A value-focused thinking approach to emergency management and community preparedness

by

Curtis Peters

A thesis/dissertation thesis submitted to the graduate faculty

in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Major: Industrial Engineering

Program of Study Committee:
Cameron MacKenzie, Major Professor
Matthew Frank
Sri Sritharan

The student author, whose presentation of the scholarship herein was approved by the program of study committee, is solely responsible for the content of this thesis. The Graduate College will ensure this thesis is globally accessible and will not permit alterations after a degree is conferred.

Iowa State University

Ames, Iowa

2023

DEDICATION

This thesis is dedicated to my family. Without your continued support, encouragement, and love, this would not have been possible.

TABLE OF CONTENTS

Page

LIST OF FIGURES

Page

LIST OF TABLES

Page

NOMENCLATURE

AAR	After-Action Report
DHS	Department of Homeland Security
EM	Emergency Management
FEMA	Federal Emergency Management Agency
OH&N	Objectives Hierarchy and Network
VFT	Value-Focused Thinking

ACKNOWLEDGMENTS

I would like to express my deepest gratitude to my committee chair, Dr. Cameron MacKenzie, for your support over the past couple of years. I greatly appreciate your patience, advice, and mentorship. I would also like to thank my committee members, Dr. Matthew Frank, and Dr. Sri Sritharan, for their support and Dr. Cristina Poleacovschi and Dr. Johanna Amaya for your guidance. Thank you to all of the other faculty, especially Leslie Potter, that supported me throughout my time at Iowa State. I want to also offer my thanks to everyone who participated in my interviews. Your insights guided this research and made this thesis possible.

This work was made feasible by the financial support from NSF Division of Engineering Education Centers through a planning grant, award number 193696.

Most importantly, thank you to my family: Mom, Dad, Jeanne, and Erica. Your encouragement got me through the ups and downs and I could not have done this without you. I am the person I am today thanks to your ongoing support. I would like to extend a sincere thank you to all of my friends who have been by my side these last few years. You made my adventure at Iowa State a wonderful experience.

ABSTRACT

The increasing severity and frequency of natural disasters have put increased strain on emergency management to allocate their limited resources to prepare for disasters. Identifying emergency management's goals and objectives can provide a foundation for evaluating alternatives for emergency preparedness. This thesis uses a value-focused thinking approach to define the objectives of emergency management through interviews with emergency management decision makers. Objectives are structured into three separate but related objectives hierarchies and networks based on the timing of a disaster: pre-disaster, disaster onset, and post-disaster. The interviews and analysis led to insights into the differences in objectives between first responders and emergency managers and decision makers in rural and urban areas. Based on insights gathered from interviews, this thesis provides several recommendations to improve emergency management.

CHAPTER 1. INTRODUCTION

The frequency and severity of natural disasters have significantly increase since 2000. In 2022, 18 natural disasters exceeded $1 billion in damage in the United States, with a combined death toll of 474 people (National Centers for Environmental Information, 2023). This trend of increasing frequency and severity is expected to continue in the future as climate change continues. Emergency management (EM) is the field focused on building community preparedness and responding to disasters. EM involves individuals; businesses; first responders such as fire departments, law enforcement, and medical personnel; county emergency managers; city and county government officials; governors and state agencies; the National Guard; and federal agencies. The Federal Emergency Management Agency (FEMA) is the leading federal government agency for coordinating the response to disasters when local and state resources become overwhelmed.

EM is challenging for several reasons. Community preparedness and responding to major disasters require coordination among all the entities mentioned in the previous paragraph. Those entities may have different goals and objectives, which can hamper effective preparedness and response. EM relies on many different preparedness actions, such as community education, training personnel, strengthening infrastructure, and purchasing equipment. Disasters are unpredictable, and knowing which preparation activities are necessary can be challenging. The benefits of preparedness are often invisible and may only be realized after a disruptive event occurs. Funding for EM competes with other priorities at the local, state, and federal levels, and consequently, emergency preparedness remains underfunded and under-resourced (Choi, 2008; Pines et al., 2014; Rudman et al., 2003).

No single study can solve or even address all these challenges in EM, but identifying and analyzing what EM decision makers want to achieve provides a useful base for addressing some of these challenges. Since many different agencies at different levels of government play an important role in EM, understanding their goals and objectives can help us identify points of agreement and disagreement. Disagreement among EM decision makers hampers coordinating resources and activities. If EM decision makers broadly agree about their goals and objectives, they can find common ground even if they disagree on details in achieving those goals. Identifying goals and objectives for the EM community can help decision makers increase community preparedness by assessing alternatives on the basis of those objectives. Identifying metrics that align with the objectives can help assess and evaluate the performance of EM.

This thesis identifies goals and objectives in EM through interviews with EM decision makers at different levels of government who represent different types of communities. The research uses a value-focused thinking (VFT) approach to identify and structure those objectives into objectives hierarchies and networks (OH&Ns). VFT is a structured approach to creative decision making by encouraging a decision maker to identify his or her values before considering and comparing different alternatives. VFT helps decision makers identify creative alternatives for their decision situations.

This research is unique because we construct OH&Ns based on objectives identified through interviews with 20 EM decision makers. This represents the first attempt to identify and structure objectives across the different roles and responsibilities of EM decision makers. The OH&N begins with a strategic goal and then identifies fundamental objectives that help define the strategic goal. Means objectives describe how the EM community tries to achieve those fundamental objectives. Based on our interviews, we structured the objectives into three separate

but related OH&Ns based on the timing of the disaster: pre-disaster, disaster onset, and post-disaster. We use the interviews and resulting structures of the objectives to identify differences among EM decision makers that may be important for understanding potential challenges to greater cooperation in the EM community. Finally, we make some recommendations that can improve EM decision making based on identifying alternatives that support the OH&Ns.

The rest of the thesis is structured as follows. Chapter 2 summarizes VFT and reviews the literature on EM goals, objectives, and decision making. Chapter 3 presents the methodology and strategy for determining the decision makers' objectives. Chapter 4 presents the OH&Ns, and Chapter 5 derives insights gathered from conducting interviews and analyzing responses. Chapter 6 concludes this thesis with some recommendations for improving EM based on our findings.

CHAPTER 2. LITERATURE REVIEW

Value Focused Thinking Objectives

VFT aims to provide a set of objectives from which alternatives can be identified and evaluated. In VFT, an objective is comprised of three components: a decision context, an object, and a direction of preference (Keeney, 1992). The decision context is the activity being examined. For example, a fire department considering the purchase of a fire truck may have an objective to minimize cost. In this example, the decision context is the purchase of a fire truck, the object is cost, and the decision maker prefers less cost to more cost. Purchasing a fire truck could also be an alternative within a broader decision context. For example, purchasing a fire truck is an alternative that could help the fire department achieve the objective of maximizing public safety. Other alternatives in this decision context could be launching a public education campaign or requiring more training for fire fighters.

In VFT, there are three types of objectives: strategic, fundamental, and means. Strategic objectives are ultimate, all-encompassing objectives for an organization, and all decisions should be taken to fulfill these objectives. Strategic objectives are too broad to provide useful guidance on how to make decisions, so VFT focuses on fundamental objectives and their corresponding attributes to narrow the focus of decision situations. Fundamental objectives represent the core reasoning for interest in a decision situation. Fundamental objectives can be broken down into additional, more specific fundamental objectives to provide clarity and definitions for the higher-level objectives. Measurable attributes can be identified to measure the achievement of fundamental objectives. Measurable attributes further clarify the meaning of objectives and enable quantitative analysis for the decision situation.

Means objectives represent methods to achieve fundamental objectives and tend to be more related to alternatives. Expanding on the previous example for the fire department, maximizing public safety is a fundamental objective and minimizing the number of fatalities is a lower-level fundamental objective, or attribute, that helps to define public safety. A means objective for public safety could be to increase fire mitigation activities in community households. People implementing more fire mitigation activities should contribute to public safety. Increasing fire mitigation activities in community households is not a fundamental objective, however, because the fire department is interested in these fire mitigation activities only to the extent that they contribute to public safety. Other means objectives, such as minimizing response time or modernizing the department's equipment, also contribute to maximizing public safety.

Keeney (1992) describes nine properties to ensure a quality set of fundamental objectives. Objectives should be *essential* and *controllable* meaning they have the correct specificity for alternatives to be evaluated in terms of their impact on objectives. A set of objectives is *complete* if all objectives of interest are included. The set of objectives is *nonredundant* and *concise* when redundant and unneeded objectives are eliminated from the set. The properties of *operational* and *measurable* are met when it is possible to access information to determine if objectives are met according to the consequences resulting from alternatives. Objectives are *decomposable* if they can be broken down so that separate aspects can be analyzed. Finally, an *understandable* set of fundamental objectives allows decision makers to use them in decision situations.

Structuring objectives helps create a deeper understanding of objectives and provides further clarity on the decision context. A fundamental objectives hierarchy structures all of the

fundamental objectives relevant to a decision context, and a means-ends objectives network structures both the fundamental and means objectives. The term objectives hierarchies and networks (OH&N) will be used in this thesis to represent both objectives hierarchies and means-ends objectives networks. An example of a means-ends objectives network can be seen in Figure 1 where lines connect related fundamental objectives and arrows show the influence of means objectives. In Figure 1, fundamental objectives 2 and 3 help define fundamental objective 1. A fundamental objective can only be related or connected to one higher-level fundamental objective, but a means objective can help achieve multiple fundamental objectives. Means objective 1 helps achieve both fundamental objectives 2 and 3.

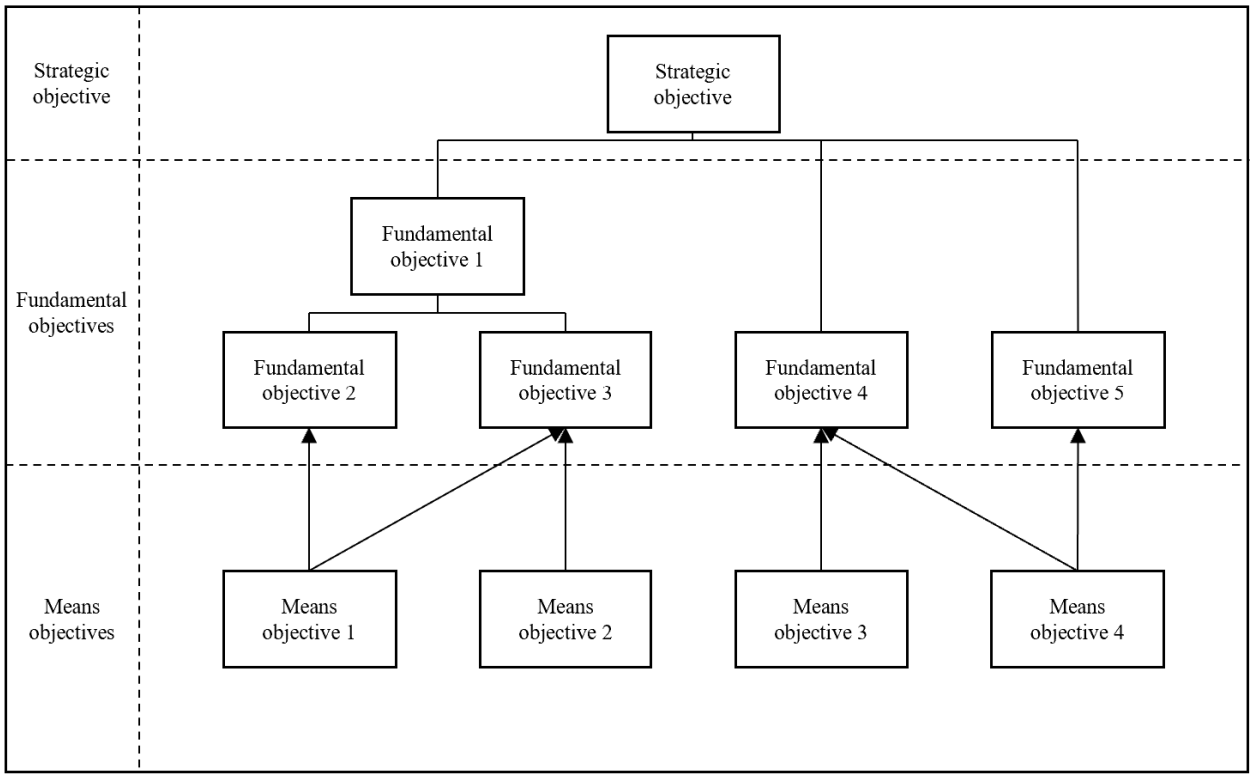

Figure 1. Example of Means-Ends Objectives Network

VFT, multi-attribute value theory (Kirkwood, 1997; Wall & MacKenzie, 2015), and multi-attribute utility theory (Clemen & Reilly, 2013; Keeney & Raiffa, 1976; Kirkwood, 1997) have been applied to a wide variety of disciplines over the past 30 years. The literature

