# EVOLUTION OF CULTURE AMONG WARNING SYSTEM

# ORGANIZATIONS

by

Danielle Nagele

A dissertation submitted to the Faculty of the University of Delaware in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Disaster Science and Management

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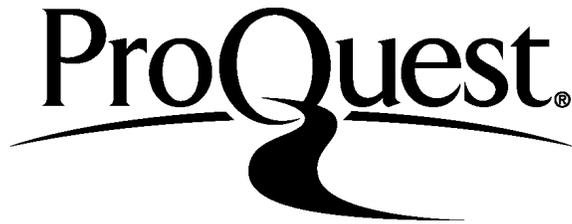
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# ACKNOWLEDGMENTS

# TABLE OF CONTENTS

Chapter

# LIST OF TABLES

# LIST OF FIGURES

**ABSTRACT**

Thousands of natural hazards affect the United States each year, many resulting in loss of life, injuries, and damaged property. These hazards make obvious the need for an effective warning system with the ability to reduce losses. A warning system can be thought of as the actors, resources, and processes involved in detection, prediction, and communication of impending disasters. Understanding the way this system works and the interactions between each component is imperative if we are to determine what is effective and what needs to be improved. This dissertation explores a conceptual model of the weather warning system in order to extend our understanding of the organizations and tasks involved. In addition, this analysis examines the inter- and intra-organizational variations that can arise among warning systems in different regions. Building on the idea of disaster subculture, it is proposed that repetitive impacts from the same hazard can lead to changes in the communication structure, the roles and influence of the actors, and the available resources and their uses.

This research was conducted using a multiple case study design where organizations located within National Weather Service Warning Forecast Office regions were interviewed. Two of the cases represent areas in which the organizations face repetitive impacts from tornadoes. While all regions are at risk to some degree, the other two cases represent areas that do not have a particular hazard consistently

impacting them. The subjects in each case study were drawn from six types of organizations within each area. Interviews addressed tasks and activities associated with the warning system, inter- and intra-organizational communication, roles and responsibilities, and the use of resources.  All interviews were transcribed within Atlas.ti and analyzed using open, process, and values coding as well as pattern development.

A final conceptual model of the weather warning system including major tasks, activities, and communication methods is presented. Additionally, results address the organizational culture present among warning system organizations in each of the cases. Ultimately, analysis led to three broad conclusions: 1) Prevalent similarities between the cases suggest many aspects of organizational culture remain the same across different regions. 2) On the other hand, results did indicate some evolution of culture due to frequent hazard impacts. These areas developed deeper, more established relationships and exhibited collaborations rooted in exchange of opinions and ideas rather than just information. 3) There is also evidence to suggest a continuum of culture rather than discrete differences. In other words, warning systems likely evolve continually and organically rather than in a step-wise manner.

# Chapter 1

# MODEL AND COMPONENTS

## 1.1 Introduction

There are thousands of natural hazards affecting the United States each year. Many result in loss of life, injuries, and damaged property. An effective warning system could reduce these losses substantially. Warning is not a new area of study and in fact has held the interest of researchers for decades. Sorenson (2000) states that "warning systems detect impending disaster, give that information to people at risk, and enable those in danger to make decisions and take action." Though this definition may be simple, it illustrates the fact that warning systems are not one step or action but are made up of various components that interact with one another. Similarly, Quarantelli (1990) puts forth the idea that warning involves "a social system which consists of three basic elements or activities: (1) assessment, (2) dissemination, and (3) response." He describes assessment as all activities from the point of hazard detection through the creation of the warning message. Dissemination is then the transmission of the warning message to the threatened population and response is the behavior brought about by that message (Quarantelli 1990). Such a complex system requires the involvement of many different actors and organizations interacting with one another. In order to determine successes and areas of improvement, it's imperative that we understand the way the warning system functions and the interactions between each component.

In agreement with Quarantelli, it is widely understood that the warning system includes an assessment, dissemination, and response component. The public response component is an integral part of the system and consequently the most comprehensively studied. Disaster literature houses numerous studies centered on the intricacies of public response. On the other hand, the organizations and tasks involved in the assessment and dissemination phases has been the focus of only a few comprehensive studies. For that reason, the current study will focus on the organizational side of the warning system, namely the assessment and dissemination components. While research has addressed variations of the warning system for different hazards it has not yet focused on differences between organizational and regional instances of warning systems. Building on the idea of disaster subculture, this analysis will examine the inter- and intra-organizational variations that can arise among warning systems in different regions. More specifically, I will explore the communication structure among and within organizations, availability and use of resources, and the roles of the actors. Before discussing my reasoning and approach, it is important to conceptualize what exactly is meant by the warning system.

## 1.2   Overview of Model and Components

Throughout the literature there is some consensus on the main components and actors of a warning system. As discussed above, past research (McLuckie 1970, Quarantelli 1990, Nigg 1995) agrees that two main analytical elements make up the warning system, assessment and dissemination. These broad terms involve a multitude of various tasks, activities, and actors within each. A conceptualization and understanding of these details within the assessment and dissemination components will allow for more effective improvement of the warning system. For instance, we

cannot address the deficiencies or successes of these components without knowing the communications and activities that are occurring and the resources being used. To explore this further, the following sections will propose and describe the specific tasks and activities within the assessment and dissemination components.

Using personal experience, professional correspondences, and existing theoretical and empirical studies, this dissertation is designed in part to explore a conceptual model of warning system components (Tables 1 and 2). Through years of informal discussions with colleagues and friends in the meteorological community as well as personal experience in hazardous weather situations, I developed an understanding of the warning system. I merged my informed, but limited viewpoint with key disaster and organizational literature. This general model is meant to be applicable to all rapid-onset events under National Weather Service (NWS) jurisdiction. For instance, this could include but is not limited to flash floods, tornadoes, and severe wind events.[1] The following sections describe in detail the actors involved in the system as well as the tasks and activities within each component as they are laid out in Tables 1 and 2. More in depth descriptions of the specific activities are provided using a tornado event as an example.

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[1] While the conceptual model is meant to be applicable across a variety of rapid-onset events, two of the cases were chosen due to their frequent impacts from tornadoes. This was done to address the over-arching question; are there inter- and intra-organizational variations that arise among warning systems in different regions?

Table 1:     Conceptual Model Assessment Component

| Component | Task | Activities | Resources | Actors |
|---|---|---|---|---|
| Assessment | **Monitoring** scientific situation/conditions | • Recognizing favorable environment<br>• Staffing decisions<br>• Displaying relevant data | • # of forecasters, EMs, Police Officers, Fire Fighters, TV met. at station<br>• Technology available – display capabilities, computers, comp. programs<br>• # of years' experience for staff/officers<br>• Degrees of TV met. and WFO forecasters | • NWS<br>• EM<br>• Fire<br>• Police<br>• TV |
| | **Interpreting** scientific information related to the environmental context | • Interpreting radar/velocity imagery<br>• Utilizing algorithms<br>• Analyzing surface observations and wx parameters<br>• Verifying ground reports using radar/velocity | Same resource considerations as above | • NWS<br>• EM<br>• Fire<br>• Police<br>• TV |
| | **Detecting** the threat/hazard | • "Chasing" hazard or watching through camera feed<br>• Detecting hazard development<br>• Calling in reports | Same resource considerations as above | • NWS<br>• Storm Spotters<br>• EM<br>• Fire<br>• Police<br>• TV |
| | **Deciding** to warn on the threat/hazard | • Discussion among forecasters or officials<br>• Decision made by supervising official | Same resource considerations as above | • NWS<br>• EM<br>• Fire<br>• Police<br>• TV |

Table 2: Conceptual Model Dissemination Component

| Component | Task | Activities | Resources | Actors |
|---|---|---|---|---|
| Dissemination | **Construction** of the warning message | • Filling out warning template with appropriate information<br>• Creating police loudspeaker message<br>• Creating text/graphics for broadcast | • Technology available – text templates, polygon drawing programs, graphics<br>• # of years of experience<br>• Degrees of mets | • NWS<br>• TV<br>• EM<br>• Police |
| | **Alert** public of warnings:<br>**Sub-tasks** | | | |
| | • Sound sirens | • Initiate sirens | • # of sirens<br>• Layout of sirens | • EM<br>• Police<br>• Fire |
| | • Initiate EAS | • Initiate EAS through NWR, radio stations or TV stations | • If there are participating TV stations | • NWS<br>• TV<br>• Radio |
| | • Broadcast of warning information and hazard information on radio/TV | • Deciding/Getting permission to break in<br>• Explaining graphics<br>• Describing situation, ground reports, hazard development | • Technology available – graphics, computers, programs, cameras<br>• # years' experience of TV met.<br>• # of TV met. | • TV<br>• Radio |
| | • Text/Call/Email public | • Initiate reverse 911 if available<br>• Call/email if system is available | • Capability to text, call, email<br>• Reliability of internet/phone | • TV<br>• EM |
| | • Post warning/info on websites | • Update website with info/graphics | • Capability to text, call, email<br>• Reliability of internet/phone | • NWS<br>• TV<br>• Radio<br>• EM |

### 1.2.1 Organizations/Actors

Though many organizations can be involved with the warning system, past research (Brouillette 1966, McLuckie 1970, Kueneman 1974, Carter 1979, Nigg 1995, Sorenson 2000) has focused on six core actors which are most integral. They are the National Weather Service (NWS) Weather Forecast Offices (WFO), the Office of Emergency Management (OEM), fire protection, law enforcement, TV stations, and radio stations. Across the studies listed above, these actors were fundamental to the functioning of the warning system and continually linked to one another. In other words, these organizations were in regular contact, their roles tended to intersect, and their goals were largely similar. Given the historical relevance of these organizations, as well as their continued importance, they will be the core actors examined in this study. It also must be noted that storm spotters have become increasingly important to the warning system. Storm spotters are not new, in fact they have been around since the 1940s; improved technologies in recent years have allowed them to become an integral part of the warning process. Enhanced communications and improved training have led to the transformation of these actors (Doswell, Moller and Brooks 1999). Because of the more recent developments impacting these actors, there has been little research on how they impact the system. For the above reasons, storm spotters will be a seventh core actor in this study. The following sections now describe each of the tasks these actors can be involved with.

### 1.2.2 Monitoring

Monitoring the scientific situation and conditions is one of the five assessment tasks that I include in my conceptual model. I consider monitoring to be the assessment of the overall conditions present in the atmosphere. During this task,

evaluation of the data occurs only to the extent needed for organization and understanding of the situation.  In other words, actors would be collecting data related to the hazard that may be needed at that moment or in the future.  They would also keep a close eye on the environment to monitor it for changes, giving them an early understanding of a situation in flux.  More in depth interpretation and analysis would take place within the interpreting task.  Two prior studies focus on what I consider monitoring; McLuckie 1970, Nigg 1995.  Concurrent with my definition, McLuckie (1970) describes it as the collection and evaluation of data.  His description differs from mine in that I see more detailed interpretation of the environmental context as a separate task, not one included in the monitoring phase.  Nigg (1995) defines monitoring as scientific modeling of the earth's processes and collection of data through various monitoring systems.  While her description also involves understanding the environment, it takes a more high-level approach.  In other words, Nigg includes the research done in universities and scientific institutions, including the development of theoretical models.  Since I intend to focus only on the more immediate warning period, I do not include these processes in the monitoring task.  On the other hand, Nigg also discusses the collection of data through barometers, thermometers, rain gauges, and others; I would consider this type of activity a part of monitoring.

