011). New research expands on previous concepts linking social capital with community resilience to explore the connection between social capital, resilience, and performance within businesses and organizations. These include but are not limited to schools, community-based nonprofits, and government organizations (Seville, 2017; Andrews, 2010; Doh and Zolnik, 2011; Foster et al, 2003; Leana and Pil, 2006).

Many components of social capital that contribute to improved resilience within communities are also applicable to organizations impacted by natural disasters as well as human-related impacts, such as economic disruptions or problems within the

organization. Emergency response organizations[2] are vulnerable to the same impacts as non-emergency response businesses, but strategies that may be implemented to assist other types of organizations are not all applicable to EROs due to their location-based critical roles during and after disaster impacts. While manufacturing and retail companies may move to alternative sites and continue business operations prior to disasters and during recovery efforts, emergency responders must provide essential life-saving services in the impacted communities where their stations and equipment are located. Additionally, many emergency response personnel live in or adjacent to the communities they serve, increasing the likelihood that their own homes and families will be experiencing the same event or disaster impacting their work communities. These unique characteristics of EROs demand a greater focus on identifying and implementing resilience-building practices and policies designed for EROs. Social capital is an essential component of organizational and community resilience, hence understanding the types and levels of social capital held by EROs provides important insights into how social capital may be used to improve ERO resilience. This article presents the findings of a social capital assessment of ERO leaders and offers recommendations for how elements of social capital may be applied to EROs to improve organizational resilience and contribute to community resilience-building initiatives.

Components of social capital, including social networks, reciprocity, trustworthiness, and access to resources and capital, are essential to the resilience of

[2] For the purposes of this research, Emergency Response Organizations are defined as fire, police and law enforcement, emergency medical services, emergency management agencies, and public works departments as established by the U.S. Department of Homeland Security in the Emergency Services Sector-Specific Plan (Thompson, J. and Durkovich, 2015).

EROs. This study defines resilience as the "capacity of any entity – an individual, a community, or an organization – to prepare for disruptions, to recover from shocks and stresses, and to adapt and grow from a disruptive experience" (Rodin, 2014). The presence of high levels of social capital can contribute to higher levels of resilience within EROs due to stronger social bonds and greater trust between colleagues within the organization and between response organizations, providing responders with more information and access to resources. Likewise, the lack of social capital can hinder EROs in responding to and recovering from large scale disasters due to lack of access to social networks, resources, and trusted connections. Thus, social capital must be considered as an essential component of ERO resilience.

Although multiple sources discuss social capital in communities, the literature reviewed for this study does not address the importance or role of social capital as a component of resilience in EROs. The purpose of this study is to assess the forms and levels of social capital currently held by 41 EROs leaders in three case study locations. As the field of social capital research expands, studies offer new approaches and recommendations for building and supporting social capital as an avenue to increasing resilience. The unique challenges inherent in EROs' roles and responsibilities prior to, during, and after disasters compel research focused on the forms of social capital held by EROs. Additionally, the results of this study offer recommendations for ERO leaders on how they can encourage and support social capital development within their departments and organizations.

3.2 Background

Defining Social Capital and Resilience

Hanifan's study of a rural West Virginia school community center identified social capital in the contact and fellowship between neighbors and cooperation between parts of the community that "may easily be directed towards the general improvement of the community well-being" (Hanifan, 1916, p. 131). This early description of social capital laid the foundation for many disciplines that have revised and clarified the scope, components, and outcomes of social capital. Some researchers, notably Coleman (1988), Putnam (1993), and Bourdieu (1993) describe social capital as consisting of components, specifically networks, norms, and trust, that form a resource for collective action. The networks and relationships between individuals and groups or communities are explored further by Portes (1998) and Putnam (1993). Putnam's work highlights the importance of social connectedness, networks, and trust in establishing and maintaining social capital, elements that reemerge in many subsequent definitions of social capital (Putnam, 1994; Portes, 1998; Onyx and Bullen, 2000; Aldrich and Meyer, 2014). Due to the broad influence of Putnam's definition on social capital research, this study utilizes his definition of the concept, focusing on networks, norms, and trust to evaluate ERO levels and forms of social capital. As research on social capital examines the networks, resources, and trust relationships within communities and organizations, the important ties between social capital and community and organizational resilience are highlighted (Tompkins, 2005).

The field of resilience research includes social capital as a key element in many assessments of resilience within communities. Adger's contributions include examination of social-ecological resilience in a coastal disaster framework (Adger et al, 2005), social contracts as a mechanism for climate change adaptation (Adger et al, 2005), and social

capital as a contributing factor in resiliency and adaptive management (Adger, 2003). Aldrich expands on Adger's work on the topic of social capital, arguing for the reorientation of disaster preparedness and recovery programs and plans to focus on social infrastructure and social capital instead of "standard fixes" focused on physical infrastructure and rebuilding (Aldrich, 2010, p. 1). One of the central themes that emerge from Adger and Aldrich's work is the key role of social capital as a contributor to resilient systems.

A capital-based approach to conceptualizing disaster resilience identifies five major forms of capital (social, economic, physical, human, and natural), extending the social capital approach outlined by Adger et al. (2005), and providing a framework for defining and analyzing community disaster resilience (Mayunga, 2007; Tierney 2006). Aldrich (2012, p. 15) suggests that high levels of social capital serve as the core "engine of recovery" following a disaster more than commonly discussed factors such as socioeconomic conditions, population density, amount of damage or aid. Social capital resources, including networks of strong and weak ties within communities, community norms, and collective action, may be incorporated and utilized to improve communities' disaster resilience (Murphy, 2007; Cox and Perry, 2011; Aldrich, 2010; Aldrich, 2012; Adger, 2003; Adger, 2000; Tobin, 1999).

It is important to keep in mind that social capital can have strong positive and negative impacts. High levels of social capital within a community can be a benefit to society, contributing to community disaster resilience and providing critical networks and resources following a disaster; however, groups such as gangs and organized criminal enterprises may also have high social capital levels that negatively impact society

(Murphy, 2007; Aldrich, 2012). In addition, while strong social networks may benefit the majority of survivors from a disaster, "marginalized groups within society that hold less social capital benefit little and often are harmed" by the mainstream groups holding stronger social capital and hence greater power and access to resources following a disaster (Aldrich, 2012, p. 14). Although there is extensive literature focused on social capital's role in community resilience and preparedness, no research identified to date focuses on the role of social capital in ERO resilience.