demonstrates that different methods are used to identify and structure objectives and create a value model. Dozens of stakeholders may participate in the development of the objectives hierarchy and the value model (Buede & Bresnick, 1992). Convening a workshop of stakeholders with conflicting perspectives (e.g., business representatives, environmental advocates, government officials) can create a consensus on objectives among the stakeholders (Gregory & Keeney, 1994) and highlight differences among the stakeholders (Höfer et al., 2020). Rather than eliciting objectives from a wide variety of people, it may be sufficient to interview a few of the organization's senior decision makers to develop an objectives hierarchy (Keeney et al., 1986; Keeney & McDaniels, 1992). Multiple interviews and meetings with stakeholders and experts enable further refinement of objectives and criteria for decision making (Pereira et al, 2020)

When access to senior decision makers is limited, the objectives hierarchy can derive from reviewing the organization's policy, strategy, and planning documents (Burk & Parnell, 1997 ; Doyle et al., 2000; Parnell et al., 2001), which are sometimes referred to as "Gold Standard" documents (Parnell et al. 1998; Simon et al., 2014). Supplementing this document review with interviews of senior decision makers can generate an objectives hierarchy more aligned with those decision makers' preferences (Deckro & Kloeber, 2001; Ewing et al., 2006; Keeney & von Winterfeldt, 2011). Dyer et al. (1998) created an objectives hierarchy for plutonium disposal based on a preliminary set of measures from Lawrence Livermore National Laboratory and by examining objectives hierarchies from previous studies for technology.

A means-ends objectives network may be developed instead of a fundamental objectives hierarchy if the interviews or the study of documents identifies both fundamental and means objectives. The means-ends objectives network can be created through interviews with and

surveys of multiple stakeholders (Peharda & Hunjak, 2008; Sheng et al., 2010), focused and repeated discussions with a few senior decision makers (Alencar et al., 2011; Morais et al., 2013), and reviewing an organization's policy and strategy documents (Simon et al., 2014). Connecting means objectives to fundamental objectives to strategic objectives provides a wholistic view of the decision context and helps decision makers understand how their alternatives influence their ultimate goals.

Emergency Management Review

EM is the field responsible for protecting communities from natural or man-made disasters by reducing the community's vulnerabilities and increasing their ability to respond to disasters. EM is defined by four phases: mitigation, preparedness, response, and recovery. Mitigation focuses on reducing the likelihood and impacts of potential disasters (Department of Homeland Security [DHS], 2015; DHS, 2016; McLoughlin, 1985). The preparedness phase builds capabilities through actions such as creating and improving plans for disasters, learning about hazards, and training (McLoughlin, 1985; Sutton & Tierney, 2006). The response and recovery phases pertain to after a disaster has occurred. The response phase aims to save lives and limit the magnitude of an event in the immediate aftermath (DHS, 2015; McLoughlin, 1985). Recovery aims to sustain life in the short-term and rebuild the community back to its previous state in the long-term.

Several groups share EM responsibilities. At the local level, county emergency managers are responsible for coordinating the actions of their local governments and departments (McLoughlin, 1985). First responders (e.g., fire service, law enforcement) are responsible for the initial response to disasters and everyday emergencies. State departments of EM focus on guiding and assisting local agencies and directing federal support. At the federal level, FEMA is

responsible for providing technical guidance and financial support and coordinating the response of other federal agencies.

Prior literature has determined objectives in EM and community preparedness, but the focus is frequently on a specific phase of EM or applied to a given type of disaster. Training is a common objective in the preparedness phase in order to build skills and knowledge in EM (Choi, 2008; Gillespie & Streeter, 1987; Khan et al., 2018; Nelson et al., 2007). Developing plans (Choi, 2008; Gibson et al., 2012; Gillespie & Streeter, 1987; Khan et al., 2018) and coordinating the actions of different agencies and departments (Gibson et al., 2012; Kapucu et al., 2013; Kahan et al., 2009; Khan et al., 2018) are commonly identified objectives. Khan et al. (2018) identified the objectives of leadership and surveillance (Gibson et al., 2012) in the preparedness phase. Ethics is another objective (Khan et al., 2018; Owen et al., 2016). Gibson et al. (2012) and Khan et al. (2018) discussed the need to engage with and educate the community on EM.

Objectives also define the effectiveness of mitigation. Community preparedness has an objective to mitigate the effect of hazards (Gibson et al., 2012; Kapucu et al., 2013). Conducting risk analysis (Khan et al., 2018), incorporating risk within the context of planning and resource allocation, and minimizing the cascading effects of a disaster (Kahan et al., 2009) can all be objectives for mitigation. In the response phase, Owen et al. (2016) discussed the need to prioritize the safety of EM personnel and achieve the safety, well-being, and security of the community. An objective in EM is increasingly to maximize community resilience. Kahan et al. (2009) and Kapucu et al. (2013) define resilience as the ability to recover and rebuild to the pre-disaster state. Assessing and measuring community resilience typically identifies several attributes and metrics and categorizes those measures among several dimensions including

social, economic, infrastructure, and environment (Bruneau et al., 2003; Cutter, 2016; Cutter et al., 2010; Suresh, 2019).

Multi-criteria decision analysis has been used to help EM prepare for and respond to disasters. Many multi-criteria analyses in EM identify similar attributes although some analyses may introduce unique criteria that other studies did not consider. The criteria of health and safety are measured through the attributes of fatalities and injuries for nuclear disasters (French, 1996; Hämäläinen et al., 2000; Turcanu et al., 2008), flood response (Levy et al., 2007), storm surge evacuation (Kailiponi, 2010), and emergency preparedness planning (Larsson, 2008). French (1996) and Gelderman et al. (2009) used radiation dose, and Turcanu et al. (2008) used ingestion dose of contaminated food to measure public health after a nuclear disaster. The psychological impacts on the public caused by a nuclear disaster (French, 1996; Hämäläinen et al., 2000) and flood (Levy et al., 2007) can also be criteria. Economic costs are considered for several applications (Barquet & Cumiskey, 2018; French, 1996; Hämäläinen et al., 2000; Kailiponi, 2010; Larsson, 2008; Levy et al., 2007; Turcanu et al., 2008). Flexibility is an important criterion for hospitals preparing for disasters (Ortiz-Barrios et al., 2020) and responding to nuclear disasters (French, 1996). Political acceptance is considered for the preparedness of coastal communities (Barquet & Cumiskey, 2018), nuclear accidents (French, 1996; Geldermann et al., 2009), and public relations for emergency preparedness planning (Larsson, 2008). Coordinating EM activities through communication is an objective when planning for disasters in hospitals (Mojtahedi et al., 2021; Ortiz-Barrios et al., 2020) and staffing for fire departments (Alzahrani & Alfares, 2021). Alzahrani & Alfares (2021) also identified the attributes of the crew size for a fire station, the coverage area, and the risk to fire personnel when determining the staffing for fire stations.

Studies have sought input from various stakeholders to gather different inputs on objectives in EM. Stakeholders representing different government jurisdictions (e.g., local, state or province, federal) identified objectives for disaster resilience in Victoria, Australia (Goode et al., 2017) and managing multiple threats and hazards (Wells, 2022). Stakeholders from businesses, non-profit organizations, community groups, and researchers contributed objectives for disaster resilience in Victoria (Goode et al., 2017). Khan et al. (2018) elicited objectives from the healthcare sector, policy makers, EM agencies, and community decision makers in order to analyze and assess public health preparedness. Little et al. (2015) relied on stakeholders representing an energy company, a fire department, and a sheriff's office to develop objectives for a decision support tool for restoring critical infrastructure. Wells (2022) interviewed a variety of roles and representatives from all areas of the United States for managing compound threats. Emergency managers in urban areas may have different priorities than those in rural areas. Emergency managers in urban areas were more concerned with communication limiting the effectiveness of community preparedness actions, and rural counties were more concerned about time (Kapucu et al. 2013). Evaluating community preparedness may also rely on surveys of community members and residents (Gillespie & Streeter, 1987; Kapucu, 2008).

This literature review illustrates the complex nature of EM and the involvement of varied stakeholders with different roles and perspectives. Some goals and objectives have been identified for specific phases in EM, and the examples of multi-criteria decision analysis usually contain a few specific objectives. These attempts and other decision-support models are frequently focused on one disaster or a specific aspect of EM. To our knowledge, no study has attempted to identify and structure objectives across the entire EM cycle that includes a multitude of decision makers at different levels (local, county, state, and federal), roles (federal

and state planners, emergency managers, and first responders), and for urban and rural areas. Our research fills a gap in the literature by applying VFT to EM with the goal of creating a common set of objectives for decision makers in EM and using the structure of objectives to provide insight and recommendations for improvement within the EM community.

CHAPTER 3. METHODOLOGY

The goal of this research is to apply VFT to EM by identifying and structuring objectives in disaster preparedness and response. Objectives were elicited through semi-structured interviews with participants representing different levels of government, EM functions and areas of different population sizes. The participants' responses enable us to create OH&Ns for EM and provide insights into the differing objectives and challenges for different EM functions and population sizes. This study received IRB exemption (see Appendix B).

Data Collection

Participant Demographics

The twenty participants are categorized based on their role in EM and the population size of their geographic area of responsibility. Other research with similar methods included inputs from 33 decision makers for objectives in managing compound threats through interviews (Wells, 2022), 18 decision makers for objectives in agricultural countermeasures in a nuclear emergency through interviews (Turcanu et al., 2008), 7 focus groups for community preparedness in rural communities (Kapucu et al., 2013), and 113 decision makers for community preparedness in Australia through surveys (Goode et al. 2017). Initial participants were contacted through the research team's professional network, and additional participants were contacted through snowball sampling. Initial participants were located in Iowa before a colleague connected us to contacts in Florida. Table 1 depicts the demographics of the participants. The roles of participants are first responders, emergency managers, and state and federal planners. First responders represent law enforcement and fire departments at either a city or county level. The ten emergency managers interviewed consisted of eight county emergency managers and two emergency managers at universities. State and federal planners are decision

makers at FEMA or a state agency for EM. Since the challenges and objectives of urban and rural emergency managers can differ (Kapucu et al. 2013; Khan et al. 2018; Owen et al., 2016), we include emergency managers of both geographic areas. Of the eight county emergency managers and five first responders, eight served in urban areas and five served in rural areas. For this research, 90,000 to 500,000 residents represent the urban counties, and 60,000 to 250,000 residents live in an urban city. The rural counties have 4,000 to 20,000 residents, and rural towns have 1,000 to 10,000 residents.