In a tornado situation, monitoring would involve understanding the overall mesoscale environment for that day, which elements make it favorable for tornadic development, and the location and extent of the main threat.  Monitoring also involves displaying relevant meteorological data and information using available software.  Several actors could potentially be involved with this task:  NWS WFO, OEM, fire

fighters, law enforcement, and TV stations.  These actors have varying amounts of resources to use on this task as well as varying techniques.  Because weather monitoring is their main focus, WFOs arguably has the most suitable set of resources for this task, although the other actors are certainly capable of monitoring radar and velocity imagery, environmental cues, and current atmospheric observations if they have the knowledge and/or resources available to them.  TV stations at times have their own weather center and meteorologists, in which case their monitoring may be very similar to the way it is done at the WFO.

### 1.2.3   Interpreting Environmental Context

Another task associated with the assessment component of the warning system is the interpretation of the scientific information related to the environmental context. In my conceptual model, this is an important task related to but separate from monitoring.  While monitoring may be readying and recognizing the appropriate resources and data, interpreting involves the utilization of this data.  During this task, actors analyze the environment in and around the potential threat area, giving themselves a more in depth understanding of the situation.  This task requires a large amount of human interaction and expertise.  Actors must know how to use relevant data in order to forecast for an upcoming weather event or to understand an unfolding event.  Some research (Williams 1964, McLuckie 1970, Carter 1979) hints at interpretation, but groups it together with monitoring and evaluation.  Similar to my definition, Nigg (1995) notes that there may be an understanding in a scientific community of processes within the physical environment, but actors must then "interpret data in 'real time'" in order to develop a forecast and eventually a warning. Her description of interpretation begins to deviate from mine as she focuses on the

difficulty of the scientific community to predict events "with any degree of certainty."
Tailoring her description to an earthquake event, she goes on to discuss the ethical and
legal issues that can ensue when an event has high levels of uncertainty. While
weather-related events, such as tornadoes, hurricanes, and floods may never be fully
predictable, their forecasting techniques are much more established than those for
geologic events (volcanoes, earthquakes). My model is tailored to events under the
jurisdiction of NWS, thus the interpretation phase does not entail the long professional
review process that may go along with interpreting geological signals. Due to the time
sensitive nature of most weather-related hazards, these interpretation activities
generally do not allow for a multi-day, national level disagreement or controversy as a
part of the warning process.

In a tornado situation, the interpretation of the environmental context includes
a variety of activities. Analyzing the radar and velocity imagery can provide many
clues that a storm is either capable of producing a tornado or already producing one.
A forecaster or official may look at various levels of the storm to get a more complete,
3-dimensional view of it. Computer algorithms can also aid in the interpretation of the
imagery by notifying the user that there is a certain level of rotation being detected
within a storm. Other severe weather parameters can also be used to determine the
condition of the surrounding environment. Established parameters can indicate that
the storm is moving into a more favorable environment for tornado production. The
same actors involved in monitoring the system are also involved with the
interpretation of the data. Again these actors will have varying degrees of technical
knowledge and resources available to them. For instance, a police chief may only
have basic radar imagery available in his office and little meteorological knowledge.

His interpretation may be as simple as noticing a dangerous storm cell on radar and observing the changing environment outside. On the other hand, a forecaster may apply their knowledge of the atmosphere by recognizing a key radar signature and optimal surface conditions. In other words, these actors may have different levels of expertise, but are still working on the same task of interpretation.

### 1.2.4   Detecting

Another important task associated with assessment is the detection of the hazard or threat. While interpreting the environmental context involves analyzing the broader situation, detection involves officially understanding and labeling the storm cell or storm system a real threat. Up until this task the potential hazard is not yet formally being considered for warning purposes. In my conceptual model, detection can come in many forms. It could be as simple as a visual confirmation of the hazard from a camera feed or ground report, but more times than not first detection comes indirectly through scientific monitoring and interpreting. In other words detection can occur on a computer screen tens or even hundreds of miles away from the threat. Past research (Williams 1964, Quarantelli 1990, Sorenson 2000) has made mention of detection as a part of the warning system, but either view it as part of the monitoring and/or interpreting phases or state that it occurs without going into further detail on its theoretical implications. This may overlook some of the nuances surrounding detection leaving gaps in our understanding of this step in the warning process.

Relating this task to a tornado event, detection means recognizing the tornado or the storm capable of producing one. Depending on the actor and the circumstance, the tornadic storm could be detected through the use of radar and velocity imagery, live camera feeds, and visual confirmation. In some cases, a tornado may not yet be

on the ground but the actor detects strong low level rotation within the storm and deems it capable of producing a tornado in the immediate future. In other cases, an actor may be "chasing" a storm and actually watch the tornado form. Either way, visual detection can verify and enhance radar and velocity detection. The actors involved with these activities may be the same as those for monitoring and interpreting with one addition, storm spotters. These trained members of the public can play a large role in the detection of tornadic storms, because they are one of the only actors capable of spending large amounts of time following and watching these storms in person even if they may not have the time available to "chase" these storms directly. Most other actors have the computing resources available to detect the hazard remotely. Some TV stations may even have cameras set up around the area allowing them to have a visual representation of the storm in their offices.

### 1.2.5 Deciding

During the assessment phase there comes a point when the actors must make the decision to warn the public of the hazard. I see this as its own distinct task given that there must be a conscious decision made before the creation and dissemination of the warning can actually occur. If it were melded with either the warning construction task or the interpreting task, many of the details and intricacies of the decision process would be overlooked or simplified. The decision to warn can be made by various actors and organizations. The NWS WFO may not officially post a warning even as the local TV station feels that the situation is dangerous and warrants alerting their viewers. In this hypothetical case, the NWS made the decision not to warn, while the TV station made the decision to warn. In general, an important choice such as this is made by a supervising official of the organization after deliberation and discussion

with others in their office. Throughout the warning system literature most studies also allude to this task (Williams 1964, McLuckie 1970, Carter 1979, Quarantelli 1990, Nigg 1995), but generally combine it with the issuing and/or dissemination tasks. On the other hand, Williams (1964) and McLuckie (1970) see it as a separate task and describe it in a way that coincides with my own definition. He mentions the serious consequences surrounding the decision to warn or not to warn on a potential threat. It is not a decision that is generally made lightly; the costs are weighed and considered. He also makes the important point that the decision to warn can be made by multiple actors. It is not always clear whose responsibility it is to make this decision and many times one organization will feel the need to warn while another may not. Williams limits his discussion to a couple paragraphs, but also points out that the current situation and the consequences to warning must be evaluated as actors make their decision.

In the case of a tornado, the actors are again the same as those involved with the monitoring and interpreting tasks. Currently, policy states that NWS WFOs are the only actors that can create an official warning. Despite this, warning is at the discretion of the TV stations, OEMs, or fire and police officials to decide if a situation warrants a public alert. In other words, there is no national law that bars the other actors from alerting the public of a potentially dangerous situation even if the local NWS WFO has not yet warned on the weather system.

### 1.2.6 Construction

Once the decision has been made to warn on a storm, the actor/s move into the dissemination phase of the warning system. In my conceptual model, construction of the warning message involves the actual creation of the written, spoken, or drawn alert

before it's given to the public.  By focusing on the activities involved in warning

construction, the primary actors, and their communication and collaboration during

this process, my model offers the opportunity to better understand the organizational

aspects of this task.  In agreement with my model, nearly all warning system literature

(McLuckie 1970, Carter 1979, Quarantelli 1990, Nigg 1995, Sorenson 2000) explicitly

states or at least hints at the existence of a construction task within the system.  On the

other hand, most of these studies diverge from my description by framing their

discussion in terms of public response.  They discuss the most effective wording and

content to move the public to action.  Nigg (1995) also details some popular response

myths, as well as known public response behavior.

In a tornado situation, the actors potentially involved in this task are NWS

WFO, OEM, law enforcement, radio stations, and TV stations.  Depending on the

actor, this task will involve varying sets of activities.  For instance, a WFO forecaster

may fill out a pre-made warning template with the information unique to the specific

storm they're warning on.  Along with this, they may draw a warning polygon over the

area they believe will most likely be affected by the tornado.  A TV station

meteorologist may decide on the graphics and message he/she will want presented on-

air.

### 1.2.7    Alerting/Warning

A warning is useless unless it is eventually used to alert the public of the

impending hazard.  I describe this task as the physical transmission of the message to

the public.  My model focuses on the activities involved with alerting the public, as

well as the communications and resources used among actors during this time.

Several studies have focused on this task, but tend to diverge from my description in

various ways.  Nigg (1995) focuses mainly on the conversion from scientific to user-friendly messages when explaining this task, while I see this as a part of the construction task rather than the alerting task.  Similarly, Sorenson (2000) takes a more technical approach and focuses on descriptions and evaluations of the technologies and techniques available for alerting the public.  McLuckie (1970) and Williams (1964) discuss the various modes of communication (face-to-face, telephone, mechanical) and their corresponding effectiveness in various situations.  Essentially, much of this discussion centers on success of different communication methods given the characteristics of the affected population and the type of hazard.  My description of the task does not focus on the effectiveness of various methods or the public use of the alert, but instead focuses on the inter-organizational and intra-organizational activities involved in alerting.  In order to better describe this task, I find it is useful to separate it into several different sub-tasks.  By doing this, it is possible to see the communicational nuisances and resource needs specific to each type.  Each sub-task represents a different method of alerting the public.  These sub-tasks are essentially different warning channels.  Depending on the type of hazard, these warning channels may vary slightly.

Using the example of a tornado situation, alerting comes in many different forms.  Some communities have a network of sirens that they use to alert the public.  In this case, the only activity involved is to actually sound the sirens.  This can be done by the OEM, fire fighters, or law enforcement, depending on the community set-up.  The emergency alert system (EAS) is our nation's official alert system.  This is initiated through NOAA weather radio (NWR) and participating TV and radio stations when an official NWS warning has been issued.  One of the most common and

14

efficient methods of alerting the public is through the radio or televised broadcast of warning and storm information.  Decisions within the TV station must be made as to when to break-in to regularly scheduled programming to present this information.  Graphics must also be explained and the emergency situation itself must be described.  Some communities have ways to text, call, or email the public in the event of tornado.  This may mean initiating a reverse 911 for the area affected.  It may also mean texting, calling, or emailing those subscribed to let them know their area may be in danger.  Depending on the community these tasks generally fall to the TV stations or the OEM.  Yet another method involves posting information on a relevant website.  This could be the NWS WFOs official website, a TV or radio website, or an OEMs website.  In this case, someone must update the website with important information on the warning and storm.

### 1.2.8  Updating within Tasks

Though rarely mentioned, the updating of storm information for an ongoing event is an important part of the tornado warning system.  Information and data during each task must be continually renewed and adjusted.  In the case of a tornado situation, this may be most prominent in situations involving multiple tornadoes and/or long track tornadoes in which it is imperative that information is always kept current.  For instance, during a long track tornado actors would want to continue detecting and watching the storm for signs of weakening, strengthening, or direction change.  They would also want to continue updating the surface observations and severe storm parameters to understand the atmosphere the storm is moving into.  Actors would also have to update their decision to continue or discontinue a warning on the storm or in the case of multiple tornadoes, make new decisions to warn on a more recently formed

15

storm. The warning message must also be revised and the alerts to the public must be updated. For instance, the same warning message may not suffice throughout the whole lifecycle of the storm. The content, such as geographical area, storm intensity, and storm speed may change in which case the message must be adjusted so the public will ultimately get the most relevant information. All sub-tasks within the alerting task must also be updated in order to reflect the most current situation. Broadcast of the warning and storm information must evolve to include new details. A storm may be shifting to the right so in this case those broadcasting the information must update their graphics and description to reflect this change in direction.