Social Capital in Emergency Response Organizations

Due to the critical nature of the work performed by EROs, social capital must be considered as a key component of ERO resilience. Elements of social capital relevant to EROs include trust and networks of relationships (Putnam, 2000). Trust is an essential component of social capital and takes years to build, and times of crisis are when trust is most needed. If organizations do not invest the necessary time and effort in building strong social ties of trust and connection prior to a disaster event, ERO leaders will not have those relationships to draw upon in times of crisis (Seville, 2017). While relationships between organizations are important, the essential component is the relationship between people and how well they are connected with each other (Aldrich, 2012; Barabasi, 2002). Seville (2017, p. 74) identified individuals sharing strong connections as "3:00am friends," people who already know and trust each other and are sources that can be called upon at 3:00am for assistance and support when needed. Stevenson (2014, p. 183) uses the term "relational resilience" to describe the type of resilience created through patterns of interactions between organizations and people. Organizations with the capacity to form and manage networks of relationships effectively

are better able to access resources, information, or support when needed (Seville, 2017; Stevenson, 2014). Thus, organizations must prioritize and invest in developing and supporting trust-based relationships with other organizations, and individuals, in order to build their own resilience (Seville, 2017; Stevenson, 2014). The leaders of EROs are uniquely positioned to build social capital within their organizations and communities due to their leadership roles and influence over organizational training, planning, and management.

Bonding, bridging, and linking relationships are all important forms of social capital contributing to EROs' levels of social capital. Bonding social capital, described by Aldrich and Meyer (2014, p. 5) as the "connections among individuals who are emotionally close, such as friends or family" is likely to exist within the emergency responder community. The strong family-like bonds within emergency response departments are partially formed though organizational acculturation during formal recruitment and training, but informal social interactions and assimilation also serve to reinforce these bonds (Myers, 2005). Granovetter's work describing the "strength of weak ties" (1973, p. 1361) demonstrates the importance of bridging social capital, connections spanning social groups. Individuals working in emergency response organizations have been found to be highly engaged in other community activities that would contribute to bridging capital such as playing on and coaching sports teams, participating in religious organizations, and playing active roles in community groups and clubs (Stebbins and Graham, 2004). The linking form of social capital, "connecting regular citizens with those in power," (Aldrich and Meyer, 2014, p. 6) may be found in EROs through ERO leaders' frequent contact with local and regional elected and

appointed leaders. Many municipalities have formal or informal groups including ERO leaders that act as advisors to municipal leadership during pre-disaster and disaster periods. This linking connection provides EROs with potential resources during incidents and may act as a conduit for information sharing.

Approaches to Measuring Social Capital

Three forms of social capital are identified in current social capital research: bonding social capital, bridging social capital, and linking social capital (Aldrich and Meyer, 2014; Seville, 2017; Foster, 2003; Lancee, 2010). Bonding social capital may be assessed through identification of social networks, family and social ties, and analysis of levels of mutual trust and dependence. Bridging social capital can be assessed through proxies such as ties to social and religious organizations, participation in voluntary associations and clubs, and engagement with formal and informal support groups. Linking social capital focuses on the networks and relationships between individuals and communities and those in power; thus, it may be measured through contact between citizens and government representatives and civic engagement in local government (Aldrich and Meyer, 2014).

Within the field of social capital research, there are a variety of approaches to quantifying and measuring levels of social capital. Three primary approaches are addressed in the literature: the cognitive approach, behavioral approach, and field experiment approach. The cognitive approach focuses on identifying and examining attitudes and behaviors while the behavioral approach focuses on actions taken by individuals. In the cognitive approach, attitudes of individuals are used to measure subjective levels of trust (Aldrich, 2012; Aldrich and Meyer, 2014; Putnam, 2000).

Surveys are used to measure general trust as a component of social capital through multiple choice or scaled questions, asking participants how much they trust their neighbors, their friends, or specific groups such as community leaders, emergency responders, or local government officials (Putnam, 2000; Aldrich and Meyer, 2014). The second approach uses behavior-focused surveys to assess specific actions (donating blood, participating in community events, etc.) of individuals as indicators for levels of social trust and social capital, the behavioral approach (Aldrich and Meyer, 2014; National Social Capital Community Benchmark Survey, 2000, 2006). This approach also uses individuals' participation in social and community events such as voting, political demonstrations, festivals, community organization membership, and volunteering as a proxy assessment for social capital. The third method uses field experiments such as trust games to measure social preferences (Aldrich, 2012; Aldrich and Meyer, 2014). This method has been used in both laboratory and field experiments (Cardenas and Carpenter, 2008; Levitt and List, 2009).

Some researchers combine these methodological approaches resulting in studies based on a mix of cognitive and behavioral measures. These studies vary in their methods with some using qualitative interviews and others multiple choice and Likert-scale surveys, but they are consistent in their use of both cognitive and behavioral approaches to measuring social capital. Bell (2009) developed a social capital index through qualitative interviews examining levels of trust, a cognitive approach, and membership and volunteer engagement, a behavioral approach. Numerous other researchers implemented similar approaches in their examinations of social capital in schools, immigrant communities, and entrepreneurs and in comparing levels of social capital

between communities (Lancee, 2010; Leana and Pil, 2006; Doh and Zolnik, 2011; Onyx and Bullen, 2000). By combining cognitive and behavioral approaches to measuring social capital, these studies demonstrate a holistic method of assessing social capital.

3.3 Methodology

This research seeks to measure the levels of bonding, bridging, and linking forms of social capital currently held by EROs in in three coastal New England municipalities. A Likert-scale survey of 41 participants quantitatively measured the levels of bonding, bridging, and linking social capital of the EROs. Following the survey, semi-structured interviews conducted with the same participants provided qualitative insights into the organizations' social capital, giving context to, and elaborating on, the quantitative findings.

Case Study Sites and Respondents

Research participants were recruited in three case study sites in southern New England: Westerly, Rhode Island, West Haven, Connecticut, and Stratford, Connecticut. The sites are all mid-sized (23,000-54,500 according to the U.S. Census Bureau, 2011) coastal communities that sustained impact and damages from Superstorm Sandy (2012), have taken identifiable steps towards reducing future impacts of major storms, and have municipal-based emergency services including fire departments, police departments, emergency medical services (EMS), emergency management agencies (EMA), and public works departments. These sites were selected based on their similarities and subsequent comparability. Study participants were recruited from each ERO based on their leadership role within the organization. ERO leaders in each case study site were

identified based on publicly available information and contacted by email inviting them to participate in the study. In-person interviews were scheduled in February and March 2018 and conducted by the researcher at the participants' place of work. A total of 41 ERO leaders were interviewed for this research, 15 in Westerly, 10 in West Haven, and 16 in Stratford, providing a total population sample of ERO leaders in the three study sites. Participants included leaders from fire departments, police departments, emergency medical services (EMS), department of public works (DPW), and emergency management agencies (EMA) (Table 3.1). Due to this study's small sample size, the results may not be generalizable to a broader selection of EROs, however the sample includes the complete leadership of all five EROs in the three case study sites.