Table 1. Participant Demographics

Role in emergency management	**n**	**%**
First responder	5	25%
Emergency manager	10	50%
State or federal planner	5	25%
Population of geographic area of responsibility for first responders and emergency managers	**n**	**%**
Urban	8	54%
Rural	5	33%
University	2	13%

Throughout this thesis, specific terminology will be used to reference different people. A decision maker is defined as someone whose job responsibilities focus heavily on EM, and all individuals with EM responsibilities make some decisions. A stakeholder is someone who has a vested interest in EM, but their primary role is not within EM. For example, a county emergency manager and a fire chief are decision makers, while a mayor and a city planner are stakeholders. A participant is one of the twenty individuals (or decision makers) interviewed for this research. We refer to residents and citizens in the public as community members.

Interview Questions

Participants were asked a series of predetermined questions designed to facilitate discussion in order to elicit their objectives (see Appendix A for a list of the predetermined questions). Follow-up questions were asked to have the participants further expand on statements to gather more objectives and improve clarity. Questions such as “what does success look like” and “how would this be achieved” were commonly used. Participants were also asked to explain their answers and were prompted to break their objectives into separate components.

Participants were first asked about their goals and objectives in emergency preparedness. All participants were able to identify at least a couple of objectives in this stage, with some having more success than others. Participants were asked about their goals in the different phases of the EM cycle. This question helped participants focus their attention on specific elements of the work that they do in the different phases.

Participants were asked about a hypothetical disaster that would occur in their geographic area of responsibility, and the disaster was described for the EM phases. The hypothetical disasters and the questions associated with different phases helped the participants think about their objectives while imagining the ideal preparedness, response, and recovery phases. For example, a severe storm was expected to occur within the next 24 hours with the potential to produce a tornado. Participants were asked to describe their ideal preparation for the community and for EM. The scenario was advanced, and a tornado was identified near a town or city, and participants were asked to identify their ideal actions for this scenario. The tornado caused significant damage to the town or city, and participants described their ideal response. Finally, they were asked to discuss their ideal recovery in both the short and long term for the community.

In addition to a hypothetical disaster, participants were asked to reflect on recent events they had experienced. They were asked to define elements of the response that were successful and lessons they learned from that event. Many participants were involved in the response to and recovery from the August 2020 Midwest derecho, which occurred across several Midwestern states, especially Iowa, on August 10-11 and involved sustained wind speeds of 70 miles per hour. Participants discussed improvements they made after the derecho which they implemented while preparing for the December 2021 Midwest derecho, which occurred on December 15 across several Great Plains and Midwestern states. Some participants also described their experiences with the I-35 bridge collapse in 2007, a train derailment, a tornado, and the COVID-19 pandemic. The participants' real experiences helped them reflect on what elements went well or poorly and why they considered those outcomes good or bad.

In order to identify measurable attributes to assess the achievement of objectives, we asked participants about metrics they use to track success in their job. They were also asked about data that would be beneficial for them to determine the preparedness level of a community.

Keeney (1992) encourages decision makers to reflect on their objectives in a constraint-free manner because decision makers may fail to identify objectives because constraints such as limited resources, time, or budget appear to make those objectives unlikely to be obtained. We encouraged participants to think constraint free and be more creative in reflecting on their objectives. Towards the end of the interviews, participants were asked to describe their wish list for their department or community. They were told their items could be of any size, complexity, feasibility, and likelihood of happening.

CHAPTER 4. RESULTS

Throughout the interviews, participants expressed goals for different time frames in disaster preparedness. Because of these different time frames, creating three separate but related OH&Ns best reflects the participants' thinking. The first OH&N represents the decision maker's objectives pre-disaster, during the mitigation and preparedness phases. No disaster is occurring or is expected to occur in the immediate future. The second OH&N is for disaster onset, transitioning from the final preparation phase to the immediate response phase. A disaster has just begun or is expected to start in the immediate future. For example, radar indicating a strong storm with a high likelihood of tornadoes is an example of when the second OH&N would apply. The final OH&N is for post-disaster, during the response and recovery phases. This OH&N outlines the goals and objectives while responding to and recovering from a disaster. Figure 2 depicts a timeline of how the three OH&Ns align with the four phases in emergency management and the timing of disaster. The exact times at which OH&N 1 finishes and OH&N 2 begins and when OH&N 2 finishes and OH&N 3 begins is left fuzzy, and there can be overlap between the ending of one OH&N and the beginning of another OH&N.

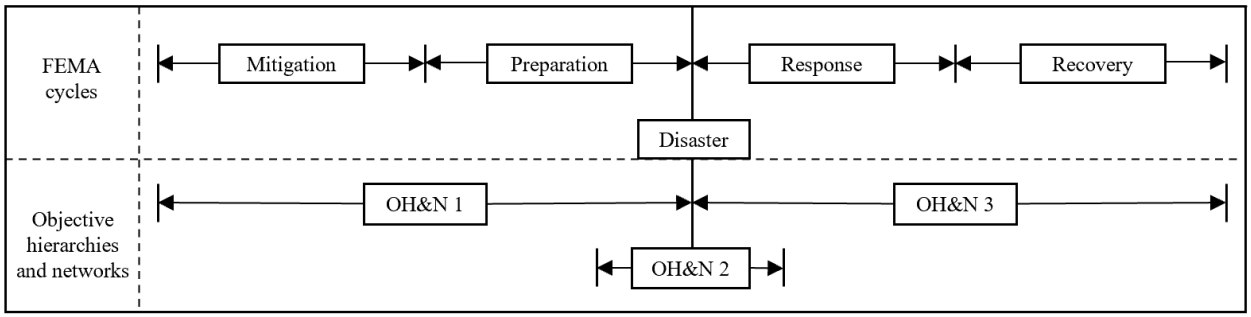

Figure 2. Timeline of FEMA Phases and Objectives Hierarchies and Networks

Pre-Disaster: Mitigation and Preparedness Means-Ends Network

The first OH&N applies before a disaster occurs during the mitigation and preparedness phases. As the participants discussed their objectives in greater specificity during the pre-disaster phases, they consistently identified means objectives. Their responses to our questions suggest that a means-ends objectives network is an appropriate way to reflect objectives in emergency management during the pre-disaster phases. Figure 3 displays the means-ends objectives network. The strategic objective is maximizing public safety. This strategic objective is supported by the two high-level fundamental objectives of (i) maximizing the protection and preparation of the community and (ii) maximizing the response ability of EM. Protecting and preparing the community is an external objective, and developing a capable response ability is an internal objective.

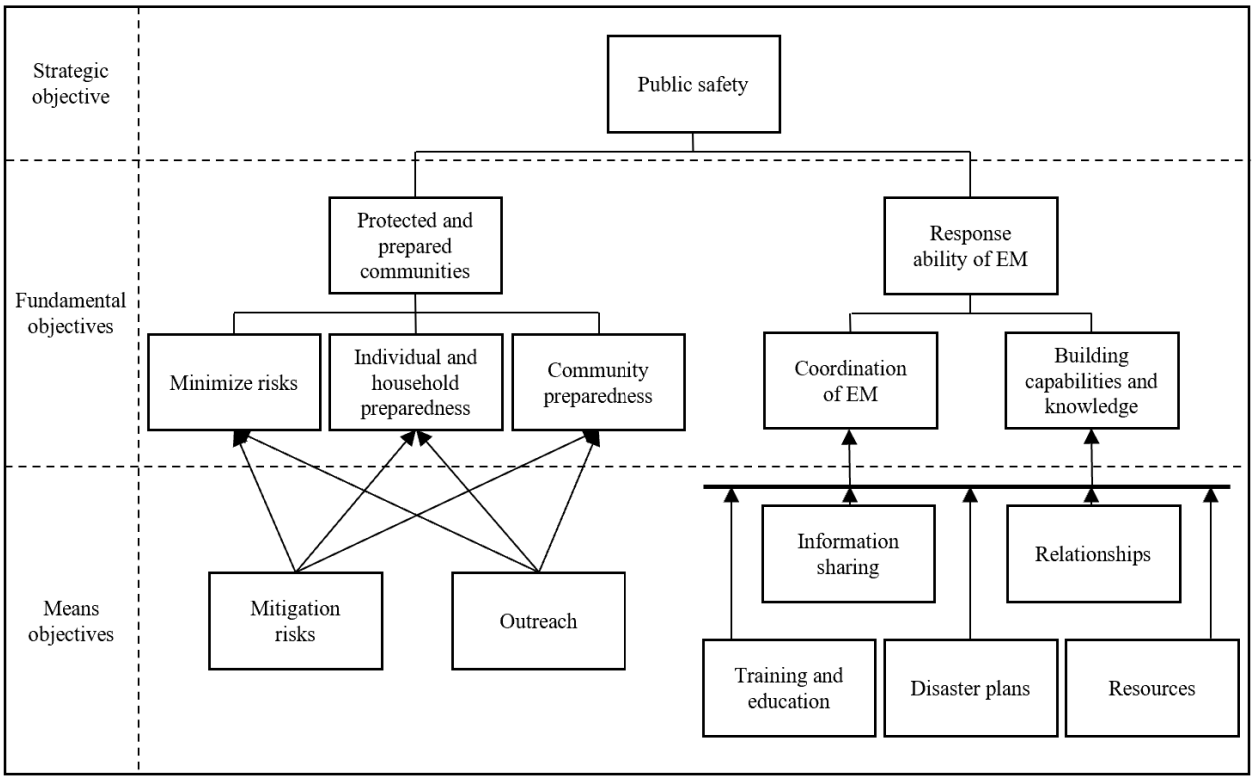

Figure 3. Pre-Disaster Means-Ends Objective Network

Protected and Prepared Community

Participants expressed their desire for protected and prepared communities so that the communities and individual citizens are less reliant on EM in the event of a disaster. Three fundamental objectives support this objective: (i) minimize risk, (ii) maximize individual and household preparedness, and (iii) maximize community preparedness. The two means objectives supporting these fundamental objectives are (i) mitigation projects and (ii) outreach.

Minimizing risk focuses on reducing both the likelihood and potential impact of disasters. Individual and household preparedness aims to develop awareness and self-sufficiency in community members. A prepared individual can self-sustain in a disaster by having emergency plans, extra supplies, and adequate financial preparation. Participants said that financial preparation included having an adequate emergency fund and insurance coverage (interviews 10 & 18). More self-sufficient community members allow resources to be directed elsewhere in a disaster, and EM capabilities are less likely to be overwhelmed. Participants also expressed the increased need for preparedness for vulnerable individuals. Low-income households and people with medical conditions requiring care, such as people on oxygen, were two scenarios brought up most often by participants (interviews 3, 6, 7, 10, 18, & 19). One participant gave the example of a small kitchen fire to illustrate how vulnerable populations are less resilient (interview 10). A small kitchen fire that destroys a food supply could overwhelm a household if they do not have an emergency fund large enough to buy additional food. Although this household could usually rely on organizations for additional support, these organizations' resources are likely to be spread thin during a large disaster. Individuals who cannot self-sustain put more stress on EM.

Community preparedness focuses on government leaders outside of the EM community (e.g, mayors, county executives) understanding how EM operates and leading effectively to

enable preparedness actions. Community preparedness also entails having resources ready such as having shelters for residents to use in the event of a disaster. Participants discussed preparing government leaders, residents, and businesses so they are not surprised if and when a disaster strikes within the context of individual and community preparedness with one participant saying they want to build a culture of preparedness in communities (interview 17).

Mitigation projects

The two means objectives that participants identified that enable them to achieve a protected and prepared community are mitigation projects and outreach to the community. Mitigation projects reduce the likelihood and impacts of potential disasters. One example of reducing the impacts of a disaster is the government purchasing homes in a flood zone to reduce the number of people that would need to be evacuated in a flood (interview 10). Another participant discussed the need to trim branches near electric power lines to reduce the likelihood of a branch falling and causing power outages (interview 5). Effective mitigation depends on maximizing the overall impact of projects by implementing as many projects as possible with high impact in a timely manner. Several participants also discussed implementing mitigation projects while a community recovers and rebuilds after a disaster (interviews 15, 16, 18, & 19).