### 1.2.9 Resources

The warning system and its various tasks and activities can be affected by the resources available to the actors and organizations. These resources may be human, intellectual, or technological. In terms of human resources, an OEM may have only a couple employees, whereas another office may have a dozen. Similarly, WFOs and TV stations may have differing numbers of forecasters. Each organization may also have different intellectual resources. This means the number of years of experience the forecasters have or the degree held by the TV weather reporter. It may also mean the employees' level of expertise with regards to a certain hazard or technology. For instance, a police officer will most likely not have as much weather expertise as a professional forecaster. In terms of technological resources, NWS WFOs have available to them sophisticated computer programs and tools, as well as specific warning creation technology. TV stations will also have their own technology, but depending on funding, they may have differing levels of computing capabilities and forecasting tools. Emergency managers, police officers, and fire fighters may also

have computers available to examine radar imagery or communicate amongst other officials.

### 1.2.10  Integrated Nature of the Model

It is important to note that I do not list the above tasks and activities in a chronological order viewing them as something to be completed in order to get to the next step.  In reality it is not practical to assume that every actor will complete the tasks as if they were steps, unable to move to the next if the current one wasn't completed.  By putting the parts of the system in a certain order, we would be limiting our ability to fully understanding the complexities of the process.  Instead the tasks within my model can occur in any order with some even occurring at the same time.  For instance, a storm capable of producing a tornado may be detected so the actor then begins interpreting the conditions ahead of the storm to determine if it is moving into an area favorable for further development.  Some actors may only detect the storm, but never go through the monitoring task at all.  So, the tasks within this model are not a linear progression of steps, but instead an ongoing, integrated process.  In the same way, the actors and organizations involved communicate vertically and horizontally within and across the various tasks and activities.  These characteristics were drawn from the idea of an integrated warning system, which has been discussed multiple times in past literature.  The following paragraph summarizes some of these findings.

Sorenson (2000) describes integration as "the melding of scientific monitoring and detection with an emergency organization that utilizes warning technologies coupled with social design factors to rapidly issue an alert…."  He notes that even if all the individual components are working perfectly, a lack of integration can still cause the system to become ineffective.  Similarly, Nigg (1995) asserts that all the

actors and organizations involved in a warning system "must be linked through an interactive process in order to effectively disseminate warning messages to the general public." She goes on to suggest the importance of intergovernmental planning, coordination, and communication among the different parts of the system. Carter (1979) also insists that "an effective warning system…depends in large part on the existence of reliable communication linkages."

Chapter 1 sought to develop and describe a conceptual model of the weather warning system. Using personal experiences and correspondences, as well as relevant literature, I proposed a set of tasks and activities within the assessment and dissemination components of the system. Building from this base, chapter 2 seeks to explore the inter- and intra-organizational dynamics that develop as actors and organizations go about performing these activities.

# Chapter 2

# ORGANIZATIONAL CULTURE

## 2.1   Evolution of Culture among Organizations and Actors in Warning Systems

Beyond tasks and activities, I'm also interested in the more organizational aspects of the warning system.  Chapter 2 will address how the organizations and actors described in the previous chapter communicate, interact, and work with one another.  Building off of disaster subculture literature, I begin by exploring the idea that a certain culture will have developed among and within the warning system organizations regardless of hazard impact.  I then expand upon this notion by reviewing relevant inter- and intra-organizational relationship literature in order to explore more specific characteristics of an area with a frequent hazard.

Due to the nature of the warning system, the actors and organizations involved will have developed a certain dynamic or disaster culture amongst themselves regardless of external factors.  To some degree and in some fashion they interact during the warning process.  Certain physical characteristics of the area in which the warning system operates can impact this dynamic.  Specifically, repetitive impacts from the same hazard followed by consequential damage can lead to an evolution of the inter- and intra-organizational culture.  This dissertation examines the variations between warning systems operating in two different types of areas; one meeting this hazard impact criteria (repetitive hazard, substantial damage) and one in which these criteria do not apply.  I am interested in how the communication structure, the roles and influence of the actors, and the available resources and their uses would differ

among the two systems. These themes will be examined in the context of the conceptual model previously described. The following sections will review relevant literature in an effort to articulate several research propositions.

Previous studies (Moore 1964, Wenger and Weller 1973) have directly considered the possible impact of frequent hazards on an area. Specifically, they have utilized the idea of subculture. This concept has existed in the sociological community for decades. It is defined as "the culture of groups whose values and norms of behavior differ to some degree from those of the dominant culture (Anderson and Taylor 2011)." The people within these subcultures tend to share common values and views on a subject while still coexisting within the dominant culture. Some typical examples include the emergence of rap and hip-hop music as a means used by younger blacks to develop "their own style of dress and music to articulate their resistance to the dominant white culture (Anderson and Taylor 2011)." A more extreme example would be that of the Amish, who live as separately as possible from the dominant culture due to differences in values and beliefs. Researchers have discovered the applicability of this basic sociological concept to certain areas of disaster research. When examining an area frequently exposed to storms, Moore remarks that the concept of disaster culture "would include those adjustments, actual and potential, social, psychological and physical, which are used by residents of such areas in their efforts to cope (Moore 1964)." The existence of a subculture can thus manifest itself in certain elements of the community. These manifestations can be individualistic and organizational. Individualistic aspects encompass changes in how the public may prepare for, think about, or respond to the hazard. Certain beliefs may also evolve. These could range from a "we can get through anything" attitude to

myths derived from folklore about past events. On the other hand, organizational manifestations relate to how community organizations prepare for and respond to an event. Wenger and Weller (1973) found that "in the absence of a disaster subculture, disaster preparedness was not seen as a legitimate obligation for all disaster-relevant organizations." They then suggest that the development of a subculture may actually bring about a more widespread community commitment that would legitimize stronger preparedness. They found that the subculture could help communities determine what is important during a disaster situation by placing higher value on certain activities. Subculture could also affect how the hazard is perceived and what types of actions are supposed to take place in certain situations. As may be expected, an area with a subculture may have developed specific knowledge regarding the warning, hazard, and appropriate actions to take. Along with this, refined technology may develop that aids in the detection and warning of the hazard, as well as its mitigation (Wenger and Weller 1973).

The subculture literature suggests that a frequent, damaging hazard could lead to a greater community wide commitment as well as a stronger understanding of community needs and preparedness. Inter- and intra-organizational communication/coordination literature tends to reinforce this assertion. It also presents the opportunity to broaden and expand upon it. With this in mind, the following section will review relevant inter- and intra-organizational relationship literature in order to further explore expected characteristics of a locale with a recurrent hazard.

## 2.2 Communication/Coordination Structure

It's obvious to those who have studied warning systems; communication and integration are major aspects of the analysis. I am interested in the communications among and within organizations both across the various tasks as well as within the tasks. Weller and Kreps (1970) suggest that there are two types of relationships among organizations: coordinating and facilitating. The former is associated with decision-making, the giving of instructions, and divisions of labor. The latter involves one organization supplying resources to help another organization achieve its goals. Coordinating usually involves the exchanging of information and instructions, whereas facilitating involves exchanging not just information but also materials. Weller adds a third relationship, mediating, that refers to the links between the organizations involved, for instance radio systems or internet. Because there is most often an exchange of information rather than materials during the warning stage, coordinating and mediating relationships are most relevant to this proposed study. Additionally, organizations connected by similar responsibilities and/or goals, "Organizational sets," can develop leading to more regular interactions with one another. Weller even uses the example of the Weather Bureau, fire department, and radio and TV stations to describe and organizational set that may develop during the warning phase. For the current study, it is assumed that an "organizational set" develops between the actors and organizations described in the previous section given that they share similar tasks and activities during the assessment and dissemination phases (Weller and Kreps, 1970).

There tends to be two main theories on how these inter-organizational relationships (IR) develop, exchange theory and power-dependency theory (Schmidt and Kochan, 1977). Levine and White (1961) define exchange theory as "any

voluntary activity between two organizations which has consequences, actual or anticipated, for the realization of their respective goals or objectives." Exchange theory states that relations with other organizations maximize the benefits and goal attainment of each actor. On the other hand, power-dependency theory focuses on one organizations power or influence over another. In this case relations are more asymmetrical where one organization may see benefits from an IR but the other does not (Schmidt, 1977). Independent of the geographical area, the organizations within the warning system mutually benefit from working together in some way. Similarly, these organizations should have no need to exert power over or aggressively pursue another organization within the warning system. The organizations within the warning system are part of an "organizational set" in which the relationships among them are developed due to the mutual benefit of exchange of information. Furthermore the relationships tend to focus on the exchange of information rather than physical materials. Given these reasons, it is reasonable to assume that the general relations among the organizations involved in the warning system are best described by exchange theory.

I propose that an evolution of culture may be apparent in the nature and extent of the coordination and information exchange. Literature on IR (Levine and White 1961, Hall et al. 1977, Van De Ven et al. 1979, Van De Ven and Walker 1984) agrees that having consensus on ideologies and domains fosters communications and coordination between organizations. In other words, organizations that share similar ideologies, and understand and respect each other's domain will tend to communicate and coordinate more often. Organizations in an area that experiences frequent impacts from the same hazard will have had to work with each other more often and in more

continually stressful circumstances. These organizations would thus grow to share similar concerns, goals, and ideas when it comes to protecting their community. They would also develop a better understanding of each organizations expertise and domain. Rogers and Whetten (1982) list "common commitment," "agreement on domains/value of coordination," and "good historical relations with other organizations" as facilitators of inter-organizational coordination. Walton (1972) also notes that conflict over domain or identity can hinder interdependence among the organizations within the set. Literature on community of practice (CoP) tends to support these views as well. A community of practice is an organization or set of organizations that are characterized by "mutual engagement, shared repertoire, and negotiation of a joint enterprise (Iverson 2011, p. 39)." Warning system organizations all work together to some degree, but organizations experiencing regular hazard impacts have had more opportunity to collaborate in similar circumstances and develop stronger community goals. They have learned to interact with each other regarding managing the community hazard, share specialized knowledge with each other regularly, and articulate and act upon the common goal of warning their community of the hazard. Assuming organizations with this type of dynamic can be considered a CoP or at the very least similar in nature, characteristics of communication within CoPs should be relevant to the discussion. In a CoP, discussion and informal communication among the members is fostered and information and knowledge is readily shared. Learning from one another is important and members tend to have mutual respect for each other's expertise (Wenger et al., 2002). Drawing upon previous IR, CoP, and subculture literature, I have developed several research propositions with regards to inter-organizational communication.

When comparing an area frequented by the same, damaging hazard with an area that does not fit this criteria...

1.    …communications among organizations will be more frequent.

2.    …communications among organizations will be more two-way rather than one-way...

3.    … communication among organizations will also be more frequent during normal times...

The types of exchanges among organizations can vary.  They can be voluntary, mandatory, or formalized voluntary.  Mandatory exchanges are generally not applicable to the warning system because coordination among the various organizations is not mandated by law.  Voluntary exchanges are the most informal and may simply be a quick phone call to a friend in another organization.  Formalized voluntary exchanges can still be informal in nature, but some sort of formal spoken or written agreement exists among the organizations (Hall et al., 1977).  Organizations in area with a recurrent hazard will have worked with each other frequently in similar situations.  Thus, they will have had more of an opportunity and need to develop more formal communications and agreements.  Similarly, Warheit (1970) suggests that plans in "disaster prone" areas tend to have more functional, less superficial plans. With this in mind, I articulate two more research propositions with regards to the nature of the inter-organizational communication:

When comparing an area frequented by the same, damaging hazard with an area that does not fit this criteria...

4.    …the plan of communications/coordination will be more formal/developed.