Case Study Site	**Total**	**Fire**	**Police**	**EMS**	**DPW**	**EMA**
Westerly, RI	15	n=4	n=3	n=3	n=2	n=3
West Haven, CT	10	n=6	n=2	n/a	n=1	n=1
Stratford, CT	16	n=3	n=3	n=5	n=2	n=3

Table 3.1. Research participants represented five emergency response organizations in three case study sites.

Survey Development, Administration, and Analysis

The study design implemented in this research combines two methodological approaches to quantifying social capital: the *cognitive approach* using individuals' attitudes to measure subjective levels of trust (Aldrich, 2012; Aldrich and Meyer, 2014; Putnam, 2000) and the *behavioral approach* using community and civic participation,

engagement, and volunteerism as indicators of social capital (Onyx and Bullen, 2000; Putnam, 1993; Aldrich and Meyer, 2014; Stone, 2001). These combined approaches provide a method for quantifying and examining the levels of social capital present in the case study sites' EROs. The Likert-scale survey questions are based on the cognitive approach. Survey questions were developed through a review of the literature as well as topics related to social capital that emerged through the development of the Emergency Response Organizational Resiliency Framework (see Manuscript 1) and during mental model interviews focused on ERO resilience (see Manuscript 2). The draft survey instrument was tested on six individuals who met the requirements for participation but worked in jurisdictions outside the case study locations included in this research. Following testing, three survey questions were revised for clarification and the final survey instrument was tested on an additional three individuals with no further revisions made.

The survey instrument consisted of ten 5-point Likert scale questions ranging from 1 (*not at all, never*) to 5 (*very much, a lot*) (Table 3.2). Questions were designed to quantifiably measure the participants' levels of three identified forms of social capital: bonding, bridging, and linking (Putnam, 2000; Mignone and O'Neil, 2005; Aldrich and Meyer, 2014; Lancee, 2010; Seville, 2017; Kirmayer et al*,* 2009). Individuals participating in this study were surveyed by the researcher in person in their place of work in February and March 2018.

Forms of Social Capital	**Likert Scale Questions**

Bonding	How much do you rely on the leaders/chiefs/directors of your organization?
	How much confidence do you have in the leaders/chiefs/directors of your organization?
	How much do you rely on your colleagues within your organization?
	How much confidence do you have in your colleagues within your organization?
	How much do you rely on your colleagues within your organization to accomplish your job tasks and goals?
Bridging	How much do you rely on members of other emergency response organizations within your community? (Other fire departments, the police department, etc.)
	How much do you trust members of other emergency response organizations within your community? (Other fire departments, the police department, etc.)
	How much do you rely on members of other organizations to accomplish your organization's tasks and goals?
Linking	How much do you trust community leaders within your town?
	How much connection do you think there is between citizens and local/municipal government in your community?

Table 3.2. The three forms of social capital measured in this study with their corresponding Likert-scale survey questions.

Interview Development, Administration, and Analysis

The seven interview questions (Table 3.3) were designed to elicit a qualitative description of participants' engagement in their communities, the role of social capital in

their jobs, organizations, and communities, as well as how social ties and connections impacted their response during recent disasters. Semi-structured interview questions were developed based on the methodology described by Wengraf (2001). A list of initial questions was generated with the goal of eliciting interviewees' descriptions of bonding, bridging, and linking social capital in their organizations. In order to maintain consistency, interview questions were drawn from the same literature and sources as the survey questions described previously. The draft interview instrument was tested on the same six individuals as the survey instrument and two interview questions were revised for clarification based on the test participants' feedback. The final interview instrument was tested on three additional individuals with no other revisions made. The original list of 12 questions was consolidated and revised to the final seven questions based on feedback from test participants. An additional list of potential follow-up questions was developed in order to prompt interviewees to expand initial "yes/no" responses if necessary (Wengraf, 2001). Few research participants needed any prompting from the researcher during interviews, thus the follow-up question list was not ultimately used while conducting interviews. All interviews were conducted in the participants' places of work during business hours in February and March 2018. Interviews were held privately in interviewees' offices or conference rooms in order to maintain privacy and anonymity of participants' responses. The interview portion of each meeting was recorded with permission of the participant for subsequent transcription and coding.

Interview Questions
How often do you participate in community events such as parades, festivals, or demonstrations?

How often do you vote?
Do you donate blood? How often?
Are you a member of any community organizations, religious organizations, voluntary associations or clubs? How many hours do you volunteer/participate with each per month?
In what ways do social ties and connections function within your organization? How important are these connections?
In what ways do social ties and connections between your organization and other organizations within the community function? How do inter-organizational ties and connections affect your organization? Please describe.
What role did social ties and connections have in your organization's response during recent disaster events? (Superstorm Sandy, Winter Storm Nemo, recent blizzards)

Table 3.3. Interview questions designed to provide a qualitative description of participants' bonding, bridging, and linking forms of social capital.

Data Analysis

In order to analyze the collected data, the Likert-scale survey questions were divided into three groups based on the form of social capital each question corresponded to (see Table 3.2). Bonding, bridging, and linking scores were calculated for each participant based on their mean survey responses. The resulting bonding, bridging, and linking scores were averaged for each ERO within each case study in order to examine the mean social capital score for the individual emergency response organization. These scores were analyzed based on case study site and ERO, allowing the researcher to compare study sites as well as the five EROs. These results offer a quantitative measurement of the forms and levels of social capital present among EROs in the three case study sites.

Responses to the interview portion of the study instrument were transcribed and qualitatively analyzed with the assistance of NVivo data analysis software using a general inductive approach (Thomas, 2006). To apply the inductive approach, the researcher identified and coded key themes including upper-level and lower-level categories (Thomas, 2006). Examples of upper-level categories include interviewees' descriptions of relationships between response organizations and how their EROs obtain needed resources, while lower-level categories include discussion of specific trainings and exercises conducted and identification of individual resources such as radio and generator systems. Following identification and coding of categories, overlapping and redundant categories were revised and condensed to clarify the key themes and a code book was developed. Quotations that "convey the core theme or essence of a category" were selected to capture the key aspects of each theme (Thomas, 2006, p. 242). This method was selected in order to provide a thorough and descriptive assessment of EROs' social capital and the role of social capital within each organization and case study site. The results of the analysis provide insights into the types and levels of social capital held by EROs, how they access and use social capital prior to and actively during events, as well as how ERO leaders use their understanding of social capital's benefits and potential costs when dealing with intra- and inter-organizational operations.