Outreach

In addition to mitigation projects, participants identified outreach to community members as a way to protect and prepare communities. Outreach helps educate community members about the limitations of EM. One participant stated that they tell residents first responders are not coming for them in a disaster because there will be too many people to help and that they should take action now to better prepare themselves (interview 6). Outreach also helps government officials outside the EM community understand preparedness so that they can make more informed decisions during and after a disaster. One participant noted that their local government

promised debris removal to residents in a shorter timeframe than was possible given the capabilities of EM, leading to displeasure among the public (interview 10). Finally, outreach also focuses on building situational awareness in community members by identifying their own risks and identifying threats in the community. When one identifies their own risks, one can better prepare and/or coordinate with EM to mitigate them, such as a factory with hazardous chemicals keeping a detailed log of materials in the facility that can be shared with first responders in the case of a fire. A community member's ability to identify public threats leads to reporting issues to EM more quickly and subsequent faster response.

Response Ability of EM

The second high-level fundamental objective that participants identified is the ability to respond. This objective is supported by two fundamental objectives: (i) maximize the coordination of EM and (ii) maximize the capabilities and knowledge of EM. The coordination of EM focuses on communities' working relationships with partners to enable an efficient, coordinated response to a disaster. Building capabilities and knowledge requires the proper equipment and skillsets to respond to a disaster. The means objectives that enable EM to achieve these fundamental objectives are (i) effective information sharing, (ii) effective relationships, (iii) education and training, (iv) disaster plans, and (v) resources.

Information sharing

Participants discussed information sharing and how it develops the abilities of EM. Participants usually discussed information sharing in the context of communication with other stakeholders (interviews 1, 2, 5, 7, 8, & 10), but some also mentioned it in the context of gathering information from sources such as weather radar or the scene of a disaster (interviews 3, 4, & 12). Effective information sharing depends on the quality of information and communicating effectively within the EM community and to the greater public. When discussing

information quality, participants expressed their desire for large quantities of accurate information (interviews 10 & 16). In this pre-disaster phase, it is important to consider as many different facets of a disaster as possible since a time-sensitive emergency does not exist. Participants wanted information to be clear, timely, and consistent when received from different sources. They expressed the need for access to trusted sources of information that can be relied on during time-sensitive emergencies and to limit misinformation in the community and online. Having trusted sources of information improves the coordination of EM, providing a faster and more effective response in a disaster. Participants identified open communication lines within EM as necessary to maintain frequent communication with stakeholders in one's network (interviews 4 & 8). Frequent communication also improves coordination and keeps stakeholders up to date.

Relationships

According to the participants, effective relationships depend on increasing the size of their network of relationships and engaging in quality relationships. A large network helps decision makers maintain contact with as many stakeholders as possible. Prioritizing relationships with the closest departments, cities, counties, and states is important because these stakeholders can provide mutual aid the fastest if the response capabilities in a community are overwhelmed (interviews 4 & 8). Participants noted the importance of seeking out relationships with a wide variety of organizations, such as volunteer organizations and subject matter experts (interviews 2, 5, 8, 10, 12, & 13). A diverse network creates more robust preparation by being able to call upon individuals in a large variety of disasters. Quality relationships mean parties trust each other, are consistently engaged, and mutually understand expectations and capabilities. Mutual understanding of capabilities is important for two main reasons. First, decision makers will know when their capabilities will be overwhelmed in a disaster, so they know when to ask

for help. Second, decision makers know how to support one another, or as one participant put it, knowing who holds what cards and getting them to speak up (interview 10). Relationships within EM are critical for accessing resources and personnel that one will need to respond effectively to a disaster.

Training and education

Participants expressed the need for training and education to enhance their response capabilities. They expressed the need to learn from past events and training (interviews 4, 5, 9, 13, 14, 18, & 19). The EM community uses after-action reports (AAR) to reflect on events and training exercises. First responders use AARs after responding to emergencies to reflect on what they expected to happen, what actually happened, what went well, and what did not go well. These reports help first responders learn from past events and improve their skills. Participants also expressed the need to conduct training events to build their skills and test disaster plans (interviews 1, 4, 6, 8, 9, 13, 14, & 19). One participant stated that if the training event did not identify any issues with their disaster plans, the group did not train hard enough (interview 9). These training events help EM improve the coordination with other stakeholders as it helps build an understanding of roles and expectations in response. Participants also stated that they want to learn from events that have impacted other communities in order that they can build more robust plans for similar events without first going through them themselves (interviews 8 & 10).

Disaster plans

Participants emphasized the need for accurate, up-to-date disaster plans to better protect their communities. These plans should be reviewed frequently and should have input from different stakeholders to ensure they can be effectively used in a response. Buy-in from stakeholders ensures better input and wider spread usage of the plans following a disaster. Multiple participants discussed the need for plans to provide structure for a response while

remaining flexible and not providing too many tactical details (interviews 9, 14, & 16). Successful disaster plans should provide guidance for a response but should only act as a starting point due to the unpredictable nature of disasters. Plans should also aim to reduce pinch points (interview 9), as one participant stated, and have secondary and tertiary plans to ensure an effective response. One participant stated that disaster plans should reference people, not 1-800 numbers (interview 17). This relates to the relationship objective as disaster plans rely on a mutual understanding between stakeholders.

Resources

Resources were another area of concern for participants due to their limited budgets from which to purchase equipment and fund staff. Participants expressed the desire for equipment to be dependable for a long period of time (interviews 7 & 11). Departments with smaller budgets (e.g., smaller counties) expressed the need for the equipment to be both versatile and compatible with their existing equipment (interview 7). Participants also discussed the need to minimize the costs of purchasing and maintaining the equipment (interviews 1, 2, 4, 7, & 11). Along with equipment, participants desired more staffing for EM offices and first responders (interviews 2, 4, & 6).

Disaster Onset: Transitioning from Preparation to Immediate Response

The second OH&N is for disaster onset, transitioning from the final preparation phase to the immediate response phase. This OH&N begins when a disaster has started or is expected to commence in the immediate future. A visual of the time frame can be seen in Figure 2 and the means-ends objectives network is shown in Figure 4. The strategic objective is to maximize public safety. The main fundamental objectives in this hierarchy are (i) minimizing the demands of EM during a disaster and (ii) maximizing the effectiveness of EM deployment.

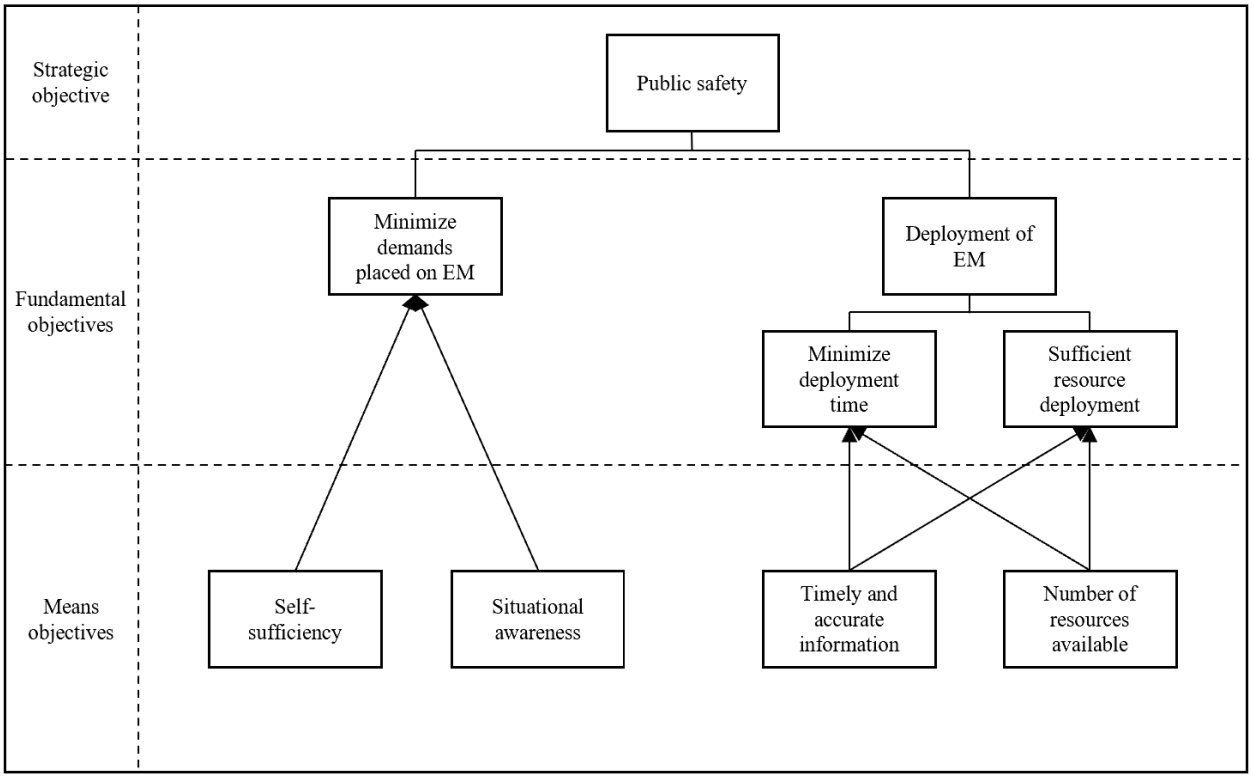

Figure 4. Disaster Onset Means-Ends Objectives Network

Demands Placed on EM

Participants expressed the limitations of EM and the need for community members to be prepared so they can self-sustain in the aftermath of a disaster. Disasters tend to overwhelm communities and EM capability very quickly. Better prepared community members who can self-sustain helps keep the scale of the disaster manageable by allowing EM resources to be directed to higher-priority issues. One fire chief went as far as to say he hopes to build a community that is so well prepared that the fire department is no longer needed (interview 11). Reducing the demands placed on EM is supported by the means objectives of (i) self-sufficiency and (ii) situational awareness.

Self-sufficiency

Minimizing the demands on EM in a disaster largely depends on the ability of community members to self-sustain. The outreach and mitigation actions during the pre-disaster phase are

focused on creating prepared and protected communities that do not require as much assistance from EM. Participants noted the importance of community members having enough supplies at home to get by for a couple of days after a disaster (interviews 3, 6, 12, & 18). Participants also noted the importance of community members having disaster plans, so they know what to do in a disaster (interviews 2, 6, & 9).

Situational awareness

Some final actions should occur in this disaster-onset time frame that reduces the demand on EM. Community residents need to listen to communications about potential threats and take heed if needed. Critical infrastructure may require additional attention and staffing for incoming disasters to operate or bring the infrastructure, such as the electric power network, back online. In addition, actions such as sandbagging for flooding events are last-minute mitigation efforts in the lead-up to disasters.

Deployment of EM

Effective deployment by EM after a disaster is defined by two fundamental objectives: (i) minimize deployment time and (ii) sufficient resource deployment. Two means objectives support these fundamental objectives: (i) timely and accurate information and (ii) number of resources available.

Deploying quickly depends on several factors. Participants expressed the need to identify and report threats early for a quick deployment time. Participants also discussed the need to respond quickly to an event to limit its effects. Participants discussed the need for community members to be aware of their surroundings and alert EM to threats (interviews 4 & 20). Participants also discussed the need for advanced warning on potentially dangerous storms (interviews 4 & 9). Participants from Iowa often noted the difference in warning between two recent derechos in Iowa. The August 2020 Midwest derecho struck Iowa on August 10, 2020,

and most departments had little to no warning. One participant stated they only received a warning a couple of minutes ahead of time from a police officer in a nearby town calling after the storm hit his city (interview 4). The December 2021 Midwest derecho occurred on December 15, 2021. Due to better recognition of this threat on the radar, participants received warnings about the second derecho days prior to December 15, leading to more preparation efforts thanks to an earlier activation of EM.