5. …the plan will be more known, understood, and utilized by members of the organizations.

Not only is communication among organizations important within the warning system, but also communication within organizations. Just as with inter-organizational communications, intra-organizational relations will be more practiced an area with frequent hazards. Many of the same principles discussed above can apply to intra-organizational communication. Greater use of one another's knowledge, greater exchange of information, and more collaboration are all expected. With this in mind, I developed several research propositions regarding intra-organizational communication:

When comparing an area frequented by the same, damaging hazard with an area that does not fit this criteria...

6. … communications within organizations will be more frequent.

7. …communications within organizations will be more two-way rather than one-way

## 2.3    Roles, Domain, and Influence

Actors have set roles in accordance with their position at their organization, but they may also have more informal roles that they take on during the warning process. In the same way, each organization may have formal or informal roles within the organizational set during the warning process. As discussed above, organizations in an area with a recurrent hazard are expected to have developed a mutual understanding of each other's domains during the warning process. The "kinks" have been worked out over time and through practice. Individuals within an organization and organizations within an organizational set have come to learn and accept the strengths

26

and weaknesses of each. Trust will have also developed, perhaps in a different way than it would in an area without a frequent hazard. In a circumstance where there is "unconditional trust" among the organizations or members, "shared values now structure the social situation and become the primary vehicle through which those individuals experience trust (Jones and George, 1998 p. 536)." This is not meant to be the type of 'unconditional trust' seen in a personal relationship, but simply a term to illustrate an organizational trust that is not contingent upon any specific criteria or situations. Because the existence of a shared, frequent hazard leads to a common goal and greater community wide commitment, it's probable that during the warning process this 'unconditional trust' described by Jones and George 1998 exists among the organizations or at least members within organizations. On the other hand, organizations and actors in an area without this recurrent hazard binding them together would most likely exhibit "conditional trust," in which "both parties are willing to transact with each other, as long as each behaves appropriately (Jones and George, 1998 p. 536)." It is enough to allow for future interactions, but the development of relationships and identity is much shallower. In general, unconditional trust leads to "interpersonal cooperation and teamwork and the strong desires of team members to contribute to the common good (Jones and George, 1998 p. 539)." Unconditional trust affects certain aspects of organizations and their members. They are likely to define their roles more broadly and "include whatever acts they are capable of performing that contribute to common goals and raise performance (Jones and George, 1998 p. 540)." It is also common to see communal relationships, high confidence in others, free exchange of information, and help-seeking behavior. Given the literature reviewed in the previous sections, as well as the characteristics of unconditional trust

discussed above, I propose several research propositions regarding roles, domain, and influence during the warning process:

When comparing an area frequented by the same, damaging hazard with an area that does not fit this criteria...

8. ...members within each organization are more willing/capable of going beyond their normal/set roles.

9. ... organizations will have a clearer understanding of the roles of the other organizations during the warning process.

10. ... organizations will feel more comfortable going beyond their normal time roles.

11. ... TV station meteorologist/s will take on more of a leadership/expert role within the station during an event.

12. ...there will be less centralization of authority within each of the organizations during the warning process.

13. ...there will be more collaboration between actors within each organization especially during times of decision-making and interpretation.

14. ...the NWS will have more influence over the other organizations during the warning process. In other words, the NWS will be more respected as an expert opinion.

15. ...a specific organization will act as the leader or organizer for the storm spotter network.

## 2.4   Resources

Available resources and their uses are an important aspect of the warning system. Many of the concepts discussed in the communications section above are

relevant to resources as well. Exchange theory implies that much of the communications among organizations is spurred on by the exchange of resources. In the case of the warning system these resources are primarily intellectual. If organizations in areas experiencing a hazard regularly tend to have more frequent communications, it is reasonable to assume more intellectual resources are also transferred.

When comparing an area frequented by the same, damaging hazard with an area that does not fit this criteria...

16. …there will be a greater transfer of intellectual resources between organizations.

17. …the organizations will make more use of the NWS chatroom.

Furthermore, these professional communities tend to unite with a common goal. Emergency operations and plans will be seen as a more legitimate community priority (Wenger and Weller 1973). Organizations within the warning system will have become more accustomed to stressful situations and frequent hazards.

When comparing an area frequented by the same, damaging hazard with an area that does not fit this criteria...

18. …there will be more full time, rather than volunteer employees within the OEMs and fire departments.

19. …there will be a more extensive storm spotter network.

a. ...the storm spotter network will be used more frequently.

Not only will human resources be affected, but also technological resources. Again, organizations will have become accustomed to dealing with a frequent hazard and in turn learned to adapt to it. The OEM will have a more

developed knowledge of the hazard since it would be one of the more frequent emergencies they experience. It is expected that they will become a larger part of the assessment period and thus have more of a need for technological resources to aid in monitoring, detecting, and interpreting.

When comparing an area frequented by the same, damaging hazard with an area that does not fit this criteria...

20. ...there will be more technological resources available to the OEM.

The dissemination of the warning will also have been repeated and practiced numerous times in an area with a frequent, damaging hazard. Adaptation during this component of the system is also sure to develop. Dissemination technologies will expand and agreements on how they are used will become more refined.

When comparing an area frequented by the same, damaging hazard with an area that does not fit this criteria...

21. ...there will be a greater selection of warning channels available to each organization.

22. ...there will be a clearer understanding/agreement over how the warning channels are used and by whom.

Chapter 2 explored the concept of disaster subculture as applied to an evolution of culture among warning system organizations. This literature suggested that a frequent, damaging hazard could lead to a greater community wide commitment as well as a stronger understanding of community needs and preparedness. Beyond this, I was also interested in the more detailed characteristics of an area with recurrent impacts. Drawing from inter- and intra-organizational relationship literature, I

30

proposed a set of propositions focusing on the nature and frequency of communications, roles and influence, and availability and use of resources. Chapter 3 will describe the case selection, data collection and coding processes used to address these concepts.

# Chapter 3

## METHODS

### 3.1    Overview

In order to address the above research propositions, I used a multiple case study design.  According to Yin (2009), "how" and "why" questions tend to lend themselves to case study research.  My general research question fits this profile: How does a frequent, damaging hazard affect the culture among and within organizations that are a part of the warning system?  Furthermore, Yin (2009) states that the case study method "allows investigators to retain the holistic and meaningful characteristics of real-life events."  While I am not investigating a single, specific event, I am attempting to deepen our understanding of an important phenomenon.  My work will investigate complex interactions and processes within the warning system for which there is a limited existing knowledge base.  It is necessary to explore these concepts in great detail to sufficiently build this base and allow for more generalizable studies in the future.  Case studies allow the researcher to do just that by examining their subject at a level of depth that is not possible with other methods.

This dissertation can be considered an exploratory study in part since there is little existing literature addressing the warning system.  Consequently I drew from personal experience and correspondences to supplement the limited empirical base. Exploration of this model required openness to the possibility that component, themes, and nuances not yet represented may become evident during data collection and analysis.  I also entered analysis with the expectation that despite careful development

of logical assertions some aspects of my model may not prove to be as relevant or accurate when viewed empirically. On the other hand, this research is also explanatory (causal), in that I hypothesized an effect of a frequent hazard on organizations within a warning system. Wenger and Weller (1973) were some of the first to note the possibility that a recurrent hazard could affect the way a community operates. For this reason I will use their criteria for what it specifically means to be impacted by a frequent hazard. An area must experience "repetitive disaster impacts (9)" from the same agent. That agent must also "allow for some period of forewarning (9)" and result in consequential damage, significant to the whole community (Wenger and Weller, 1973). A multiple case study design can be ideal for both types of research. Both exploratory and explanatory studies benefit from the enhanced validity that replication can provide.

## 3.2   Case Selection

Explanatory studies that are causal in nature benefit from at least two cases that can be compared (Yin, 2009). For these reasons, I chose four cases. When considering the selection of my case locations, I employed theoretical sampling explained by Strauss and Corbin (1998) as a way to "maximize opportunities to discover variations among concepts and to densify categories in terms of their properties and dimensions" (p.201). In other words, I selected my cases based on their "potential manifestation or representation of important theoretical constructs" (Patton, 2001, p. 238). For instance, two of the cases experience frequent hazard impacts and two do not. All regions of the US experience some form of weather hazards; it is not necessary to this study to find cases that experience no hazard at all. Instead, I compared areas that meet the above Wenger and Weller criteria with areas

that do not fully meet it. In other words, all four cases experience some amount of rapid-onset weather hazards, but only two repeatedly incur significant damage from tornadoes.

Aside from the frequency of hazards, there are other considerations I also took into account when choosing my cases. For my case study areas I am using WFO regions. In particular much of the analysis will be focused on the main city for which they service. Because one of my core organizations is an OEM, I ensured that an OEM exists within the county or primary city or for which the WFO serves. Finally, the population of the main city can also greatly influence the funding available to warning system organizations. For this reason, the main cities for all four cases have populations between 350,000 and 650,000. The following sections describe each chosen case area. Table 3 provides a summary of the case selection.

Table 3:      Case Selection Summary

| Case | Frequent Hazard | Population |
|---|---|---|
| Wichita, KS | Yes (Tornado) | 380,000 |
| Nashville, TN | Yes (Tornado/Severe) | 620,000 |
| Raleigh, NC | No | 400,000 |
| Portland, OR | No | 600,000 |

## 3.3    Frequent Hazard Cases

### 3.3.1   Wichita WFO

Wichita, KS and the areas surrounding it have been experiencing damaging tornadoes for decades. Over the past 20 years, when normalized by area, Kansas has received the second highest amount of tornadoes of all the states (National Climatic

Data Center).  This hazard has also caused repeated significant damage.  As a combined total over the last 50 years, Kansas incurred the highest cost per capita for tornado damage of all states.  Similarly, Kansas is ranked 3rd for tornado fatalities (Geography Statistics).  It is clear that Wichita is an area that experiences repeated impacts from a destructive hazard.  Wichita also meets the population criteria with approximately 380,000 people living within the city.  For these reasons the Wichita WFO and the surrounding area will serve as the other "frequent hazard" case.

### 3.3.2   Nashville WFO

Nashville, TN can also be considered an area with a "frequent hazard."  Over the past 20 years, Tennessee ranks 15th for number of tornadoes by area when compared to all other states.  In addition, Tennessee ranks 1st for number of strong tornadoes (EF3 to EF5) by area (National Climatic Data Center).  With regards to damage, Tennessee falls close to the middle of the State rankings (26th) for total damage costs per capita over the past 50 years.  On the other hand, it ranks 8th for tornado fatalities per capita and 12th for tornado injuries per capita (Geography Statistics).  Given these statistics, it can be said that Tennessee and consequently Nashville experiences frequent impacts from the same damaging hazard.  The city of Nashville also meets the population criteria with approximately 620,000 people residing in it.  For these reasons the Nashville WFO and the surrounding area will serve as one of my "frequent hazard" cases.

### 3.4    Non-Frequent Hazard Cases

### 3.4.1    Raleigh WFO

Although, North Carolina gets its fair share of hazards each year, it doesn't have one particular agent affecting it repeatedly.  While North Carolina has a similar ranking as Tennessee for number of tornadoes by area, it ranks much lower (bottom half) for number of strong tornadoes (EF3 to EF5) by area (National Climatic Data Center).  In addition, this state does not experience repeated consequential damage from tornadoes when compared to the other states.  It ranks in the bottom half for injuries and damage costs per capita (Geography Statistics).  Of the states that experience tropical systems, it is also ranked as one of the lowest for hurricane impacts.  Furthermore, the Raleigh WFO is entirely inland and thus does not generally experience the level of surge and wind impacts felt by the coastal areas. While North Carolina also experiences other hazards such as flooding, winter weather, and wildfires, none occur on a substantially regular basis when compared to other states in the US.  The city of Raleigh also falls within the criteria for population size, approximately 400,000.