3.4 Results

ERO leaders' responses were compared between case study sites and between response organizations to provide insight into EROs' levels and types of social capital. The type and balance of social capital held by EROs were determined using both the Likert scale survey data and interview data (Aldrich and Meyer, 2014). The survey

instrument used the cognitive approach to identify levels of trust and confidence participants had in their leaders and colleagues within the organization, members of other EROs within their communities, and in community leaders. The qualitative interviews used the behavioral approach to capture ERO leaders' displays of social capital in daily life through such indicators as membership in clubs and associations, volunteer work, participation in social, religious, and recreational events and altruistic behavior such as donating blood. Through these approaches the levels of bonding, bridging, and linking social capital were assessed to identify the types and strengths of connections between individuals within the same ERO and between members of different organizations.

ERO	Average Combined	Bonding	Bridging	Linking
Fire (n=13)	3.79	4.27	3.87	3.23
Police (n=8)	3.75	4.10	3.71	3.44
EMA (n=7)	3.82	4.54	3.57	3.36
EMS (n=8)	3.60	4.43	3.04	3.32
DPW (n=5)	3.71	4.24	3.68	3.20

Table 3.4. Social capital components summarized including EROs from all three case study sites (scale 1-5 with 5 equivalent to highest level).

When comparing the results based on ERO, the average combined social capital levels including the three identified forms indicate that emergency management agencies had the highest average social capital score (3.82) on a 1 to 5 scale with 5 indicating the highest level (see Table 3.4). Fire departments had the next highest score (3.79) followed

by police departments (3.75) and department of public works (3.71) with emergency medical services (3.60) holding the lowest average score. The difference in scores between the five EROs is small, with a range of 0.22 separating the highest and lowest scores. Examination of the average scores for each of the three forms of social capital reveals similarly small differences between highest and lowest scores across the organizations. Bonding scores go from a high of 4.54 (EMA) to a low score of 4.1 (police), a range of 0.44. The highest score in the bridging form was 3.87 (fire) and the lowest was 3.04 (EMS), a range of 0.83. The range in the linking score is 0.24 with a high score of 3.44 (police) and a low score of 3.20 (department of public works).

The scores of EROs highlight the components of social capital that are strongest and weakest within each organization. Most EROs had closely grouped scores across all components, however EMS had larger differences in their scores, with high scores in bonding (4.43) and the lowest score of all EROs in all components with 3.04 in linking. Emergency management agencies had the highest average score as well as the highest bonding score. Police and fire departments had very similar average scores with fire departments having higher bonding and bridging scores and police departments having higher linking scores.

Town and ERO	Average Combined	Bonding	Bridging	Linking
Westerly, RI (n=15)				
Average	3.58	4.03	3.81	3.01
Fire (n=4)	3.13	3.35	3.42	2.63
Police (n=3)	3.87	4.07	4.22	3.34

EMS (n=3)	3.67	4.33	3.67	3.00
DPW (n=2)	3.58	4.00	4.00	2.75
EMA (n=3)	3.65	4.40	3.22	3.34
West Haven, CT (n=10)				
Average	3.78	4.38	3.74	3.21
Fire (n=6)	4.08	4.63	4.28	3.33
Police (n=2)	2.96	3.70	3.67	1.50
DPW (n=1)	3.86	4.40	2.67	4.5
EMA (n=1)	4.21	4.80	4.33	3.50
Stratford, CT (n=16)				
Average	3.87	4.54	3.58	3.50
Fire (n=3)	4.10	4.80	3.67	3.84
Police (n=3)	3.82	4.40	3.22	3.84
EMS (n=5)	3.55	4.48	2.67	350
DPW (n=2)	4.02	4.40	4.67	3.00
EMA (n=3)	3.87	4.60	3.66	3.34

Table 3.5. Social capital components summarized by case study site and ERO within each site (scale 1-5 with 5 equivalent to highest level).

Comparing the average combined social capital scores and individual component scores between the three case study sites highlights areas of social capital strength and weakness. Stratford EROs had the highest average combined social capital scores of the

three municipalities (3.87), with West Haven second highest (3.78), and Westerly having the lowest average score (3.58). There was no consistency across the case study locations in the type of EROs holding the highest and lowest scores. In Westerly, the police department had the highest average combined social capital score (3.87) while the fire department had the lowest score (3.13). In contrast, the West Haven emergency management personnel had the highest average combined score (4.21) with the police department holding the lowest average score (2.96). In Stratford, the fire department also had the highest average score (4.10) while EMS had the lowest score (3.55).

In addition to the social capital scores described above, ERO leaders' levels of community engagement were assessed through the interviews based on membership in community organizations, volunteering, and voting in local as well as state and national elections. The following results should be interpreted with caution because self-reporting assessments of volunteering and voting behavior is prone to bias. Individuals may not accurately report their actions, potentially exaggerating such behaviors. This study used a self-reporting assessment in order to obtain data comparable to national averages (Bureau of Labor Statistics, 2015). 30 (73%) of the 41 participants reported that they were members of at least one community organization while many participated in numerous different organizations. One fire chief interviewed was an active member of 12 separate organizations and clubs and estimated that he spent approximately 80 to 120 hours per month in volunteer work. In Westerly, 80% of respondents participated in community organizations spending an average of 17.3 hours per month volunteering (see Table 3.6). 80% of West Haven respondents also participated in community organizations, volunteering an average of 44.4 hours per month. Only 62.5% of respondents in Stratford

participated in community organizations, averaging 15.4 hours of volunteer work each month. Although fewer Stratford respondents engaged in community organizations, and they volunteered fewer hours than ERO leaders in West Haven and Westerly, all three case study sites had levels of organizational participation and hours of volunteer work that were higher than the American national average of 24.9% participation in organizations and 32.1 hours of volunteer work per year (Bureau of Labor Statistics, 2015).

Location	**Organizational Participation**	**Average Volunteer Hours per Month**
Westerly, RI (n=15)	80%	17.3
West Haven, CT (n=10)	80%	44.4
Stratford, CT (n=16)	62.5%	15.4

Table 3.6. Summary of ERO leaders' self-reported organizational participation and volunteering.