Sufficient resource deployment also improves the effectiveness of EM deployment after a disaster. Sufficient resource deployment means getting the right amount of equipment and personnel where they need to be in order to respond effectively. Participants also discussed the need to get the right type of equipment to respond to the disaster (interviews 4, 8, & 13).

Timely and accurate information

Participants expressed the need for the right amount of information sharing during the activation of EM. During the preparedness and mitigation phases, there is no immediate threat, and there is time to move slowly and gather large amounts of information. With a looming disaster and during a disaster event, communication must be more efficient. Preexisting relationships facilitate communication because there is an understanding of how other people work, and the information shared between trusted sources does not need to be verified (interviews 10, 13, 14, & 15). A participant discussed the need for first responders to be able to prioritize what information to say on the radio when communication lines are stressed (interview 8). This participant responded to the I-35 bridge collapse near Minneapolis, Minnesota, on August 1, 2007. During the response, the radios were overwhelmed, and firefighters needed to determine if what they were dealing with was important enough to say on the radio. This participant went on to say that it is important that people can communicate even if the main

communication lines are not working. Overall, efficient communication is needed to share the correct amount of information to quicken the activation and response from EM.

Number of resources available for deployment

The number of resources available for deployment impacts the deployment time and sufficient resource deployment. Participants discussed the need to have as many resources as possible for deployment. These resources could be within the department responding or using preexisting relationships to access needed equipment and personnel. For example, the I-35 bridge collapse required the fire department to call upon their relationships to obtain substantial help. The fire department needed more first responders to help with search and rescue, civil engineers to assess the structural integrity of components of the bridge to determine the safest way to proceed with rescue, and Navy divers to navigate the wreckage and assist with recovering bodies trapped underwater (interview 8). Participants recognized the need to accurately identify the situation and deploy the correct equipment and personnel for response (interviews 4, 11, 12, & 13). Strategically staging resources at the disaster onset enables more effective deployment and response. Participants stated that they section off cities before a storm and deploy personnel to each section to have more coverage after the storm (interviews 3 & 4).

Post-Disaster Event: Response and Recovery

The third OH&N represents participants' objectives in the response and recovery phase of the EM cycle. Although majority of most interviews focused on the mitigation and preparation phases, participants noted that reducing the impact of disasters was the end goal of their job. One participant stated that a community can never truly know how prepared they are until after a disaster strikes (interview 17). The fundamental objectives for the post-disaster event are (i) life safety, (ii) scene stabilization, (iii) minimize damage, and (iv) recovery effectiveness. The interviews focused primarily on these fundamental objectives without delving much into means

objectives. Consequently, an objectives hierarchy as displayed in Figure 5 is sufficient to summarize the participants' thinking.

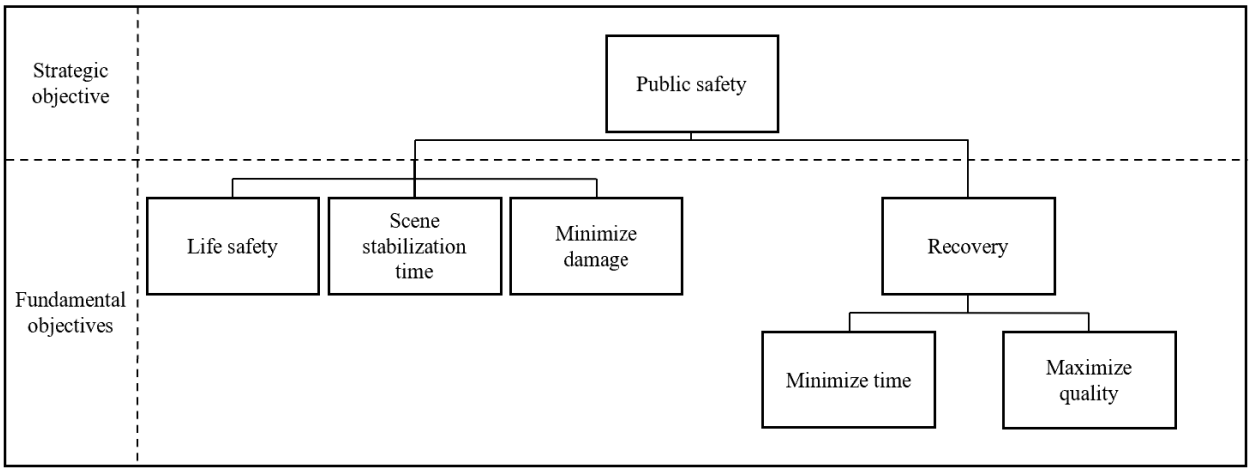

Figure 5. Post Disaster Fundamental Objectives Hierarchy

Life Safety

The most important objective for every participant was life safety. Participants categorized this objective into life safety for first responders and life safety for the public. Life safety is measured in fatalities and injuries. Participants discussed the need to get to people quickly in response to save them. This depends on the timely deployment of the correct resources by EM, objectives from the second hierarchy. One participant stressed the importance of balancing between speed and safety (interview 11). Firefighters need to respond quickly to emergencies, but they should not be running to the fire truck because they would be unable to do their job in helping the public if they slipped, fell, and were hurt. Participants also discussed the impact of the means objectives from the pre-disaster OH&N on life safety in the post-disaster objectives hierarchy. The most notable example is the need for first responders to train to keep themselves safe when responding and to act quickly for better outcomes.

In addition to the initial response by first responders, life sustainment was another priority after a disaster. Life sustainment first focuses on meeting the short-term needs of

community members, such as food, water, and shelter, before transitioning people into long-term solutions to meet their needs. The life sustainment aspect of life safety was most commonly brought up by state and federal planners.

Scene Stabilization

Participants identified scene stabilization as the second most important priority after life safety during the response phase. Effective scene stabilization was defined as controlling the threat or hazard and its cascading effects to the point where the disaster no longer worsens. One metric for scene stabilization is the time until the scene is under control and getting to the recovery phase of the EM cycle. Some participants explained that stopping a disaster at its present state may not always be wise; instead, disaster response requires decision makers to identify where they can effectively engage with the disaster and then limit the impact at that point (interviews 1, 11, & 13). Lessening the magnitude of the disaster and focusing protection on critical utilities supports effective scene stabilization. State and federal planners often discussed using FEMA's seven lifelines to guide scene stabilization (interviews 1, 13, 14, 16, & 19). The seven lifelines are safety and security; food, water, and shelter; health and medical; energy; communications; transportation; and hazardous material (Federal Emergency Management Agency, 2020). The seven lifelines provide a benchmark for emergency managers and to guide resources to restore lifelines.

Minimize Damage

The third objective for participants is to minimize the damage caused by the disaster. Participants emphasized the damage to private property and critical utilities. Mitigation efforts discussed in the first objectives hierarchy help reduce the impacts of disasters through the strengthening of infrastructure and reducing vulnerabilities. Like scene stabilization, minimizing damage also helps guide efforts in responding to disasters. Participants discussed the response to

a storm where electricity was lost (interviews 5 & 9). When power was restored, workers prioritized the restoration of power at water treatment facilities to avoid a boil order for the city. Cascading effects, such as power outages causing issues with the water supply, were addressed by participants as a critical area to focus on in the response phase (interviews 9 & 19). Multiple surface-level effects might have the same root cause, which must be addressed to stop additional issues from cascading. One participant also discussed damage to the environment, reputation, and data (interview 9).

Effective Recovery

The final objective for the post-disaster hierarchy is the effectiveness of the recovery phase. Participants defined recovery as returning conditions to their pre-disaster state or, more often, getting conditions to the new normal state. Two important attributes in the recovery phase are the length of time to arrive at the new normal and the quality of recovery. Participants acknowledged that quality and time might be conflicting objectives (interviews 15 & 19). State and federal planners preferred to see rebuilding done to a higher standard to better mitigate future disasters but noted that local officials often prioritized the speed of the recovery (interviews 15 & 18). State and federal planners in FEMA referred to themselves as “force multipliers” (interview 18), stating that their role was to provide money to the local level and support states in achieving their main goals (interviews 15 & 16). Especially for small counties, the quality of recovery is also defined by the return of culture, businesses, and people after an event (interviews 2 & 7).

Participants also connected the recovery phase to mitigating and preparing for future disasters. Governments and local EM receive money from FEMA, and individuals receive money from insurance companies, which enables future mitigation projects to better prepare the community for a future disaster event. In relation to the education objectives from the first

objectives hierarchy, participants stated that learning from the disaster can help them mitigate and prepare for a similar event in the future (interviews 4, 5, 8, & 9).

CHAPTER 5. DISCUSSION

Five notable trends arose during the interview and objectives hierarchy creation process. Three of these insights focus on the EM community and are derived from the participants' responses. The latter two are insights into decision analysis and focus on the methodology surrounding the interviews and analysis of the interview responses.

Mission-Oriented Versus Strategic Planning Goals

The different roles of participants influence their identification and discussion of objectives. This difference was most prevalent when comparing the responses between first responders and county emergency managers but was also notable when comparing against the responses of state and federal planners. Emergency managers generally had a relatively easy time identifying goals and objectives during the mitigation and preparedness phases whereas first responders focused primarily on their goals and objectives during the response phase.

County emergency managers focused more on the preparedness and mitigation phases because their daily job focuses more on planning and preparing for disasters. They aim to strengthen communities and build response abilities for potential future disasters. Because of the variety of threats and the unpredictable nature of disasters, county emergency managers identified broader goals that they wanted their counties or communities to achieve. The emergency manager for one of the larger counties had their objectives prominently displayed in the office so that everyone was on the same page during meetings or during activation of the emergency operations center (interview 10).

First responders expressed many of their objectives in a mission-oriented manner. They often struggled to identify fundamental objectives, instead identifying alternatives and means objectives. Their daily job involves responding to calls for help for local emergencies where

there are clear tasks that need to be accomplished. Their goals are centered around being able to respond in a safe, timely, and effective manner that fulfills the mission. When they discussed their preparedness goals, they focused on having equipment available for the next call so that they could respond quickly. For example, two participants discussed how the layout of their fire station is optimized to minimize the distance between firefighters and trucks (interviews 8 & 11). The first responders' focus on relationships before a disaster is a means to be able to receive mutual aid when a disaster overwhelms their capabilities and to be able to assist other first responders. A law enforcement official emphasized their available resources because resources enable them to respond effectively and build capability within their law enforcement department (interview 4). This participant identified acquiring drones, along with other pieces of equipment, as one of their goals. This supported the means objective in the first hierarchy of accessing resources, but the participant had trouble identifying other objectives that drones supported. After further discussion, the participant gave an example of a train derailment as a potential use for the drones. He stated that the drones could be used to assess what was on the train without putting first responders close to potentially hazardous material. From his explanation, the objectives of life safety and timely and accurate information were elicited.

The difference between the objectives of emergency managers and first responders is demonstrated in their viewpoint of training. Both groups identified similar reasons for why training is important, but each group focused on what was most relevant to their job. Emergency managers stressed that training and exercises are critical to identifying gaps in their disaster plans and EM capabilities so the gaps can be addressed and improved (interviews 8, 9, 10, 14, & 18). First responders reasoned that training enabled them to maintain their personnel's skill levels and competencies (interviews 4, 8, & 11).

State and federal planners in FEMA also identified goals that were more strategic in nature. Their main focus in responding to disasters was restoring capabilities and the seven lifelines. In addition, there was notable consistency among FEMA representatives about FEMA's goals. Several participants said that FEMA's role in response was to act as a "force multiplier" (interview 18), and FEMA does not set priorities for response and recovery (interview 16). Instead, FEMA representatives viewed their role as supporting states' priorities (interviews 17 & 18) with one participant saying "disasters start and end local" (interview 15).

Differences in Preparedness Between Large and Small Communities

Participants had different objectives for preparedness in their community depending on whether they represented an urban or rural area. Larger counties have more resources than smaller counties, meaning smaller counties and rural areas can have difficulty meeting all of their requirements. Larger counties have more people to protect, and larger populations mean a more diverse set of needs that are challenging to address in a disaster.