### 3.4.2    Portland WFO

While Oregon has also been affected by many hazards over the years, it does not have one specific hazard impacting it on a regular basis.  When normalized by area, Oregon has received the second lowest amount of tornadoes over the past 20 years (National Climatic Data Center).  In addition, it ranks 32nd for total per capita tornado damage.  Oregon also ties several other states for the least number of tornado injuries and fatalities per capita (Geography Statistics).  While it does rank slightly above average for total flood damage, much of this statistic is due to a single flood

event in 1996 rather than repeated impacts. If this year is excluded from the average, Oregon ranks in the bottom 25% for total flood damage when compared to the other states (States Data Set). Portland also meets the population criteria with nearly 600,000 people.

## 3.5   Data Collection

Yin (2009) described three 'principles' of data collection for case study research: "1) Using multiple, not just single, sources of evidence; 2) Creating a case study database; and 3) Maintaining a chain of evidence" (p. 101). The data used in this analysis was obtained primarily through in-depth phone interviews. The interview questions addressed the research propositions in the context of the warning system model described above. They focused on general tasks and activities performed by the employees, inter- and intra- organizational communication, understanding of roles and leadership, and the transfer and use of resources. In addition to the qualitative interviews, I sent out an email survey[2] to each organization focusing on human and technological resources. Since I was only able to utilize two forms of data collection, I attempted to strengthen the construct validity within my interviews by speaking with two representatives from each organization. This allowed me to sample different perspectives to reduce subjectivity and provide a more complete understanding of the organization. For consistency, I tried to reach actors with the specific position titles listed in Table 4. This was not possible in every case and some adjustments were made, as will be described in Table 5. There was a full length interview[3], focused on

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[2] See Appendix C

[3] See Appendix A

both inter- and intra- organizational relations intended for a person of leadership within the organization and an abbreviated interview[4], focused only on intra-organizational relations intended for a general employee. When possible, I chose interviewees that had been at their respective location for at least 5 years, to ensure that they know their organization well and fully understand the culture and context that the office functions in. Of the 48 interviews attempted, I was able to successfully obtain 38. One organization declined a phone interview, but consented to a short email questionnaire with four broad questions. A breakdown of interview participation for each case is shown in Table 5. Permission was giving for the majority of interviews to be recorded, but six preferred it to be unrecorded. For these, I took extensive notes during the interview.

To address Yin's second and third principles, I transcribed all interviews and loaded them into Atlas.ti before analysis. I then recorded all notes prior to and throughout coding with the use of memos within Atlas.ti. A document logging the coding and analysis process was also created. It served as part of the database and as a "chain of evidence" describing my analysis from initial memoing to final theoretical concepts. I recorded my thoughts and decisions as I worked through the creation of and adjustments to codes. Details of the memos, codes, and analysis will be described in the following section.

Table 4:     Sampling methodology for interviews

| Organization | Actor | Interview Type |
|---|---|---|
| NWS WFO | Warning Coordination Meteorologist | Full |

[4] See Appendix B

| | Forecaster | Abbreviated |
|---|---|---|
| **OEM** | Director/Chief | Full |
| | Emergency Manager | Abbreviated |
| **Fire Protection** | Fire Chief | Full |
| | Fire Fighter | Abbreviated |
| **Law Enforcement** | Sheriff or Chief of Police | Full |
| | Police Officer | Abbreviated |
| **TV Station** | General Manager | Full |
| | Meteorologist | Abbreviated |
| **Radio Station** | Manager or Producer | Full |
| | On-air Personality | Abbreviated |
| **Storm Spotter Network**[5] | Storm Spotter Organizer | Full |

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[5] A storm spotter leader may not exist; someone is not always specifically assigned to oversee this. If there is a leader/organizer, this person is almost always someone from within one of the other six organizations or a storm spotter within the network. If it is a storm spotter, this will be the person I speak to about both inter- and intra-organizational relations. If it's someone in another organizations, I will provide an abbreviated interview (or add a few questions to the already assigned interview) for this person addressing issues specifically related to managing the network and its relations with other organizations.

Table 5:      Summary of interview participation

| Case | Actor | Participation |
|---|---|---|
| **Nashville** | NWS Anonymous Representative | Yes |
| | NWS - Forecaster | Yes |
| | Senior Emergency Manager | Yes |
| | OEM - Operations Officer | Yes |
| | Fire Chief | Email questionnaire |
| | Fire Fighter | No |
| | Police Chief | Yes |
| | Police Officer | Yes |
| | TV - News Director | Yes |
| | TV - Meteorologist | Yes |
| | Radio - Program Director | Yes |
| | Radio - On-air Personality | Unable to contact |
| | Storm Spotter Organizer | NWS organize |
| **Wichita** | NWS - Warning Coordination Met. (WCM) | Yes |
| | NWS - Forecaster | Yes |
| | EM Director (County level) | Yes |
| | EM Deputy Director | Yes |
| | Fire Station Anonymous Representative | Yes |
| | Fire Fighter | Yes |
| | Police Captain | Yes |
| | Police Officer | Unable to contact |
| | TV - Executive Producer | Yes |
| | TV - Meteorologist | Yes |
| | Radio - News Director | Yes |
| | Radio - Reporter/Anchor | Yes |
| | Storm Spotter Organizer | EM organize, NWS train |
| **Raleigh** | NWS Anonymous Representative | Yes |
| | NWS - Forecaster | Yes |
| | EM Director (County level) | Yes |
| | EM Specialist | Yes |
| | Fire Chief | Yes |
| | Fire Fighter | Yes |
| | Chief of Police | No |

| | Police Officer | No |
|---|---|---|
| | TV - News Producer | Yes |
| | TV - Meteorologist | Yes |
| | Radio Anonymous Representative | Yes |
| | Radio - Assistant Program Director | Yes |
| | Storm Spotter Organizer | EM organize |
| **Portland** | NWS - WCM | Yes |
| | NWS - Forecaster | Yes |
| | EM Operations Manager (City level) | Yes |
| | EM Software Administrator | Yes |
| | Fire - Public Information Officer | Yes |
| | Fire Fighter | Yes |
| | Police - Public Information Officer | Yes |
| | Police Officer | No |
| | TV - General Manager | No |
| | TV - Meteorologist | Yes |
| | Radio - Program Director | Unable to contact |
| | Radio - On-air Personality | Unable to contact |
| | Storm Spotter Organizer | NWS train |

## 3.6  Data Analysis

This dissertation seeks to explore both tangible aspects of the warning system through a conceptual model of the broad tasks and the intangible through a set of propositions addressing the organizational culture.  While my model and propositions provide a clear foundation for deductive analysis of the data, I wanted to avoid remaining closed to emergent themes.  My model was largely derived from personal experiences and professional correspondences.  Similarly, my propositions were based on extensive organizational culture literature, but applied to a topic not yet empirically examined: the potential subculture that develops in areas with a frequent hazard.

Without a strong base of empirical knowledge, I felt it was important to begin analysis with an inductive approach.

I initially used open coding as I thoroughly read each transcript. During this process I recorded memos rather than traditional codes to allow myself to creatively explore the data in an unstructured way. I first noted anything that stood out to me regarding recurring themes, words reiterated multiple times, the tone of the conversation, and more. I used a combination of "pre-coding" and more traditional memos as described by Saldana (2009). He notes the opportunity first use "pre-coding" to "circle, highlight, bold, underline, or color rich or significant participant quotes or passages that strike you. (p. 16)" These sorts of records can serve as examples and potential codes further into analysis. I also used more extensive analytic memos during this initial open coding. Saldana prefers to refer to all memos as 'analytic' rather than categorizing them further. He keeps their purpose broad and fluid by describing it as a way to "document and reflect on: your coding process and code choices; how the process of inquiry is taking shape; and the emergent patterns, categories and subcategories, themes, and concepts in your data. (p. 32)". While I used notes and memos later in analysis to describe my coding choices, I first wrote memos to record all my initial thoughts, feelings, and observations. For instance, I wrote a memo on the consistent use of the word 'partner' in one of the interviews. Throughout another conversation I noted extra probing was required to get information on preparation. By allowing the data to speak for itself, I was able to capture emergent themes and nuances with these memos. While it was important to remain open during first round coding, I wanted to conduct more focused analysis during second round coding to ensure my original goals were fully addressed. Based

on initial memos, I decided to choose three characteristics of the warning system that would capture topics relevant to my conceptual model and propositions, while also taking into account the developing themes and issues revealed through my memos. The next few sections will describe this process and reasoning in detail before moving into an explanation on theme and pattern development during the final stages of analysis.

### 3.6.1    First Round Coding

As noted above, I initially read each interview while producing an extensive set of memos.  This process allowed me to not only orient myself to the data, but also remain open to emerging concepts.  While this round of analysis was predominantly inductive in nature, I did remain aware of the general topics important to my original goals.  Six significant broad observations developed from my first round coding: an activity needed to be defined, resources were not captured in the way I initially intended, communications needed to be addressed in context, roles were opinion based, relationships were a frequent area of discussion, and a variety of abstract feelings emerged.  Each of these will be discussed in detail below.

Initially, I placed memos on quotations I saw as an activity, but to get an unbiased view of the data, I did not consider if or how they would fit into the conceptualized tasks in my model.  Through this process I struggled with what an activity should be considered.  For example, a quote from the Wichita radio station illustrates this difficulty:

> "We have four two-way radio equipped vehicles that go out and we have reporters spot the storms and described the storms and describe the weather conditions."

Would this be considered one activity or multiple activities?  Specifically, I asked

myself if coding this as 'storm spotting' would fully represent the activities going on

in this quotation.  And would something like using the two-way radios to

communicate represent a separate activity?  Given this struggle, I noted the need to

clearly define an activity during second round coding.

While physical resources were important to both the conceptual model and

propositions, my email surveys rather than the interviews were originally intended to

primarily address this topic.  As described above, these surveys asked respondents to

list number of staff, computers, and other relevant tools.  Unfortunately, data

collection for this element did not go as intended.  The response rate was fairly low

with only 15 of the 24 organizations returning their survey and of those few answered

all questions.  Even completed survey contained inconclusive information.  For

instance, when asked 'How many are volunteers and how many are paid staff?' one

respondent answered "425."  On the other hand, resources were discussed within the

interviews without being specifically asked or probed for this information.  I

discovered that they were brought up in the context of an activity or communication

rather than a list.  Essentially they discussed their use of them rather them simply

stating they had them.  For example, the Portland EM discussed their use of WebEOC

rather than simply telling me it was available to them:

> "We send out a notification to all the elected officials and everyone that
> a housing shelters been opened up or that there's a severe weather
> webinar and here's the notes it, we document that in WebEOC."

Given these unexpected observations, I noted that resources would need to be

addressed with regards to their use during subsequent rounds of coding.

Communications between organizations was a key topic within the propositions and clearly present when initially reading and memoing the interviews. As with resources, communications were discussed in the context of either the activity going on or the tool they were using to interact with each other. For instance, the TV station at Wichita was describing how they get information about sirens during a storm:

> "Immediately as the storm is happening usually we might just call them and see if they're setting off the sirens depending on where they are."

If I were to only code the section "we might just call them" as simply 'the TV station called the EMs', I would be missing the timing (immediately as the storm is happening) and the reason (if they're setting off the sirens) of this communication. Because the context continually appeared critical during my memoing, I noted I would need a way to capture the full environment rather than just the instance of communication.