The ERO leaders participating in this study also had far higher voting rates than the national average. Among the respondents in all three sites, 90% (37) reported that they voted in every election, from the local school board to the national presidential election. The 10% (4) who reported that they did not vote in every election stated that they voted in every national election but not all local elections. The national average voter turnout is 60% of the voting age population during presidential elections and 40% during midterm elections, thus the high levels of voter turnout reported by ERO leaders

in this study are noteworthy and suggest high levels of engagement with their communities (United States Elections Project, 2017).

3.5 Discussion

The importance of social capital in community and organizational resilience is widely recognized (Aldrich and Meyer, 2014; Murphy, 2007; Seville, 2017), but little research so far has examined social capital within emergency response organizations. The insights gained from the analysis and description of ERO leaders' social capital shed light on the role of social capital in EROs and suggest ways that existing social capital may be harnessed to build ERO resilience and methods that can be used to increase and sustain social capital within the emergency response community. The results of this study clearly indicate that EROs have high levels of social capital overall, while an examination of the scores across the three identified forms of social capital highlights areas of strength and weakness.

Examining ERO Social Capital

When comparing the scores for the social capital components between EROs, each organization's unique roles and focus are reflected in the high and low scoring components. The participants with the highest average score were the emergency management agencies with a score of 3.82 out of 5.00. As leaders of EMAs, individuals surveyed display high levels of trust and confidence in the members of other emergency response organizations that they must work with in preparing for and responding to disasters. In the three case study municipalities, there were no more than three individuals working in EMA for each town and in West Haven there is only one person engaged in

EMA work on a part-time basis. During interviews, study participants revealed that this level of staffing is typical for emergency management agencies on the municipal level in the New England region where many towns have part-time EMA personnel or full-time fire or police personnel who are tasked with additional emergency management responsibilities. Given that the EMA organizations in the case study sites have such low staffing levels, it is essential that EMA leaders work closely and have strong connections with the leaders of other EROs in their towns. As one participant told the researcher, "I can't save this town by myself if a big storm hits, I have to work with fire, with police, with everyone and maybe together we can prevent the worst from happening." EMA leaders also had the highest average bonding score (4.54), providing further evidence of the strong connections maintained within the emergency response community, especially within the emergency management agencies. Due to the small sample size obtained for this study, these results may not be representative of the larger ERO population, however they provide preliminary findings that may be expanded in future research.

Fire departments in this study had the highest average scores in bridging social capital (3.87) and the second highest overall score (3.79). Active engagement and participation with communities and other emergency responders is part of the culture of fire departments (Alyn, 2010; Stinchcomb and Ordaz, 2007; Gregory, 2012). Many fire chiefs brought this up during interviews. Building relationships with the communities they serve is considered "essential for maintaining good operations and providing the best service possible," as one chief stated. Another chief noted that having close relationships with other emergency responders, especially EMS and police, "improves communications, builds camaraderie, and is essential for good operations in the field,"

adding that "we all get more done when we can work well together." Of the 13 fire chiefs interviewed for this study, 10 reported that, in the words of one interviewee, "treating each other like family" was a key component of fire department culture, supporting the high scores in the bonding form of social capital. The Westerly, West Haven, and Stratford fire departments actively engage in mutual aid with adjacent towns and districts, including participating in inter-departmental trainings throughout the year. Mutual aid agreements exist in many emergency response organizations and consist of formal or informal arrangements to assist neighboring departments when they are in need of additional personnel or resources. Common examples of mutual aid include an ambulance crew responding into a neighboring town for an emergency when that town's ambulances are already occupied, or multiple towns in an area sending fire engines and personnel to large structure fires. A Westerly fire chief described during his interview how large incidents like major structure fires will usually result in firefighters from Westerly, Charlestown, Ashaway, Richmond, and Hope Valley Fire Departments working together in order to control and extinguish the fire. These types of participation in mutual aid agreements and training serve as one mechanism through which fire departments can maintain and build their bridging social capital, increasing the strength of connections between individuals in different departments and organizations.

The department of public works leaders had the fourth lowest average score (3.71) and bonding score (4.24) and lowest linking score of all EROs surveyed (3.2). Unlike the fire, police, and EMS departments, department of public work leaders participated in community organizations and events at far lower levels than other ERO leaders. The respondents did not rank engagement with other EROs as important for their

jobs or organizations and were not concerned with building relationships with members of other EROs within their communities. One director of public works noted the importance of "building camaraderie and working together during big storms," indicating that he wanted to have the social capital established and available to access during events. However, all public works directors interviewed reported that they were not considering efforts to build those relationships and connections prior to an incident or disaster. Multiple fire, police, and EMA personnel interviewed stated, in the words of one EMA director, "you don't want to be trading phone numbers on the fire scene, you never want to trade business cards during the storm," highlighting the importance of establishing relationships on "blue sky days," prior to disasters or major events.

Changing Communities

One concern voiced by multiple interview participants was the impact of shifting populations within communities and changes in the composition of EROs and their personnel. As one fire chief stated: "Back when I joined the department all the guys were from here, a lot of us grew up together, we went to school together, we all lived in town… our kids went to school together, our wives were friends, we all knew each other and we knew this town. This new generation, they aren't from here… we are hiring guys who live 45 minutes or an hour away, they come in for their shift and they go home, they aren't connected to the community anymore." The changes in where emergency response personnel lived in relation to their departments was noted particularly by ERO leaders in Westerly and West Haven, however Stratford leaders also expressed concern that their personnel no longer had "connections with the community." As new emergency responders are hired who live outside the communities they serve, they no longer live in

the same neighborhoods, attend the same churches, and have children on the same sports teams. These findings reflect Putnam's concerns about declining civic engagement and social trust, accompanied by decreasing levels of social capital linked with demographic changes such as where individuals live in relation to their places of work (Putnam, 1994; Putnam, 1995). As one fire chief stated during an interview, he felt like his personnel were "coming to work for the paycheck" and he missed the "camaraderie of the old days." Numerous fire, police, and EMS leaders echoed this sentiment in interviews. Despite these concerns, two fire chiefs noted that changes in organizational hiring practices and, in the words of one interviewee, the increasing "professionalization of emergency response" resulted in higher quality candidates and better skill levels among their personnel. One fire chief stated, "back in the old days the main requirement to become a firefighter was a pulse and a reckless disregard for danger, now we are getting applicants with college degrees, they are brilliant paramedics and firefighters and they are improving the whole level of the service we provide to the community."