Since rural areas and smaller counties receive less funding, these participants focused on preparedness elements related to their limited resources. Participants frequently discussed concerns about fire departments in their communities. Fire departments in rural areas often rely on volunteers for staffing which causes delays when called upon to respond to an emergency. In addition, these departments lack equipment needed to respond effectively. One participant's wish list item for the next few years was to obtain radios for their fire department, a concern that better-funded departments do not share as their fire departments are better equipped (interview 7). In smaller communities, outreach is often focused on individuals. Some participants stated that they work with individuals on oxygen to ensure they can receive it if a disaster would disable utilities (interviews 3 & 7). Emergency managers also expressed the need to educate citizens on the limitations of EM, saying there will not be enough resources to save everybody in

disaster. Citizens need to understand that they need to be more self-sufficient.

Participants from larger counties focused on different elements of preparedness due to their increased funding and staffing, but they also have additional challenges of representing larger populations. Larger communities have established a baseline of preparedness and work to build further capabilities and mitigate threats and hazards. One participant provided the example that their local fire departments wanted to purchase large fans to help ventilate warehouses after a fire (interview 8). This is a stark contrast to the earlier example of wanting to purchase radios for firefighters in the smaller communities. Another participant discussed the county's effort to buy homes in areas prone to flooding in order to reduce the impacts of future floods (interview 5). This type of project is not feasible for smaller counties due to their budget constraints. Participants representing larger counties also engaged in different types of outreach. Outreach focused less on individual community members and more on whole community preparedness. Participants from urban communities discussed how their fire departments tour commercial buildings to help businesses understand potential challenges if the fire department needs to respond to an emergency at their location (interviews 8 & 11). Although large counties have more staff, they also have additional concerns to address. Larger counties typically have more diverse populations and more unique needs such as socio-economically disadvantaged people. Universities, event centers, and larger businesses are more prevalent in large counties, all of which require additional attention from EM.

Changing Landscape of Emergency Management and Potential Future Problems

Participants addressed many internal and external challenges for EM due to changes in society and the environment. Participants identified challenges working within the EM

community, with other government organizations, and with the public. They also discussed how climate change impacts their work to prepare communities.

Participants identified challenges within EM due to EM being a relatively new field or discipline, but with growing responsibilities. They want more professionalization within the field and a higher standard of training to ensure that new emergency managers are prepared to meet their community's needs. Some county EM offices have only one part-time employee working in the office due to a lack of funding or lack of desire to fund the EM office (interviews 1, 15, & 20). According to participants, community preparedness is not receiving enough attention in these communities because the part-time emergency manager has other responsibilities (interviews 1, 9, 10, 13, & 15). Participants were also concerned that many people become emergency managers with minimal training (interviews 16 & 19) or as a second career after serving in the military or fire service (interviews 1 & 9). Although these individuals have valuable experience, participants were concerned that these second-career people were not giving attention to the EM role that it deserved.

Participants also expressed concerns over the relationship between county emergency managers and FEMA. Participants representing small counties said that the process to access grants from FEMA has become more complicated and funds often go to larger urban cities (interview 6). Participants representing larger counties also raised concerns about the complexity of the process (interviews 1 & 10). In addition, they were concerned that FEMA abandoned their commitment to previous plans over the past few years and was becoming less transparent and more bureaucratic (interview 10). FEMA participants also expressed a desire for their agency to simplify. Specifically, participants mentioned their desire to simplify documentation (interviews 15 & 16) and to provide block grants (interview 18).

Changes in culture within society were another area of concern that participants identified. Society has paradoxically become more dependent on and less trusting of government. Several participants stated that people are less self-sufficient than in the past, and they expect that government responders will bail them out during a disaster (interviews 6, 9, 17, & 19). Participants noted that society today is faster paced with some calling it an “instant society” (interviews 17 & 19). These expectations can be unrealistic when they are applied to disaster response and recovery. Debris management is a good example of these unrealistic expectations. After a storm, debris is a visible effect from the storm, and people will call city hall and complain that their debris is not removed. Even though there may be higher priority items, emergency managers often must deal with debris management sooner than what is ideal because of the pressures placed on them by the public and, subsequently, the local government. The public prioritizes speed in recovery and loses out on potential funding form FEMA and opportunities to build back better.

Decreasing trust in government and the increasing amount of misinformation in the public was another area of concern for participants. Although the public expects more from government, their trust in government has decreased, making it more difficult for EM to motivate people to take appropriate preparedness actions. Disinformation that is prevalent on social media makes this trend worse (interviews 15, 17, & 19). Although participants recognized the value of social media in spreading their own messages faster and to more people (interviews 1, 12, 15, 17, 19, & 20), disinformation plagues social media. The public will sometimes listen to other posts rather than EM messages creating confusion over what are the appropriate preparedness actions.

Participants frequently expressed concern over climate change and the threats it poses to their communities. Participants are concerned about new climate-induced hazards that may

emerge and the risk of increased frequency and severity of existing natural hazards (interviews 12, 13, 14, 15, 18, & 20). Some participants stated that they would need increased funding to deal with these threats (interview 13), but another participant argued that these increasing threats was more of an issue of cost-benefit analysis and determining an acceptable risk level (interview 18). Participants were concerned about new threats that could emerge and unsure about the best way to prepare (interviews 15 & 20).

Fundamental Versus Means Objectives

Chapter 4 provides three different OH&Ns with each containing fundamental objectives. These three OH&Ns seem to reflect best how the participants thought about their objectives and represent a good, aggregated summary of our discussions with the participants. However, the post-disaster OH&N is really the only OH&N that contains fundamental objectives (e.g., life safety, scene stabilization, property damage) because mitigation and preparedness activities hopefully enable the participants to achieve those response and recovery objectives if a disaster occurs. The fundamental objectives in the first two hierarchies can really be viewed as means objectives that help achieve the objectives in the third OH&N.

The interviews revealed, however, that participants viewed the goals and objectives before the disaster in a fundamental manner. Although they recognized how different aspects of their job will benefit outcomes if a disaster occurs (e.g., reduce the number of fatalities), participants discussed their daily activities and what they were attempting to achieve in mitigation and preparedness as their fundamental objectives. Even though all the participants stated that life safety was their most important objective, the connections from their daily work to disaster outcomes such as life safety were too difficult to make.

As explained earlier in Chapter 2, Keeney (1992) discusses the need for objectives to be

both controllable and essential. Although the objective of life safety is essential, it is too broad and uncertain to be controllable. Therefore, participants focus on having a protected and prepared community and enhancing their EM capabilities through actions such as community outreach, mitigation projects, and relationship building. Participants recognized that the ultimate goal of these activities is to achieve better outcomes during a disaster, but due to the unpredictable nature of disaster, it is impossible to determine exactly how these actions would benefit the response to the unknown future disaster. For this reason, we believe that presenting the objectives in the first two OH&Ns (e.g., building protected and prepared communities and the response abilities of EM) as fundamental objectives in community preparedness is appropriate and best reflects the participants' thinking.

Decision Analysis Questions

During the interview process, several different questions were used with varying levels of success to help participants identify objectives. Many participants had not previously thought deeply about their objectives, and some participants struggled with identifying fundamental, rather than means, objectives. We discovered that some questions were the most effective in identifying fundamental objectives and getting participants to think in a constraint-free manner.

One question to which participants responded well was to ask them what their wish list was for EM. We told them that these could be items that are in the short-term, long-term, feasible, infeasible, cheap, or expensive. They were told that they were the ultimate decision maker in this scenario and what they wanted got implemented without pushback. Participants thought outside of the realities and constraints of their departments and discussed their vision for EM in the future. Some stated their desire for basic preparedness for all citizens or equipment for

first responders (interviews 2, 6, 7, & 9), and others discussed more advanced strategies of resource deployment or fire department coverage (interviews 1, 8, 11, & 15).

One strategy that helped participants to think deeply about their goals and objectives was to walk them through an imaginary scenario in their community. This strategy was explained earlier in Chapter 3 and started with telling participants that a strong storm was predicted 24 hours from now. Participants were able to identify their objectives more clearly because they could relate them to specific aspects of the imaginary event. This conversation frequently yielded new objectives not discovered by other questions.

Participants from Iowa were asked about preparedness in relation to two derechos that hit the state. Because the events were the same type of weather event, and both had occurred recently, participants easily reflected on areas of the response and recovery that went well or could be improved on. They also identified lessons learned from the first derecho that they worked to improve before the second derecho. For example, the first derecho taught them the importance of having more advanced warning for this type of storm, and they were able to have more warning for the second derecho (interviews 4 & 9). Participants also discussed, more broadly, the need to learn from past events to improve EM capabilities for the future (interviews 4, 5, 8, & 9).

When we began the entire interview process, we wanted to ask the participants to identify measurable attributes or metrics for each objective. Having measurable attributes for objectives would enable the EM community to assess the extent to which they are achieving objectives and would enable them to assess and compare different alternatives in light of those attributes. When we asked about metrics and/or attempted to motivate participants to become more specific with their objectives so that we could identify measurable attributes, many participants struggled to

identify metrics especially when the interviews focused on the mitigation and preparedness phases of EM. Their difficulty in identifying good metrics for the mitigation and preparedness phases likely indicates that the best way to measure a community's pre-disaster preparedness is by observing emergency managers and first responders' abilities during an actual disaster. Some participants were able to break down their objectives into measurable attributes and provided metrics (e.g., number of fatalities, time to respond) while discussing the response phase. After conducting a few interviews, we continued to ask participants to identify metrics, but we abandoned our original goal of identifying measurable attributes for every objective in the hierarchy.

CHAPTER 6. CONCLUSIONS, RECOMMENDATIONS, AND FUTURE WORK

The first and most important step for complex decisions is to identify values and structure objectives so that alternatives can be assessed within the context of those objectives. This thesis identifies and structures objectives for EM based on interviews with 20 participants with different roles and responsibilities. The objectives are organized into three OH&Ns: pre-disaster, disaster onset, and post-disaster. Means-ends objectives networks connect means objectives to fundamental objectives for the pre-disaster and disaster onset time frames, and a fundamental objectives hierarchy is used for the post-disaster objectives.

The OH&Ns demonstrate the connection and relation of objectives among the four phases of EM. The pre-disaster OH&N identifies several means objectives that the EM community pursues in order to create protected and prepared communities and enhance the EM response ability. Protected and prepared communities will help to minimize the demands on EM, and an effective response ability will help to maximize the deployment of EM during the disaster onset phase. These mitigation, preparedness, and immediate response objectives ultimately serve to achieve four fundamental post-disaster objectives: life safety, scene stabilization, minimize damage, and maximize recovery.

Recommendations

The interviews and the process of structuring the objectives into OH&Ns generate several recommendations to improve EM. First, ensure that decisions align with fundamental objectives. Decision making frequently focuses on alternatives and assessing the positives and negatives of different alternatives. VFT encourages decision makers to first identify and structure their objectives and use those objectives to identify creative alternatives that help them achieve their

objectives (Keeney, 1992). This study has identified and structured objectives, and the EM community can use this structure to help identify and assess alternatives.

During the interviews, many participants identified means objectives and alternatives without connecting them to fundamental objectives. First responders often described their roles in emergencies and disasters within the context of defining and completing a mission. Especially during the mitigation and preparedness phases, these mission-oriented objectives should serve to support the achievement of the fundamental objectives. Means objectives should not be pursued for their own sake. Instead, means objectives should be pursued in order to achieve fundamental objectives, and decision makers should not pursue a means objective if other means objectives or alternatives help the decision makers achieve their fundamental objectives more effectively. For example, purchasing additional equipment may be a good strategy that improves the response capability of an EM organization, but sharing existing equipment among different EM organizations may enable an EM organization to improve its response ability for less money. We recommend that decision makers take a step back in the mitigation and preparedness phases to reflect on their objectives and align their decision making with those objectives. Such alignment will help first responders and emergency managers coordinate better and enhance their response capability. County emergency managers will likely need to take the initiative of working with first responders in their community to ensure that everybody's actions are aligned with fundamental objectives.