As with communications, roles within organizations and within the warning system overall was an important concept to address, but as discussion of roles appeared within the interviews key unexpected observations emerged. There was no formal, agreed upon plan that laid out all the intra- and inter-organizational roles by name. There was also no set definition of an organization's or person's role aside from a job title (i.e. – Forecaster) and certain national mandates (i.e. – Emergency Management Performance Grant). Since there were no written roles beyond the aforementioned mandates and job titles within the warning system, discussion about roles was based on personal judgment. In other words, the actors seemed to develop an understanding of roles and responsibilities influenced by their own experiences and

personalities. They discussed what they felt their own or another's role was in the system based on areas of expertise and work environment. For example, the WCM at Wichita indirectly discussed his role within their office:

> "Usually I try and stay away from the forecasting aspect of it. The meteorologists that are on the floor are out there 24/7 365. They're more up to speed on the new meteorology and forecasting and so I leave it to them."

Additionally the WCM at Nashville discussed inter-organizational roles of themselves and the EMs:

> "A lot of the times an emergency manager at the county level is the person that the county mayor and the superintendent and everyone else is calling, they're calling on that person during severe weather so that person is in turn calling us so were supporting their decisions at the county level with weather information to best of our ability."

From the WCM's opinion, their role is to support the EMs and the EMs are meant to support county officials. Given these nuances, I noted that it would be important to consider not just the official role of a person or organization, but how others within the system directly or indirectly conceptualize that role.

Though I did not explicitly articulate propositions on relationships, this was another area in which opinion based discussions arose within the interviews. Interviewees frequently expressed feelings toward another organization and/or their relationship with them. For example, the Nashville EM unprompted expressed positive feelings toward the local NWS office:

> "We would follow their guidance, pretty good working relationship between our office and their office. So they'd be glad to share their advice, together were a pretty good team."

These sorts of statements were noted as a consistent theme across all cases during first round coding. Additionally, feelings toward relationships also frequently tied in with

statements on roles and communications and in general showed potential to inform on the culture between organizations. For instance, the radio station at Nashville expressed opinions on the role of the TV station and their relationship with them simultaneously:

> "Our situation is we don't a huge staff and so we really depend on our TV partner a lot, and we use them just for basic- what I would call maintenance forecast during the week, and we have a very good relationship with them."

Given the frequency of this observation and its connection to the original goals, I noted that relationships and feelings toward organizations merited further consideration.

Beyond role and relationships, other emergent feelings and opinions appeared frequently throughout first round coding. For instance, interviewees discussed feelings toward communication tools, their own confidence level, and the difficulty of certain decisions. Though these sort of cognitive expressions were not explicitly described in the model or propositions, they were clearly an integral part of the data and future rounds of coding and analysis would be incomplete without their inclusion.

### 3.6.2 Second Round Coding

My second round of analysis involved focused coding guided by three characteristics of the warning systems. These were developed to capture topics relevant to my conceptual model and propositions, while also taking into account the emerging themes and nuances revealed through my open coding process. While each case was coded individually, I did however review cases in a sequence (Wichita, Nashville, Raleigh, and Portland). To avoid the influence of patterns recognized in previous cases, I did not reuse codes, but instead began each case by creating new

47

codes specific to that case. Additionally, I equally focused on potential differences and unique themes. I employed an iterative process in which changes to code names and definitions were noted within the code descriptions as they occurred. After one complete run through of each case, I then recoded all transcripts to reflect any coding changes. The next sections will describe the reasoning behind each characteristic and the specific coding techniques employed during this phase of analysis.

### 3.6.2.1 Activity

In order to adequately explore the broad tasks within my conceptual model, a detailed analysis of individual activities was required. To ensure that the data spoke for itself and the model didn't interfere with my initial observations, I went through the transcripts line by line and coded every activity. As noted during first round coding, the term activity needed to be clearly articulated. I drew upon my memos to understand the most accurate definition of 'activity' according to the data. Continuing through with the earlier example, I considered this quotation to describe one main action with multiple activities involved.

> "We have four two-way radio equipped vehicles that go out and we
> have reporters spot the storms and described the storms and describe
> the weather conditions."

The concept of 'action' was used solely as a tool for capturing and understanding activity codes more fully and to aid in memoing. It was not a developed theoretical concept within the conceptual model. An action was a sentence or two long quote comprised of multiple activities and provided the context around them encompassed the context of those activities within the quote (i.e. For the above quote, the context would be staff reporting in the field). The action itself was not coded, but rather the individual activities. When an interviewee mentioned working with a piece of

48

technology, interacting with a specific person/organization, or giving/receiving information/resources this was considered an activity. I used process coding which utilizes "gerunds ("-ing" words) exclusively to connote action in the data (Saldana 2009)." This tended to be straightforward, brief descriptions of the activities within an action. For example, the above quote was coded with three activities, 'using two-way radios,' 'spotting storms,' and 'providing information to coworkers.' I also associated a memo with each section of text coded as an activity. These memos described the context of each activity including a description of the overall action, who was speaking, and the interview question that spawned the discussion. For example, the memo associated with each of the above activities read:

Interviewee: Wichita (radio station)

Question: Role of the radio station during a weather event?

Context: One of the major actions of the radio station during a weather event is sending mobile units out into the field to spot the storms and radio information back to the station.

### 3.6.2.2 Cognition

Throughout the open coding process, I noticed interviewees frequently expressing an emotion or opinion rather than simply describing a tangible activity or stating a fact. There were several reasons why I decided to build a warning system characteristic around this observation. Since roles are an important theme within the propositions, it was necessary to address this topic during focused coding. It was equally vital to take into account the observations in the previous phase of analysis. I discovered that concrete, written roles within the system largely didn't exist. Instead discussion of roles occurred in the form of personal understanding and judgments.

This was not an isolated incident; expressions of feelings unrelated to roles appeared continuously throughout the interviews. Many of these opinions dealt with relationships and feelings toward other organizations. While not explicitly addressed within my propositions, relationships are an important aspect of organizational culture and thus could still work toward understanding the overall subculture present in areas with a frequent hazard. Additionally, other opinions were frequently voiced on a variety of subjects including communication tools, confidence level, and the difficulty of certain decisions. Given that cognitive based discussions were prevalent across all cases and shown to be potentially important for understanding roles, relationships, and other unique characteristics, I felt it was crucial to include cognition as a main characteristic of the warning system.

Cognition codes represented any feeling, emotion, or opinion toward resources, situations, coworkers, or another organization. I used values coding to analyze these discussions. According to Saldana (2009), it "reflects a participant's values, attitudes, and beliefs. A value is the importance we attribute to oneself, another person, thing, or idea. An attitude is the way we think and feel about oneself, another person, thing, or idea. A belief is part of the system that includes our values and attitudes. (p. 89)"

### 3.6.2.3   Communication

Inter-organizational communication was a key concept within the propositions, particularly regarding the frequency and nature of the exchanges. It was also clear during first round coding that organizations did indeed interact frequently with one another. For these reason, I decided to include communication as a main characteristic of the warning system while letting observations during open coding guide my

50

approach to analysis. As discussed previously, communications were mentioned in the context of an ongoing activity. In other words, I needed a method of capturing the full environment of the communication so I decided to descriptively label and collocate communication codes with the other codes.

For instance, the quotation from the Raleigh TV station below would be coded with appropriate activity codes ('receiving information from a coworker,' 'watching the radar,' and 'providing reports to another organization') and additionally coded with a communication code recording the interaction between the TV station and NWS.

> "If we see something on radar or if one of our photographers calls in and says 'I'm seeing something, put that on TV' then obviously we're not going to wait for the weather service to tell us what we already know. We'll obviously report that to them [NWS] at the same time."

This code would be labeled as 'TV-NWS' to denote which organization was talking about the interaction and who they were talking about. By then examining the collocated activity codes and memos, I could determine what they were communicating about (storm reports), what tool they were using to do it (not specified in this case), and the overall context of the communication (the TV station may see evidence of storm development visually or on radar, broadcast this, and then share the information with NWS). Instead of having a separate communication code to describe all of this information, I utilized preexisting codes to get a fuller picture of the situation.

There were also other key benefits of inclusion of communication as a concept and coding using the above method. It allowed me to go beyond what was addressed in my propositions and include the other important aspects of communications between organizations revealed during open coding. As discussed above, I could

explore the type of information exchanged and the general context of the interaction rather than just the frequency. In addition, I noticed during first round coding that interviewees rarely discussed interactions without also mentioning the communication tool being used. While this was not something specifically addressed in the propositions, I felt it was important to explore this idea that a communication structure developed around the communication methods.

### 3.6.3   Theme and Pattern Development

#### 3.6.3.1   Tasks

Because the activity codes were highly similar across cases, I ended up going through very similar processes for condensing them into broad tasks. For the purpose of this discussion, I describe these processes and resulting broad tasks as a whole. The emphasis on specific activities, methods of communication, and involvement of each organization varied by case; the details of these nuances are described in the following case description sections.

After completing first and second round coding, I took a more deductive approach allowing my original conceptual model to guide my categorization of activities into broad tasks. This was an iterative process in which I employed pattern matching to develop the categories that reflected the data most accurately. In light of existing knowledge, I first attempted to group all observed activities into the hypothesized tasks in my conceptual model. I used code names and definitions to determine which broad tasks each activity belonged to. I found that many of the codes lost their true essence when combined into these categories, while others were left out entirely. For instance, the activity code 'coordinating broadcast' was originally

grouped in the broad task of 'constructing the warning message,' but this activity was generally discussed in the context of overall coordination of the workplace rather than simply as a part of warning construction. In this way, the above categorization was not representative of the true meaning of the code. In another example, 'prepositioning resources' was not able to be adequately grouped into any of the original tasks. In this case, it brought to light an unrepresented type of activity involving preparation. For these reasons, I took a step back from the original model allowing it to guide my categorization rather than dominate it. As needed, I developed new categories and redefined existing categories. Continuing with the example above, I noticed several other activities involving coordination and decided to create a new category, 'coordinating workplace.' 'Prepositioning resources' and 'coordinating broadcast' were then considered activities within this broad task. I continued this process of redefining and reworking until I settled on eight broad tasks listed below with corresponding activity codes to demonstrate the sort of activities within each category.

1. *Seeking weather information* – 'Checking websites for forecast information' and 'Spotting storms'

2. *Receiving information from another organization* – 'Receiving reports from another organization' and 'Receiving warning from another organization'

3. *Analyzing weather data* – 'Interpreting radar' and 'Discussing surface data with coworkers'

4. *Providing an organization with information* – 'Briefing organization on forecast' and 'Giving organization storm reports'

5. *Providing coworkers with information* – 'Reading storm report to coworker' and 'Conducting staff meeting'

6. *Utilizing a communication tool* – 'Sending emails' and 'Using NWS chat'

7. *Coordinating workplace* – 'Coordinating broadcast' and 'Overseeing staff'

8. *Alerting the public* – 'Issuing warning' and 'Broadcasting information'

While the above eight tasks were more representative of the data than the original conceptual model, I had only considered the code names and definitions rarely exploring the broader context of the activity. To ensure activity codes were accurately grouped and the broad tasks represented reality, I went deeper into the memos and co-occurring codes to more fully review the context in which the activity was being done. In the end, I made several important changes and decided on four assessment tasks and three dissemination tasks displayed in Table 6 below. It's important to note that while the main tasks are organized into two main phases, assessment and dissemination, they are not independent of each other or in chronological order. For instance, coordinating staff may require dissemination of information to coworkers. The complete description of each task and the process of their creation are detailed below.