Building and Sustaining Social Capital

Although emergency response organizations' personnel may no longer all live in the community they serve due to changes in organizational hiring practices and community composition, in interviews ERO leaders emphasized the importance of building and sustaining strong relationships within their own organizations and with their partners in the emergency response community. ERO leaders participating in this research echoed some of Putnam's recommendations for encouraging and sustaining social capital. Social capital "tends to be self-reinforcing and cumulative" such that "successful collaboration in one endeavor builds connections and trust… in other

unrelated tasks" (Putnam, 1993, p. 4). Multiple ERO leaders stated that they felt cooperation and collaboration during normal day-to-day operations, including training, cooking meals, and cleaning stations and apparatus, fostered stronger bonds within their departments. They also reported that regular formal and informal interactions with other emergency response organizations, including official drills and trainings as well as cook-outs and softball games, built connections and relationships with neighboring departments and agencies. During interviews, emergency response leaders discussed their active engagement in planning, training, and drilling, within their departments and with other organizations in their town and region. Additionally, participants discussed the importance of supporting a culture of continual improvement and development of new policies and practices to ensure they are serving their communities as safely and effectively as possible.

Although social capital has many benefits for EROs, it is important to be aware of potential negative side effects of social capital. As Durlauf (1999) notes, strong identification with a particular group or community (fire department, emergency response agency) can lead to inter-group hostility and potential conflicts with other organizations. Benefits accrued from social capital may not be shared with outsiders or minority groups (Onyx and Bullen, 2000). High levels of social capital can also give some groups priority access to critical resources, thereby depriving low social capital individuals or communities of needed resources (Aldrich 2012). One participant alluded to this when recounting an incident that occurred during Superstorm Sandy 2012. The emergency dispatch center for the town lost power during the storm, requiring the department to switch over to back-up generator power. The back-up generator functioned well and

power was restored to the dispatch center quickly, but the ERO leader said that he had "made a few calls and had three more generators and a fuel truck in reserve" if necessary. By leveraging personal relationships and networks, the ERO leader ensured that his dispatch center had multiple back-up power sources, but also prevented these resources from being distributed to other locations that may have had critical needs as well. Although no ERO leaders specifically addressed the potential negative side effects of social capital, one police chief stated in an interview that "in the response community we are a family, we take care of each other first," echoing the sentiments of a fire chief who emphasized that "the brotherhood and sisterhood comes first." This display of high levels of bonding social capital has the potential to lead to exclusion of individuals identified as "outsiders" and protection of the "brotherhood/sisterhood" to the possible detriment of the larger community.

3.6 Recommendations and Conclusion

The results of this research offer insights and recommendations for how EROs can build and sustain social capital within their organizations as well as highlighting areas for future research. Conscious efforts to identify, support, and encourage the development of social capital within and between organizations may be incorporated into existing training and organizational improvement strategies. Such efforts can be as simple as inviting departments in neighboring towns to train together more regularly, or hosting a table-top exercise incorporating all emergency response organizations in a municipality. This study revealed that fire, police, and EMS departments regularly work together during daily operations, building familiarity and relationships. Due to the roles and responsibilities of their normal operations, EMA and department of public works do not

interact as often with the other response organizations. Thus, it is essential to include EMA and department of public works personnel in training and exercises whenever possible to ensure strong relationships are established with all response organizations prior to a large-scale event. In order to build their overall social capital, EMA and DPW leaders must understand that relationships forged during non-disaster interactions are more quickly activated during times of crisis and therefore far more helpful than relying on building relationships during an event.

Although previous research has identified multiple approaches to building social capital within communities and institutions, this study suggests ways these methods may be applied to emergency response organizations. Research supports the importance of local leaders and organizations in the establishment and development of informal networks that contribute to building trust (Krishna, 2007). Other research recommendations include implementation of policies to incentivize community participation in order to foster and strengthen community bonds (Aldrich, 2010; Lietaer, 2004). Aldrich (2012) highlights the role of community clubs, faith organizations, non-profits, and volunteer groups in increasing social capital by building trust and networks. These same methods of building social capital may be applied to emergency response organizations. ERO leaders can take active roles in developing both formal and informal networks within their organizations and with other response partners. Such actions may include encouraging a culture of collaboration and cooperation within their departments and providing opportunities to work with and build relationships with partner organizations through trainings and exercises. In addition to work-related joint trainings, hosting events such as cook outs or organizing softball tournaments with ERO partners

give individuals and organizations the chance to meet and build relationships prior to disasters. In addition, EROs could implement policies that incentivize their members' participation in community organizations and activities, thereby establishing and supporting networks within their communities.

Although this research provides initial findings analyzing social capital in EROs, additional research is needed. An examination of the relative importance of each component of social capital to overall ERO resilience could give future training and education plans better focus and provide guidance on the most effective and efficient measures to implement to improve ERO social capital. Additional research on social capital in EROs can assist in identifying the specific forms of social capital that have the greatest impact on improving ERO resilience and explore potential connections with increasing community resilience. The connection between ERO resilience and community resilience must be investigated further in order to determine the methods and strategies that are most effective in improving both ERO and community resilience, including how social capital may be leveraged to increase resilience. Conducting similar research in other areas of the country and around the world would provide an opportunity to investigate social capital in EROs with different organizational structures responding to a variety of risks and hazards. Evaluating the role of social capital in EROs in a wider context would address the geographical and sample size limitations of this preliminary study and may provide results that are generalizable to the broader field of emergency response resilience. Future studies including emergency response staff and personnel, in addition to the organization leaders, may provide insight on variations in social capital in different hierarchical levels of EROs. The subject of emergency response organization

resilience and social capital research offers many opportunities for future studies with results contributing to the broader field of organizational and community resilience.

Social capital is a critical component of resilience for organizations and communities. EROs provide essential services to communities on a daily basis as well as during disasters or large-scale events; thus, the resilience of EROs can directly contribute to community resilience. High levels of social capital within EROs contribute to building more resilient and robust organizations that can withstand impacts while continuing to provide critical services; thus, social capital of EROs must be a topic of inquiry. In this assessment of EROs' levels of social capital in three coastal New England municipalities, the varying levels and forms of social capital highlight areas of strength and weakness within EROs. Through this examination of current social capital levels, areas for future focus and growth have been identified for inclusion in training, planning, and consideration of goals for each organization. Current world events including rapidly shifting political situations, climate change, and increasingly frequent natural disasters are forming an environment of constant change and uncertainty in which organizations and communities must be resilient in order to survive. Emergency response organizations are strongly rooted in their histories and traditions, but must embrace resilience to ensure their ability to continue providing essential services to their communities. It is crucial that EROs build and maintain strong relationships and networks between organizations in order for them to fulfill their mission: ensuring the health and safety of the communities they serve.

References

Adger, W. N. (2000). Social and ecological resilience: are they related? *Progress in Human Geography*, *24*(3), 347-364.