Second, identify metrics to measure the achievement of pre-disaster fundamental objectives. Decision makers can use these metrics to assess how well they are achieving their objectives and can track improvement over time. Identifying metrics for successful attainment of fundamental objectives will help decision makers better compare between alternatives because

they can evaluate alternatives in light of how they will affect metrics. Participants had trouble identifying metrics for success during the mitigation and preparedness phases since the success or failure of mitigation and preparedness activities is only really known after a disaster occurs. However, measurable attributes could be identified for the pre-disaster fundamental objectives. Individual and household preparedness could be assessed by conducting a random survey of community members and asking some key questions that can evaluate a household's level of preparedness. Coordination within the EM community could be assessed through training exercises that test the extent to which first responders, emergency managers, and state and federal planners are coordinating effectively. In the current capabilities-based planning framework, state offices of emergency management are required to quantitatively assess 32 core capabilities for emergency preparedness (DHS, 2015). This assessment could be extended to the county and local levels in order to measure the response ability of EM.

Third, increase the professionalization of EM by establishing a higher baseline of skills, abilities, and training for county emergency managers. Several participants commented on the substantial variability in the skills and abilities of emergency managers (interviews 1, 9, 10, 13, 15, & 20). Establishing a higher baseline of skills and requisite training as part of community preparedness could help the EM community increase its ability to respond and enable more effective coordination across the EM community.

Fourth, increase collaboration between county emergency managers and state and federal planners in order to create a stronger mutual understanding of roles and expectations. During interviews, it became apparent that a disconnect exists between local emergency managers' expectations of state and federal planners and how state and federal planners viewed their responsibilities. Participants at the state and federal levels indicated that local communities

frequently have unrealistic expectations of what the state or federal governments can provide during a disaster or that local communities may request resources from the state or federal governments without adequately justifying their need for that resource. During the mitigation and preparedness phases, state and federal planners should better communicate and educate about their roles during and immediately after a disaster to county emergency managers and local first responders. County emergency managers may also need to include state and federal officials in more of their exercises and plans so that state and federal officials can correct a county's assumptions about what the state and federal governments will do. Clearer expectations will help state and federal planners more effectively support communities. Coordination across the EM community is a pre-disaster fundamental objective and developing more effective coordination between the local and federal levels can lead to fewer challenges during the recovery phase.

Fifth, make AARs available across the EM community for better transparency. After an incident or a training exercise, agencies reflect on their experiences and generate lessons learned by authoring AARs. These AARs are typically not shared outside the agencies who author them. Participants discussed their desire to learn from other departments' and communities' experiences. One participant argued that these AARs should be made more accessible because they contain valuable insights and good ideas for improvement from which other agencies, states, and communities can benefit (interview 9). Although agencies are understandably hesitant about sharing information that may make them look deficient in certain areas, developing a method to share ideas from these AARs should help increase the response capability of EM.

Future Work

This work can be expanded in multiple ways to further aid EM decision making. First, interviews with other individuals that represent different geographies could further develop the

objectives presented in this thesis or identify further differences. Of the first responders and emergency managers interviewed, most serve communities in Iowa. Two participants represent Florida and others served in different geographic areas in the past, but representation across the United States was lacking. Different geographic regions face different threats. Future work could include more regional variety in the United States to capture objectives brought upon by these different threats and examine if the broad objectives presented in this thesis still apply.

Second, stakeholders in different roles could be interviewed to include additional viewpoints. For this work, law enforcement officers, firefighters, emergency managers, and state and federal planners were interviewed. Representatives from the medical services, organizations such as the Red Cross, and elected officials or their staff or could be interviewed. Interviews with decision makers in the medical services or the Red Cross could help emphasize certain objectives or define new ones. Elected officials represent the community and have concerns beyond EM, which likely means they have different goals or objectives around community preparedness and response.

Third, future work could quantify the objectives of EM and construct a value model that aggregates the objectives or metrics into a single number. This multi-attribute value function would benefit EM decision making by providing a method for choosing among alternatives. Decisions in any phase of EM frequently require making trade-offs between objectives because most alternatives will not perform the best according to each objective. The value model incorporates trade-offs from a decision maker to help assess alternatives and choose which the alternative that best meets the objectives. A value model can also assess how well an organization is achieving its objectives by providing a single number that aggregates all of the metrics. An organization could use this number to understand how well it is achieving its

objectives and track this number over time to quantify how communities are improving their preparedness.

One of the original goals of this research was to identify measurable attributes corresponding to each EM objective. As mentioned, the semi-structured nature of the interviews made this challenging, and participants did not readily identify metrics or measurable attributes especially in the mitigation and preparedness phases. In order to create the value model that aggregates all of the objectives, future research would need to identify measurable attributes or metrics for the identified objectives in this thesis, ideally in collaboration with one or more EM decision makers.

Creating a value model requires four components (Wall & MacKenzie, 2015). The first component, determining decision makers' objectives and structuring those objectives into hierarchies, was completed in this thesis. This first component is the most valuable piece of building a value model. The second component focuses on determining metrics or measurable attributes for each fundamental objective. The third component assesses a value function for each metric or attribute. This value function identifies the best or ideal level and the worst level for each attribute in order to create a range of numbers for each attribute. The fourth component determines the importance of objectives compared to each other and assigns weight to each objective and attribute. These weights would describe a decision maker's preference for making trade-offs between objectives. Assessing a value function and determining the importance of objectives in EM would require that one or two decision makers from the EM community are willing to provide their subjective preferences on the best and worst levels for each attribute and the trade-off weights. The resulting multi-attribute value function would aggregate all of the objectives, measurable attributes, and weights provided by the EM decision maker(s) into a

single number that could be used to evaluate alternatives and determine achievement of objectives.

Some of our preliminary conversations with the participants seem to indicate that they may not want to take the time to provide assessments for a multi-attribute value function. Nevertheless, the research completed in this thesis provides decision makers in EM with a framework from which to make better decisions and benefit their community even without quantifying the objectives. Prioritizing the needs of communities will become more difficult in the future, as natural disasters are expected to continue to increase in frequency and severity (Banholzer et al., 2014). Identifying the values and objectives in EM can help ensure that the interests of different decision makers and stakeholders in EM are aligned and that they are working toward common goals. Using the OH&Ns can help decision makers navigate the complexity of emergency preparedness and response and allocate resources effectively.

REFERENCES

Alencar, L. H., de Miranda Mota, C. M., & Alencar, M. H. (2011). The problem of disposing of plaster waste from building sites: Problem structuring based on value focus thinking methodology. *Waste Management*, *31*(12), 2512-2521.

Alzahrani, A. S., & Alfares, H. K. (2021). Consistency-based multi-criteria group decision-making for fire station staffing. *International Journal of Operations and Quantitative Management*, *27*(4), 303-320.

Banholzer, S., Kossin, J., & Donner, S. (2014). The impact of climate change on natural disasters. *Reducing disaster: Early warning systems for climate change*, 21-49.

Barquet, K., & Cumiskey, L. (2018). Using participatory multi-criteria assessments for assessing disaster risk reduction measures. *Coastal Engineering*, *134*, 93-102.

Bruneau, M., Chang, S. E., Eguchi, R. T., Lee, G. C., O'Rourke, T. D., Reinhorn, A. M., Shinozuka, M., Tierney, K., Wallace, W. A., & Von Winterfeldt, D. (2003). A framework to quantitatively assess and enhance the seismic resilience of communities. *Earthquake Spectra*, *19*(4), 733-752.

Buede, D. M., & Bresnick, T. A. (1992). Applications of decision analysis to the military systems acquisition process. *Interfaces*, *22*(6), 110-125.

Burk, R. C., & Parnell, G. S. (1997). Evaluating future military space technologies. *Interfaces*, *27*(3), 60-73.

Choi, S, O. (2008). Emergency management: Implications from a strategic management perspective. *Journal of Homeland Security and Emergency Management*, *5*(1). 1.

Clemen, R. T., & Reilly, T. (2013). *Making Hard Decisions with DecisionTools*. Cengage Learning.

Cutter, S. L. (2016). The landscape of disaster resilience indicators in the USA. *Natural Hazards*, *80*(2), 741-758.

Cutter, S. L., Burton, C. G., & Emrich, C. T. (2010). Disaster resilience indicators for benchmarking baseline conditions. *Journal of Homeland Security and Emergency Management*, *7*(11). 51.

Deckro, R. F., & Kloeber, J. M., Jr. (2001). Valuing psychological operations. *Military Operations Research*, *6*(2), 45-65.

Department of Homeland Security. (2015). *National Preparedness Goal*. https://www.fema.gov/sites/default/files/2020-06/national_preparedness_goal_2nd_edition.pdf

Department of Homeland Security. (2016). *National Mitigation Framework*. https://www.fema.gov/sites/default/files/2020-04/National_Mitigation_Framework2nd_june2016.pdf

Doyle, M. P., Deckro, R. F., Kloeber, J. M., Jr., & Jackson, J. A. (2000). Measures of merit for offensive information operations courses of action. *Military Operations Research, 5*(2), 5-18.

Dyer, J. S., Edmunds, T., Butler, J. C., & Jia, J. (1998). A multiattribute utility analysis of alternatives for the disposition of surplus weapons-grade plutonium. *Operations Research*, *46*(6), 749-762.

Ewing Jr, P. L., Tarantino, W., & Parnell, G. S. (2006). Use of decision analysis in the army base realignment and closure (BRAC) 2005 military value analysis. *Decision Analysis*, *3*(1), 33-49.

Federal Emergency Management Agency (2020, July 27). *Community Lifelines*. https://www.fema.gov/emergency-managers/practitioners/lifelines

French, S. (1996). Multi-attribute decision support in the event of a nuclear accident. *Journal of Multi-Criteria Decision Analysis*, *5*(1), 39-57.

Geldermann, J., Bertsch, V., Treitz, M., French, S., Papamichail, K. N., & Hämäläinen, R. P. (2009). Multi-criteria decision support and evaluation of strategies for nuclear remediation management. *Omega*, *37*(1), 238-251.

Gibson, P. J., Theadore, F., & Jellison, J. B. (2012). The common ground preparedness framework: A comprehensive description of public health emergency preparedness. *American Journal of Public Health*, *102*(4), 633-642.

Gillespie, D. F., & Streeter, C. L. (1987). Conceptualizing and measuring disaster preparedness. *International Journal of Mass Emergencies and Disasters, 5*(2), 155-176.

Goode, N., Salmon, P. M., Spencer, C., McArdle, D., & Archer, F. (2017). Defining disaster resilience: Comparisons from key stakeholders involved in emergency management in Victoria, Australia. *Disasters, 41*(1), 171-193.

Gregory, R., & Keeney, R. L. (1994). Creating policy alternatives using stakeholder values. *Management Science*, *40*(8), 1035-1048.

Hämäläinen, R. P., Lindstedt, M. R., & Sinkko, K. (2000). Multiattribute risk analysis in nuclear emergency management. *Risk Analysis, 20*(4), 455-468.

Höfer, T., von Nitzsch, R., & Madlener, R. (2020). Using value-focused thinking and multicriteria decision making to evaluate energy transition alternatives. *Decision Analysis*, *17*(4), 330-355.

Kahan, J. H., Allen, A. C., & George, J. K. (2009). An operational framework for resilience. *Journal of Homeland Security and Emergency Management*, *6*(1). 83.

Kailiponi, P. (2010). Analyzing evacuation decisions using multi-attribute utility theory (MAUT). *Procedia Engineering, 3*, 163-174.

Kapucu, N. (2008). Culture of preparedness: Household disaster preparedness. *Disaster Prevention and Management, 17*(4), 526-535.