The first major change was dissolving 'utilizing a communication tool' and instead associating the specific methods with the tasks that require interaction with others. This was more representative of reality since using a communication method was really an activity within the broad tasks rather than a task in and of itself. For instance, using NWS chat could be an activity within several of the tasks such as disseminating to another organization or gathering weather information.

After considering the context in which the tasks 'seeking weather information' and 'receiving information from another organization' were generally conducted, I

discovered that conceptually both were part of the process of gathering information about the weather or situation.  Thus *'gathering weather/situation information'* became the main task and seeking (looking at the radar) and receiving (receiving a storm report) were different methods of getting to the information.  Interestingly this was similar to the task in the original model, 'monitoring scientific conditions,' but now acknowledging that the information was not always of a scientific nature and it was gathered both by searching independently and by receiving from others.

After reviewing the 'coordinating workplace' task, I noted that a subset of the activities were unique in that they involved preparation of the staff, resources, or physical office setting.  Given the context and timing of these activities, I felt it warranted its own task, *'preparing workplace'*.  The essence of this is immediate preparation for an event.  It would not include things like yearly meetings, but would include preparing a work station for the day, perhaps by displaying radar or uploading a map of spotter locations.  The *'coordinating workplace'* task otherwise remained the same.  It involved organizing and/or overseeing activities and staff within an organization.  Within this task, two types of coordination were occurring, coordination of staff and coordination of operations.  It's important to note though that these were not mutually exclusive and often overlapped.

*'Analyzing weather data'* remained the same.  I considered including these activities with the 'gathering weather/situation information' task, but in the end saw them as conceptually distinct.  While analysis required the gathering of information, it went one step further.  It encompassed activities where scientific analysis of the data was occurring in an effort to forecast or understand the atmosphere.

Originally, I considered alerting the public as the only main task within the dissemination component. In reality, providing information to coworkers and other organizations was generally just as frequent and crucial if not more. While the main activities and description of 'providing an organization with information', 'providing coworkers with information', and 'alerting the public' were not altered, the tasks were redefined as *'disseminating to other organizations', 'disseminating to coworkers', and 'disseminating to the public'*. Within the dissemination to coworkers and organizations, the nature of the information varied from case to case but generally involved briefing, collaboration, or guidance. Conceptually, I considered briefing more one-way and meant to provide a broad overview rather than pieces of information; its main goal was ensuring everyone was on the same page. Collaboration generally involved two-way exchanges in which coworkers or partner organizations helped each other understand the situation by providing information or sharing their thoughts. When conceptualizing guidance, I viewed it as similar to collaboration, but generally one-way in which staff offer one another or other organizations advice and suggestions. Of course some exchanges did not naturally fit into one of these categories; these nuances are explored further in the case descriptions.

Table 6:     Overview of Broad Tasks for all Cases

| Assessment Task | Dissemination Task |
|---|---|
| *Gathering weather/situation info* | *To coworkers* |
| *Preparing workplace* | |

| | |
|---|---|
| Coordinating workplace | To other organizations |
| Analyzing weather data/info | To public |

### 3.6.3.2 Cognition

To understand the core opinions and feelings throughout the interviews, I grouped cognition codes into common themes which varied from case to case. Across cases, the only consistent themes were feelings toward relationships and roles. These were fairly clear and simple to categorize. For instance, listed below are several examples of codes which fit within the 'roles' theme in Raleigh.

'Going above and beyond'

'Supportive role'

'Role of another organization'

For both roles and relationships, these themes could be broken down further to show whether the feelings were regarding coworkers or other organizations. Other important themes included feelings toward the difficulty of decisions and opinion of a resource or tool.

Associated memos, quotations, and co-occurring codes were examined further to get a sense of what discussion was prompting these expressions, whether feelings were shared among organizations, and which opinions were most prevalent or emphasized. For instance, in Portland several of the organizations expressed feelings toward difficult decisions, but the nature of the decision was dependent on the type of job the organization typically performed. The perceived differences between Portland

57

and Midwestern WFOs were continually emphasized, but only be one of the organizations. Cognition themes were heavily integrated into other sections of analysis rather than discussed on their own. They provided a more complete picture of the culture by showing which activities, resources, and interactions provoked the strongest emotions.

### 3.6.3.3 Communications

I began my analysis of the communication codes by looking at co-located codes to determine which activities were occurring when the interviewee mentioned an interaction between their office and another organization. For instance, I found that in Wichita when the TV station discussed communications with the radio station (Communication code: TV-Radio) these activities were also occurring:

'Broadcasting information over the air'

'Providing information for ongoing event to other organizations'

'Providing weather information to public'

'Receiving storm reports from another organization'

'Simulcasting coverage'

To determine if the radio station shared a similar experience, I also examined the co-occurring communication and activity codes from their interviews (Communication code: Radio-TV). In this example, they shared three of the activities:

'Broadcasting information over the air'

'Simulcasting coverage'

'Receiving information about ongoing event from another organization'

From this brief analysis, I could ascertain that the TV station provided information about the weather event to the radio station while they both broadcast material to the public and simulcasted coverage. In some instances, cognition codes were also co-located with communication codes allowing me to understand what sort of emotions may have been involved in the interaction. Additionally, an activity code representing the utilization of a communication tool (email, conference call, NWS chat…) was also usually present. In Portland when the EMs spoke about interactions with NWS, the following activity and cognition (the first two) codes were applied.

'Likes an organization'

'Likes software/tool'

'Gathering weather information'

'Participating in conference call'

'Receiving information from another organization'

'Discussing forecast with another organization'

From here I could tell that the EMs received weather information and discussed the forecast with NWS through a conference call. I also conjectured that they simultaneously expressed positive feelings toward NWS and the conference calling capabilities.

Because it was difficult to get a full picture simply by viewing co-occurring codes, I also read the corresponding memos and referred back to quotations when necessary. Overall this gave me a deeper understanding of the communication structure. By reviewing quotations and looking at communication codes from the perspectives of both organizations involved (i.e. TV-Radio and Radio-TV), I was able to get a sense of the nature of the interaction. In other words, was the communication

one-way or more of a dialogue?  Also, did this change depending on which activity/s was ongoing?  As I went through the above processes, I organized my thoughts in a 6X6 matrix showing which organization discussed interactions (and with whom) and what these interactions were generally about.  This allowed me to more efficiently discuss results within my case descriptions.

Table 7:     Example of a section of the communication matrix for the Wichita case.  The full matrix would include all 6 organizations.  The top row designates who commented about the interaction.  For example, NWS explained that the TV station may contact them for more details.

|     | NWS | TV |
|-----|-----|----|
| NWS |     | Providing information and storm reports through NWS chat<br><br>Participating in conference call |
| TV  | Providing information through conference call and NWS chat<br><br>Providing weather information through NWS chat<br><br>May contact NWS to ask for more details |     |

As noted above, activity codes representing utilization of a communication tool were frequently co-located with communication codes.  After reviewing co-occurring codes, memos, and quotations, it was clear that the method of interaction was important to the communication structure.  To explore this idea further, I looked at co-located codes from the perspective of the tool used.  For example, in Wichita the

activity code 'participating in a conference call' is co-located with the following codes.

'Asking other organizations questions about storm system'

'Briefing partner organizations for upcoming event'

'EM – NWS'

'NWS – DOT'

'NWS – EM'

'NWS – Radio'

'NWS – Schools'

'NWS – TV'

I could then see who participated in the call (EMs, NWS, Radio, TV, DOT, schools) and the nature of the information being exchanged (briefing on forecast, asking questions about storm).

# Chapter 4

## CASE AND CODE DESCRIPTIONS

### 4.1 Case Analysis

I analyzed each case holistically in an effort to get a 'feel' for the culture within each warning system. Because of this, it was most organic to organize these discussions around tasks and activities, inter-organizational communications, inter-organizational roles and relationships, and intra-organizational communications and relationships. By separating the case descriptions into warning system characteristics (Activities, Communication, Cognition), my discussion would have missed the connections across these units. An explanation of each case description section is provided below.

While the broad tasks were consistent across cases, important variations and nuances were present. The 'tasks and activities' section provides a detailed description of the specific types of activities, the organizations involved in each task, and the communication methods used. It also draws in relevant cognition codes involving importance of and opinions toward certain activities.

The 'inter-organizational communications/interactions' section provides a communication structure centered around the prominent communication methods. It describes each of the tools, the type of information exchanged, and the organizations involved. All three warning system characteristics were used to build this section; cognition codes on feelings toward communication tools, activity codes describing

utilization of these tools, and communication codes showing who these interactions were between and their frequency.

The third section, 'inter-organizational roles and relationships,' goes beyond the basic communications and delves further into the roles and relationships within the warning system. It focuses on a variety of concepts depending on the themes found within each of the cases. This section draws heavily upon cognition codes to describe the feelings toward other organizations, their own roles, and the roles of others. In some cases there was a theme of teamwork, in another case there was a pattern of confidence throughout the organizations.

The final section provides brief snapshots of the culture within each organization. It describes 'intra-organizational communications and roles.' This section draws upon cognition codes relating to opinions toward coworkers and activity codes describing information exchange with coworkers. Because interviews focused most heavily on inter-organizational interactions and responses to within office questions were sparse, I found it best to contain this discussion to one section.

## 4.2 Wichita Case

### 4.2.1 Introduction

Wichita, KS represents one of the two frequent hazard cases. This WFO area is comparable in size and population (380,000 in the main city) with the other cases. Kansas has received repeated impacts from tornadoes over the years. Not only has the state received the second highest amount of tornadoes (normalized by area), but it has also suffered the highest cost per capita for tornado damage (National Climatic Data Center, Geography Statistics).

I was able to conduct interviews with all the chosen organizations. A leader and general employee were interviewed for every office except the police station. In this case, I was only able to speak with the police captain. A list of their specific titles is shown below. Because there was no emergency management department at the city level, I chose to speak with the EMs representing the county. The police and fire officials were all at the city level. The TV and radio stations broadcast throughout the WFO region and were chosen due to their reputation for severe weather coverage.

Table 8:  List of Wichita Actors Interviewed (Leadership bolded)

| |
|---|
| **NWS – WCM** |
| NWS – Forecaster |
| **EM Director** |
| EM Deputy Director |
| **Fire  - Leader** |
| Fire Fighter |
| **Police Captain** |
| **TV - Executive Producer** |
| TV - Meteorologist |
| **Radio - News Director** |
| Radio - Reporter/Anchor |

### 4.2.2  Tasks and Activities

As noted in 4.1 (case analysis) this section of the case description will describe the broad tasks and activities found within the Wichita warning system. They'll be discussed alongside relevant cognition codes and communication methods. Table 9 displays the broad task and the main tools for communication associated with each

task.  Each case description will have a similar section beginning with a table and corresponding explanation of each task.

Table 9:     Wichita Tasks and Communication Methods

| Assessment | | Dissemination | |
|---|---|---|---|
| **Task** | **Comm Method** | **Task** | **Comm Method** |
| *Gathering weather/situation info* - on own - receiving from | Radio, Chat, Phone, Social media, Email, Conference call | *To coworkers* - collaboration - briefing | Email, In person, Radio |
| *Preparing workplace* | In person | *To other organizations* - briefing - updating | Chat, Phone, Email, Conference call, Radio |
| *Coordinating workplace* - operations - staff | In person, Radio, Email | *To public* - alerts - general info | Social media, Broadcasting, Sirens, In person, EAS |
| *Analyzing weather data/info* | In person | | |

**4.2.2.1    Gathering Weather/Situation Information**

For fire and police, most information came through the EOC in the form of briefings, emails, or phone calls.  They would search out information on their own, but it was generally in the form of more passive monitoring usually by checking for forecast updates periodically.  The emphasis was on situational awareness so they could prepare effectively for response, thus much of the information was on storm location, timing, and severity.  One exception to this was police officers trained as

storm spotters who took a more active approach in seeking out their own storm information by tracking the weather in their vehicles. While the fire and police relied mainly on passive monitoring, the EMs used more active information gathering. They seemed more comfortable viewing and interpreting the radar, weather data, and NWS products. They would also participate in NWS conference calls and NWS chat to receive more detailed information about the forecast and weather.