Adger, W.N. (2003). Social capital, collective action, and adaptation to climate change. *Economic Geography, 79*, 387-404.

Adger, W. N., Hughes, T. P., Folke, C., Carpenter, S. R., & Rockström, J. (2005). Social-ecological resilience to coastal disasters. *Science*, *309*(5737), 1036-1039.

Aldrich, D. P. (2010) "Fixing Recovery: Social Capital in Post-Crisis Resilience." Department of Political Science Faculty Publications, Purdue University. Paper 3. http://docs.lib.purdue.edu/pspubs/3.

Aldrich, D.P. (2012) *Building Resilience: Social capital in post-disaster recovery*, University of Chicago Press, Chicago.

Aldrich, D. P., & Meyer, M. A. (2014). Social capital and community resilience. *American Behavioral Scientist*, *59*(2), 254-269.

Alyn, K. (2010). *The relationship between perceived leadership style and firefighter organizational commitment* (Doctoral dissertation, Capella University).

Andrews, R. (2010). Organizational social capital, structure and performance. *human relations*, *63*(5), 583-608.

Barabasi, AL (2002) *Linked: How everything is connected to everything else and what it means*, Plume, New York.

Bell, S. E. (2009). "There Ain't No Bond in Town Like There Used to Be": The Destruction of Social Capital in the West Virginia Coalfields 1. In *Sociological Forum* (Vol. 24, No. 3, pp. 631-657). Oxford, UK: Blackwell Publishing Ltd.

Bourdieu, P. (1993). *Sociology in question* (Vol. 18). Sage.

Bureau of Labor Statistics (2015). "Volunteering in the United States, 2015." Economic News Release. USDL-16-0363. www.bls.gov/cps.

Cardenas, J. C., & Carpenter, J. (2008). Behavioural development economics: Lessons from field labs in the developing world. *The Journal of Development Studies*, *44*(3), 311-338.

Coleman, J. S. (1988). Social capital in the creation of human capital. *American journal of sociology*, *94*, S95-S120.

Cox, R. S., & Perry, K. M. E. (2011). Like a fish out of water: Reconsidering disaster recovery and the role of place and social capital in community disaster resilience. *American Journal of Community Psychology*, *48*(3-4), 395-411.

Doh, S., & Zolnik, E. J. (2011). Social capital and entrepreneurship: An exploratory analysis. *African journal of business management*, *5*(12), 4961-4975.

Durlauf, S. N. (1999). *The case "against" social capital*. Social Systems Research Institute, University of Wisconsin.

Foster, M., Meinhard, A., & Berger, I. (2003). The role of social capital: bridging, bonding or both. *Toronto, Ryerson University*.

Granovetter, M. (1973). Weak ties and strong ties. *American Journal of Sociology*, *78*, 1360-1380.

Gregory, S. (2012). No One Cares What Color The Fire Truck Is: A Case Study of Interagency Cooperation In Fire Management in Central Oregon. A Masters Essay submitted to Oregon State University.

Hanifan, L. J. (1916). The rural school community center. *The Annals of the American Academy of Political and Social Science*, *67*(1), 130-138.

Kirmayer, L. J., Sehdev, M., & Isaac, C. (2009). Community resilience: Models, metaphors and measures. *International Journal of Indigenous Health*, *5*(1), 62.

Krishna, A. (2007). How does social capital grow? A seven-year study of villages in India. *The journal of politics*, *69*(4), 941-956.

Lancee, B. (2010). The Economic Returns of Immigrants' Bonding and Bridging Social Capital: The Case of the Netherlands 1. *International Migration Review*, *44*(1), 202-226.

Leana, C. R., & Pil, F. K. (2006). Social capital and organizational performance: Evidence from urban public schools. *Organization Science*, *17*(3), 353-366.

Levitt, S. D., & List, J. A. (2009). Field experiments in economics: The past, the present, and the future. *European Economic Review*, *53*(1), 1-18.

Lietaer, B. (2004). Complementary currencies in Japan today: History, originality and relevance. *International Journal of Community Currency Research*, *8*(1), 1-23.

Mayunga, J. S. (2007). Understanding and applying the concept of community disaster resilience: a capital-based approach. *Summer academy for social vulnerability and resilience building*, *1*, 16.

Mignone, J. & O'Neil, J. (2005a). Social capital and youth suicide risk factors in First Nations communities. Canadian Journal of Public Health, 96 Suppl 1, S51-54.

Murphy, B. L. (2007). Locating social capital in resilient community-level emergency management. *Natural Hazards*, *41*(2), 297-315.

Myers, K. K. (2005). A burning desire: Assimilation into a fire department. *Management Communication Quarterly*, *18*(3), 344-384.

National Social Capital Community Benchmark Survey (2000). Retrieved from http://www.ropercenter.uconn.edu/data_access/data/datasets/social_capital_community_survey.html

National Social Capital Community Benchmark Survey (2006). Retrieved from http://www.ropercenter.uconn.edu/data_access/data/datasets/social_capital_community_survey_2006.html.

Onyx, J., & Bullen, P. (2000). Measuring social capital in five communities. *The journal of applied behavioral science*, *36*(1), 23-42.

Portes, A. (1998). Social capital: Its origins and applications in modern sociology. *Annual review of sociology*, *24*(1), 1-24.

Putnam, R. (1993). The prosperous community. *The american prospect*, *4*(13), 35-42.

Putnam, R. (1994) *Bowling alone: Democracy in America at the end of the twentieth century*. Paper presented at the Nobel symposium Democracy's Victory and Crisis, Uppsala, Sweden.

Putnam, R. (1995). Tuning in, tuning out: The strange disappearance of social capital in America. The 1995 Ithiel de Sola Pool Lecture. *Political Science and Politics*, 664-683.

Putnam, R. (2000). *Bowling alone: The collapse and revival of American community*. New York: NY: Simon & Schuster.

Rodin, J., 2014. *The resilience dividend: Being strong in a world where things go wrong*. New York, NY: PublicAffairs.

Seville, E. W. (2017). *Resilient organizations: How to survive, thrive and create opportunities through crisis and change*. London, UK: Kogan Page.

Stebbins, R. A., & Graham, M. (eds.). (2004). *Volunteering as leisure/leisure as volunteering: an international assessment*. Cabi.

Stevenson, J.R. (2014). *Organizational resilience after the Canterbury earthquakes: A contextual approach*, PhD Thesis, University of Canterbury, http://www.resorgs.org.nz/images/stories/pdfs/Organizationsfacingcrisis/stevensonjr_phdthesis_v3.pdf.