Kapucu, N., Hawkins, C. V., & Rivera, F. I. (2013). Disaster preparedness and resilience for rural communities. *Risk, Hazards & Crisis in Public Policy*, *4*(4), 215-233.

Keeney, R. L. (1992). *Value-Focused Thinking: A Path to Creative Decisionmaking*. Harvard University Press.

Keeney, R. L., & Von Winterfeldt, D. (2011). A value model for evaluating homeland security decisions. *Risk Analysis: An International Journal*, *31*(9), 1470-1487.

Keeney, R. L., & McDaniels, T. L. (1992). Value-focused thinking about strategic decisions at BC Hydro. *Interfaces*, *22*(6), 94-109.

Keeney, R. L., & Raiffa, H. (1976). *Decisions with Multiple Objectives: Preferences and Value Trade-Offs*. Wiley

Keeney, R. L., Lathrop, J. F., & Sicherman, A. (1986). OR practice—An analysis of Baltimore Gas and Electric Company's technology choice. *Operations Research*, *34*(1), 18-39.

Khan, Y., O'Sullivan, T., Brown, A., Tracey, S., Gibson, J., Généreux, M., Henry, B., & Schwartz, B. (2018). Public health emergency preparedness: A framework to promote resilience. *BMC Public Health*, *18*(1344), 1-16.

Kirkwood, C.W. (1997). *Strategic decision making: Multiobjective Decision Analysis with Spreadsheets*. Cengage Learning.

Larsson, A. (2008). A framework for evaluating emergency preparedness plans and response strategies. *International Institute for Applied Systems Analysis*

Levy, J. K., Hartmann, J., Li, K. W., An, Y., & Asgary, A. (2007). Multi-criteria decision support systems for flood hazard mitigation and emergency response in urban watersheds. *Journal of the American Water Resources Association*, *43*(2), 346-358.

Little, R. G., Loggins, R. A., & Wallace, W. A. (2015). Building the right tool for the job: Value of stakeholder involvement when developing decision-support technologies for emergency management. *Natural Hazards Review*, *16*(4). 1-9.

McLoughlin, D. (1985). A framework for integrated emergency management. *Public Administration Review, 45*, 165-172.

Mojtahedi, M., Sunindijo, R. Y., Lestari, F., & Wijaya, O. (2021). Developing hospital emergency and disaster management index using TOPSIS method. *Sustainability*, *13*(9).

Morais, D. C., Alencar, L. H., Costa, A. P., & Keeney, R. L. (2013). Using value-focused thinking in Brazil. *Pesquisa Operacional*, *33*(1), 73-88.

National Centers for Environmental Information. (2023, January 10). *Billion-Dollar Weather and Climate disasters*. https://www.ncei.noaa.gov/access/billions/

Nelson, C., Lurie, N., & Wasserman, J. (2007). Assessing public health emergency preparedness: Concepts, tools, and challenges. *Annual Review Public Health*, *28*, 1-18.

Ortiz-Barrios, M., Gul, M., López-Meza, P., Yucesan, M., & Navarro-Jiménez, E. (2020). Evaluation of hospital disaster preparedness by a multi-criteria decision making approach: The case of Turkish hospitals. *International Journal of Disaster Risk Reduction*, *49*, 101748.

Owen, C., Brooks, B., Bearman, C., & Curnin, S. (2016). Values and complexities in assessing strategic-level emergency management effectiveness. *Journal of Contingencies and Crisis Management*, *24*(3), 181-190.

Parnell, G. S., Conley, H. W., Jackson, J. A., Lehmkuhl, L. J., & Andrew, J. M. (1998). Foundations 2025: A value model for evaluating future air and space forces. *Management Science*, *44*(10), 1336-1350.

Parnell, G. S., Metzger, R. E., Merrick, J., & Eilers, R. (2001). Multiobjective decision analysis of theater missile defense architectures. *Systems Engineering*, *4*(1), 24-34.

Peharda, I., & Hunjak, T. (2008). Selecting an automatic rifle using the value-focused thinking approach. *Military Operations Research*, *13*(3), 19-26.

Pereira, R. C. A., Moreira, M. Â. L., Costa, I. P. D. A., Tenório, F. M., Barud, N. A., Fávero, L. P., Al-Qudah, A. A., Gomes, C. F. S., & Santos, M. (2020). Feasibility of a hospital information system for a military public organization in the light of the multi-criteria analysis. *Healthcare*, *10*(11), 2147.

Pines, J. M., Pilkington, W. F., Cabarrus County, N. C., & Seabury, S. A. (2014). Value-based models for sustaining emergency preparedness capacity and capability in the United States. *Institute of Medicine.*

Rudman, W. B., Clarke, R. A., & Metzl, J. F. (2003). *Emergency Responders: Drastically Underfunded, Dangerously Unprepared*. Council on Foreign Relations. https://cdn.cfr.org/sites/default/files/pdf/2003/06/Responders_TF.pdf

Sheng, H., Siau, K., & Nah, F. F. H. (2010). Understanding the values of mobile technology in education: a value-focused thinking approach. ACM SIGMIS Database: the DATABASE for Advances in Information Systems, *41*(2), 25-44.

Simon, J., Regnier, E., Whitney, L. (2014). A value-focused approach to energy transformation in the United States Department of Defense. *Decision Analysis*, *11*(2), 117-132.

Suresh, r. (2019). *A value-Focused Thinking Approach to Measuring Community Resilience* (Publication No. 27547545) [Master's thesis, Iowa State University]. ProQuest Dissertations & Theses Global.

Sutton, J., & Tierney, K. (2006). Disaster preparedness: Concepts, guidance, and research. University of Colorado. *3*(1).

Turcanu, C., Carlé, B., & Hardeman, F. (2008). Agricultural countermeasures in nuclear emergency management: A stakeholders' survey for multi-criteria model development. *Journal of the Operational Research Society*, *59*(3), 305-312.

Wall, K. D., & MacKenzie, C. A. (2015). Multiple objective decision-making. In *Military Cost-Benefit Analysis* (pp. 231-270). Routledge.

Wells, E. M. (2022). *Exploration of Adaptive Resource Use and Technology Choice: Individual and Institutional Perspectives* (Publication No. 29395869) [Doctoral dissertation, Carnegie Mellon University]. ProQuest Dissertations and Theses Global.

APPENDIX A. INTERVIEW QUESTIONS

1) Overall goals
    a) What is your goal in EM?
    b) What are your (objectives/goals/priorities) when (mitigating, preparing, responding to, and recovering from disasters and emergencies?
    c) What are you trying to achieve?
    d) What does success in each of the phases of EM look like to you?
2) Community resilience
    a) How do you define community resilience or disaster resilience?
    b) What does community/ disaster resilience mean to you?
3) Equity
    a) Do you consider equity considerations when it comes to disaster planning or community resilience?
    b) What efforts do you make to ensure equity?
4) Data
    a) Imagine that you could have any data that you want at your fingertips ([a] right now/ [b] immediately following a disaster/ [c] two years from now). How would you know if you are successful at ([a] disaster planning/ [b] disaster response/ [c] enhancing resilience)?
    b) What data would help you know you are successful in ([a] disaster preparation/ [b] response to a disaster/ [c] making the community more resilient)?
5) Past experiences

   a) What are some events you have responded to that you would define as successful or unsuccessful?
   b) What components were successful/unsuccessful?
   c) Why do you consider these components to be successful/unsuccessful?

6) Hypothetical event
   a) Explain the scenario of a strong storm expected in 24 hours. What would the ideal next 24 hours look like?
   b) Same scenario but the storm is one hour away. What would the ideal next hour look like?
   c) The storm is producing a tornado. What does the ideal response look like?
   d) What does the ideal recovery look like in the short-term and long-term?

7) Current focus
   a) What is your current focus for building community preparedness?
   b) What current projects are you working on?

8) Wish list
   a) Tell interviewees they are the "ultimate stakeholder" with no limitations, what would you do and why?
   b) What would your community/department ideally look like in 1 year?
   c) What would your community/department ideally look like in 5-10 years?

9) Following up on responses
   a) What do you mean by this?
   b) How can we quantify this?
   c) What would success look like?

APPENDIX B. APPROVAL FOR RESEARCH (IRB)

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office of Research Ethics
Vice President for Research
2420 Lincoln Way, Suite 202
Ames, Iowa 50014
515 294-4566

Date: 10/26/2021

To: Cameron MacKenzie

From: Office of Research Ethics

Title: Planning Grant: Engineering Research Center for Hazard Mitigation and Community Resilience (HMCR)

IRB ID: 21-339

Submission Type: Initial Submission **Exemption Date:** 10/26/2021

The project referenced above has been declared exempt from most requirements of the human subject protections regulations as described in 45 CFR 46.104 or 21 CFR 56.104 because it meets the following federal requirements for exemption:

2018 - 2 (ii): Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording) when any disclosure of the human subjects' responses outside the research would not reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, educational advancement, or reputation.

The determination of exemption means that:

- **You do not need to submit an application for continuing review. Instead, you will receive a request for a brief status update every three years. The status update is intended to verify that the study is still ongoing.**
- **You must carry out the research as described in the IRB application.** Review by IRB staff is required prior to implementing modifications that may change the exempt status of the research. In general, review is required for any *modifications to the research procedures* (e.g., method of data collection, nature or scope of information to be collected, nature or duration of behavioral interventions, use of deception, etc.), any change in *privacy or confidentiality protections*, modifications that result in the *inclusion of participants from vulnerable populations*, removing plans for informing participants about the study, any *change that may increase the risk or discomfort to participants, and/or* any change such that the revised procedures do not fall into one or more of the regulatory exemption categories. The purpose of review is to determine if the project still meets the federal criteria for exemption.
- All ***changes to key personnel*** must receive prior approval.
- **Promptly inform the IRB of any addition of or change in federal funding for this study.** Approval of the protocol referenced above applies only to funding sources that are specifically identified in the corresponding IRB application.

Detailed information about requirements for submitting modifications for exempt research can be found on our website. For modifications that require prior approval, an amendment to the most recent IRB application must be submitted in IRBManager. A determination of exemption or approval from the IRB must be granted before implementing the proposed changes.

Non-exempt research is subject to many regulatory requirements that must be addressed prior to implementation of the study. Conducting non-exempt research without IRB review and approval may constitute non-compliance with federal regulations and/or academic misconduct according to ISU policy.

Additionally:

- All research involving human participants must be submitted for IRB review. **Only the IRB or its designees may make the determination of exemption**, even if you conduct a study in the future that is exactly like this study.

- **Please inform the IRB if the Principal Investigator and/or Supervising Investigator end their role or involvement with the project** with sufficient time to allow an alternate PI/Supervising Investigator to assume oversight responsibility. Projects must have an eligible PI to remain open.

- **Immediately inform the IRB of** (1) **all serious and/or unexpected adverse experiences** involving risks to subjects or others; and (2) **any other unanticipated problems involving risks** to subjects or others.

- **Approval from other entities may also be needed**. For example, access to data from private records (e.g., student, medical, or employment records, etc.) that are protected by FERPA, HIPAA or other confidentiality policies requires permission from the holders of those records. Similarly, for research conducted in institutions other than ISU (e.g., schools, other colleges or universities, medical facilities, companies, etc.), investigators must obtain permission from the institution(s) as required by their policies. **An IRB determination of exemption in no way implies or guarantees that permission from these other entities will be granted**.

- Your research study may be subject to **post-approval monitoring by Iowa State University's Office of Research Ethics**. In some cases, it may also be subject to formal audit or inspection by federal agencies and study sponsors.

- Upon completion of the project, transfer of IRB oversight to another IRB, or departure of the PI and/or Supervising Investigator, please initiate a Project Closure in IRBManager to officially close the project. For information on instances when a study may be closed, please refer to the IRB Study Closure Policy.

Please don't hesitate to contact us if you have questions or concerns at 515-294-4566 or IRB@iastate.edu.