Stinchcomb, J. B., & Ordaz, F. (2007). The integration of two "brotherhoods" into one organizational culture: A psycho-social perspective on merging police and fire services. *Public Organization Review*, *7*(2), 143-161.

Stone, W. (2001). Measuring social capital. *Australian Institute of Family Studies, Research Paper*, *24*.

Tierney, K. 2006. Social inequality, hazards, and disasters, in Daniels, R.J., et al. (eds.) *On Risk and Disaster: Lessons from Hurricane Katrina,* pp. 109-128. Philadelphia: University of Pennsylvania Press.

Tobin, G. A. (1999). Sustainability and community resilience: the holy grail of hazards planning? *Global Environmental Change Part B: Environmental Hazards*, *1*(1), 13-25.

Tompkins, E. L. (2005). Planning for climate change in small islands: insights from national hurricane preparedness in the Cayman Islands. *Global Environmental Change*, *15*(2), 139-149.

Thomas, D. R. (2006). A general inductive approach for analyzing qualitative evaluation data. *American journal of evaluation*, *27*(2), 237-246.

Thompson, J. and Durkovich, C.A. (2015). "Emergency Services Sector-Specific Plan: An Annex to the NIPP 2013". U.S. Department of Homeland Security. https://www.dhs.gov/sites/default/files/publications/nipp-ssp-emergency-services-2015-508.pdf.

United States Census Bureau / American FactFinder. (2011). "B11001 : Household Type (Including Living Alone)." *2007 – 2011 American Community Survey*. U.S. Census Bureau's American Community Survey Office, 2011. Web. 13 January 2018 <http://factfinder2.census.gov>.

United States Elections Project (2017). Turnout as a percentage of votes cast, except where unavailable. http://www.electproject.org/. Last updated: Jan 3 2017.

Wengraf, T. (2001). *Qualitative research interviewing: Biographic narrative and semi-structured methods*. Sage.

Appendix A: Social Capital Survey and Interview Instrument

Please rank the following questions on a scale of 1-5 with 1 equivalent to "not at all" and 5 equivalent to "very much":

1. How much do you rely on the leaders/chiefs/directors of your organization?
2. How much confidence do you have in the leaders/chiefs/directors of your organization?
3. How much do you rely on your colleagues within your organization?
4. How much confidence do you have in your colleagues within your organization?
5. How much do you rely on members of other emergency response organizations within your community? (Other fire departments, the police department, etc.)
6. How much do you trust members of other emergency response organizations within your community? (Other fire departments, the police department, etc.)
7. How much do you trust community leaders within your town?
8. How much do you rely on your colleagues within your organization to accomplish your job tasks and goals?
9. How much do you rely on members of other organizations to accomplish your organization's tasks and goals?
10. How much connection do you think there is between citizens and local/municipal government in your community? (1 = none, 5 = highly connected)

Please answer the following questions and describe your answers:

1. How often do you participate in community events such as parades, festivals, or demonstrations?
2. How often do you vote?
3. Do you donate blood? How often?
4. Are you a member of any community organizations, religious organizations, voluntary associations or clubs? How many hours do you volunteer/participate with each per month?
5. In what ways do social ties and connections function within your organization? [For each of the listed functions indicate its importance on a Likert scale]
6. In what ways do social ties and connections between your organization and other organizations within the community function? How do inter-organizational ties and connections affect your organization? Please describe.
7. What role did social ties and connections have in your organization's response during recent disaster events? (Superstorm Sandy, Winter Storm Nemo, recent blizzards) Please describe, then rank each role's importance from 1-5.

CONCLUSION

The challenges facing emergency response organizations today are growing larger and more complex in a rapidly evolving world of climate change, natural disasters, drug epidemics, international and domestic terrorism, and increasingly frequent active shooter incidents. In order to be better prepared to withstand impacts and continue providing critical services to communities during and after disaster events, EROs must become stronger and more resilient. Emergency responders strongly believe in time-honored traditions and some may be resistant to change, but ERO leaders acknowledge that the world is changing around them and they must proactively engage in efforts to incorporate new concepts such as resilience in their plans, policies, and response operations. The emergency response organizational resilience factors identified through the Delphi expert survey form a foundation on which to build stronger, more resilient response organizations that will be prepared to face new and unexpected threats and challenges in the future. By implementing the eleven key factors identified through this research, emergency response organizations can grow into resilient organizations better prepared to serve and protect their communities in an age of increasing change.

The understanding of ERO leaders' mental models of resilience gained through this research provide important insights and recommendations for future applications of resiliency-building initiatives in an emergency response context. ERO leaders have notably balanced and comprehensive default models of resilience and they are familiar with the core ERO resiliency components of resource management, planning, operations/logistics, and situational awareness. ERO leaders are also able and willing to change their mental models of resilience when reminded of the various components

contributing to ERO resilience, indicating that tailored trainings and education efforts may produce effective change in EROs' overall models of resilience. Actively encouraging leaders from emergency response organizations, including public works departments, to get involved in current community emergency planning initiatives and proactively discussing the role of resilience in their organizations is a good initial step. Throughout the research process, multiple ERO leaders in all three case study sites requested feedback from the researcher following completion of the study on how their organizations can take steps to become more resilient. There is a clear desire among ERO leaders to be as prepared as they can possibly be, and there is increasing understanding that resilience needs to play an important role in ERO planning, policies, and training.

Identifying gaps in ERO personnel and leaders' mental models of resilience highlight opportunities to tailor education, training, and outreach efforts to address the aspects of ERO resilience that they are less familiar with and/or do not understand fully. It is important to note that it may be difficult to motivate ERO personnel to change long-standing traditions and practices and it is vital to clearly demonstrate how resilience factors and strategies will improve their ability to safely and successfully fulfill their critical life-safety function during times of disaster. In addition, evaluating EROs' level and type of social capital can assist in identifying key methods for supporting existing relationships and networks and establishing new ones. Through an examination of current social capital levels, areas for future focus and growth may be identified for inclusion in training, planning, and consideration of goals for each organization.

The effective incorporation of resiliency-building factors and practices in EROs requires additional research to identify the best methods for teaching resilience principles

and strategies to emergency responders. Additionally, the connection between ERO resilience and community resilience must be investigated further in order to determine the methods and strategies that are most effective in improving both ERO and community resilience. Building resilient EROs is an essential component in the development of resilient communities, and the results of this research highlight key areas to focus future education and planning efforts. Emergency response organizations are strongly rooted in their histories and traditions, but must embrace resilience to ensure their ability to continue providing essential services to their communities.