> EM: "when we get for example the issuance of a tornado watch or a severe thunderstorm watch then we'll actually start actively looking at more real-time weather data, for example radar assets"

> The media (radio and TV) had their own mobile units comprised of employees

with two-way radio and radar equipped vehicles. 'Chasing' the weather and monitoring the radar were the main methods of seeking out their own information.

> TV: "They'll go out there all equipped with GPS and radar right there in your vehicle."

> Radio: "We have four two-way radio equipped vehicles that go out and … spot the storms and describe the storms and the weather conditions."

In addition, both the radio and TV station would be using NWS chat and phone calls to receive information from the other organizations mainly in the form of storm reports. The TV station also mentioned participating in the NWS conference call prior to the weather affecting their area. Media emphasized gathering ground truth and/or visual information more than meteorological data such as wind speed or temperature.

Due to the nature of their work, the NWS had multiple computer programs and technologies available for them to actively collect and view data on the weather. Most of their information received from other organizations was done through NWS chat, phone calls, or amateur radio with NWS chat being the most frequently used. The

information was almost always in the form of storm reports from the spotter network or media mobile units.

### 4.2.2.2   Preparing Workplace

The timing of preparatory activities varied by type of organization; NWS and media tended to do most of the preparation of their workplace before the weather was affecting their area while emergency organizations (EM and fire) did more while the storms were ongoing.

The NWS would develop a plan for the day, assigning tasks and breaking up the forecast area if necessary.  They would also take time to display relevant data.  While setting up their work station occurred every day, the type and amount of data changed during a severe weather event.  During the event, they'd require more detailed information, especially data relevant to the particular weather phenomenon.

> NWS: "I would be getting my work station all set up… trying to surround myself with, with the environment, the radar data, satellite information, and the local TV as well"

Both the TV and radio stations would have staff meetings in preparation for the event.  While these meetings occur each day regardless, the focus of the meetings would be on the possible incoming weather.  In addition, the TV stations would get ahead on regular duties in preparation for the severe weather later in the day.

> TV: "We'll obviously try to get a jump start into our regular duties, the forecasting, creating graphics for our regular newscast"

For EMs and fire, much of their preparation occurred as the weather was affecting the area.  As part of their normal severe storm season routine, the EMs would already be checking the NWS website for weather updates every morning in

preparation for the day.  Little else would change for them until warnings began.  At

that point they would activate the EOC and preposition their spotter network.

> EM: "if we go into a warning … then everything changes because
> everything else- all of the normal business things of the day go out the
> window and we deal with the emergency at hand."

For the fire station, preparation was actually one of the main topics of discussion.

Because their expertise is in response and recovery rather than forecasting, they tended

to use the time to preposition resources and check equipment.  In other words, much of

their preparation was done as the weather was affecting the area.

### 4.2.2.3   Coordinating Workplace

Every organization mentioned coordinating their staff, though the method and

nature varied.  While most coordination occurred in person, some required

communication with staff through radio or email.  The EMs discussed activating and

positioning the spotter network for their county, the fire and police stations both

mentioned directing officers to various locations, and the media discussed

coordinating the locations and activities of their mobile units.

> EM: "Somebody on our staff is keeping in contact with our spotters out
> in the field and they're just having that discussion over the public
> safety two-way, where the spotters reporting in 'I had these conditions
> at this locations' and the staff person…makes sure we've understood
> the information that's been conveyed."

For the media another important area of discussion was with the coordination

of their broadcasting.  For instance, a radio station employee mentioned being the "air

traffic controller" for severe weather coverage at their station.  For both the radio and

TV station, the presence of several mobile units in the field at once required strong

coordination of on-air material.

TV: "I am usually in the control room… coordinating the on-air coverage so, for example, when do we break in, how long do we stay on, what do we do during that time that we're on the air."

For EMs and NWS another main coordination task was in keeping the storm reports logged and organized. The EMs are in charge of all spotters for their county and must compile incoming reports quickly. NWS was receiving reports, not only from the EMs (spotter network), but also from police radio traffic, media, and independent chasers.

### 4.2.2.4   Analyzing Weather Data/Information

Though other organizations may check the forecast, look at the radar, or listen for storm reports, the actual data analysis and forecasting was done mainly by NWS. While the TV station meteorologist did mention forecasting, they did not go into further detail and spent little time discussing this. The only activity that was difficult to categorize and could cross over from gathering to analysis was 'watching the radar'. Ultimately, I felt it was conceptually part of the gathering rather than analysis task because of the context in which it was discussed. When the EMs and the TV station mentioned watching the radar, their main purpose was a real-time view of storm location and movement. On the other hand, NWS would discuss monitoring the radar in concert with their other analysis tools and data to predict future storm development.

NWS relies on a variety of information; displaying not only satellite, radar, and other meteorological data, but also maps of spotters and chasers. They seem to examine the situation holistically looking at the near-storm environment using forecast tools but also watching a webcam from a nearby spotter to get a visual. They also emphasized discussion with their coworkers. Because each forecaster would be

assigned a specific task like radar or storm reports, they each had to communicate often to understand the complete picture and successfully analyze the situation.

> NWS: "I'm going to be diagnosing the environment and the storms and gathering all the information that I can on confirmation of reports."

### 4.2.2.5   Dissemination to Coworkers

Every organization mentioned providing information to their coworkers and staff throughout the event. The nature of the information, method of communication, and frequency varied by organization. Most of the time this was done in person either informally or during a staff meeting. Smart phones, email, and two-way radios were also used particularly for media and EMs who may have had staff working outside the office.

The nature of the information was generally in the form of briefing or collaboration. Briefing was universal to all organizations and occurred more frequently before the weather had begun affecting the area. It consisted of alerting of the possibility of severe weather and reviewing the plans and/or assignments for the day.

> TV: "Our storm chase coordinator puts out an email that goes to our chasers and pretty much everybody in the TV station also to let them know that it's going to be an active day."

> EM: "I'd be notifying people through the day, particularly our spotter network, of the potential of severe weather, keep all of our volunteers in the loop as to what's going on."

Further into the event, exchanges became more collaborative as coworkers disseminated relevant information and reports to each other. This was important for organizations most comfortable with radar usage and weather information (media, NWS, and EM). Coworkers within these organizations would share what they were

seeing on radar and discuss their thoughts.  Additionally disseminating storm reports to one another was crucial.  Since reports came in frequently from a multitude of different sources, it was important for coworkers to effectively distribute them throughout their office/organization.

> NWS: "We have one person monitors all the incoming communications…they'll just kind of update me on stuff, like for example if there's a tornado confirmed on the ground on a warning that we have in effect…I also have another person that gives me updates on how the environment is changing."

> EM: "Somebody on our staff who's keeping in contact with our spotters, they're just having that discussion over the public safety two-way…the process is to make sure we've understood the information that's been conveyed and then that same information turns around and gets conveyed internally within the staff."

### 4.2.2.6  Dissemination to another Organization

Similar to dissemination to coworkers, the nature of information provided to other organizations usually came in the form of briefing or collaboration.  Collaborative updates and discussion between organizations was widespread and frequent.   Much of the briefing occurred prior to the weather impact and was dominated by NWS and EMs.  NWS seemed to be the central weather provider for the community; many of the organizations would attend their briefing conference calls prior to the weather affecting the area.  In turn the EMs seemed to be responsible for ensuring emergency organizations, elected officials, and other community entities were briefed on the upcoming weather.

> NWS: "I'm ensuring that our emergency management partners are aware of the impending event.  I'll create basically an online briefing or webinar where I'll share my screen and we'll have partners call in."

While NWS and EMs were the only organizations to disseminate information in the form of briefing, all organizations provided information to one another throughout the event. The EMs acted as an information sharing hub, coordinating communication and resources among response related organizations, elected officials, and more. Because of this role, they regularly updated these partners on the forecast, warnings, and damage reports.

> EM: "We make sure that we communicate relevant information from the spotters out in the field to the NWS."

> EM: "Our primary function in the EOC becomes a coordination point, an information sharing point, even more so than what we were before, sharing information between the different agencies that are involved in the response."

Though NWS remained focused on forecasting and warning rather than dissemination and communication, they continually updated the other organizations through NWS chat and brief phone calls if needed. The media shared storm information and updates with one another through simulcasting and phone calls. Several of the organizations shared storm reports from spotters, mobile units, or officers with NWS regularly throughout an event.

> Radio: "We would work with the TV station and we would have one of the four meteorologists at the TV station assigned to be with us on the air."

> TV: "We do regular daily weather for [the radio station], but during severe weather, they'll put us on the air. Basically our job for them is to paint the picture of where storms are, where they're headed."

### 4.2.2.7 Dissemination to the Public

All organizations except the fire station mentioned disseminating information directly to the public, though the method, nature, and emphasis of this task varied

greatly. Dissemination to the public came in two forms; an official NWS warning and general storm information. As the only organization authorized to issue an official warning, NWS released warnings on specific storms. Interestingly, aside from relaying it through NWS chat, they did not expand on how they disseminated the warnings to the public.

The EMs focused their discussion on dissemination to other organizations, but they did briefly mention their siren network and a public website displaying warnings and reports. Similarly, the police concentrated mainly on preparations and response, but if time permitted they made an effort to drive to mobile home parks and/or crowded areas to alert people of a warning in person.

As may be expected, the media focused most heavily on providing warnings and information to the public. While the radio and TV stations would relay NWS warning text over the air, they also spent time disseminating general storm information as well. Many of the times, the TV station would go into wall-to-wall coverage, giving continually updates on storm development. These updates would consist of details coming through on NWS chat, video from their mobile units, or analysis of radar imagery. Similarly, the radio station would also go into continuous coverage in some instances. They would generally be giving updates from their mobile units and simulcasting coverage from their partner TV station.

> Radio: "You'd see me reading the, any warnings or announcements from the NWS. We would take over the programming…we would talk about the severe weather extensively."

> TV: "They're breaking down the storm at the time and they're telling people 'If you're in this area or this neighborhood in should hit in 5 minutes so you need to take cover' …There's no script or anything. They're just kind of talking us through what's going on. So, whenever

they're saying 'there's a tornado warning in this area, take cover', we put up a graphic that says what you need to do."

It's important to note that the radio station also mentioned a unique method for disseminating to the public. To combat the difficulty of conveying visual information over the radio, they created a gridded map of the region and offered a hard copy and an online version to listeners. Their audience could then quickly and easily determine where the storm was in relation to their location.

> Radio: "It's called our storm alert map; we have a map of Kansas with a grid. So like for example R3 might be Dodge City and when the storms are getting close to south-central Kansas, we will use the KFDI storm alert map on the air in regular newscasts and we will say, 'We have a storm that's near Dodge City, this is R3 on your KFDI storm alert map'. So people who have these maps at home can track the storm as it gets closer to Wichita."

### 4.2.3   Inter-organizational Communications/Interactions

As shown by the discussion of the task and activities, communication with other organizations was frequent and crucial in many instances. Though a variety of communication tools were used including phones, email, and radios, four methods stood out as the most popular and useful: conference call, NWS chat, EOC, and Simulcasting/IFB.
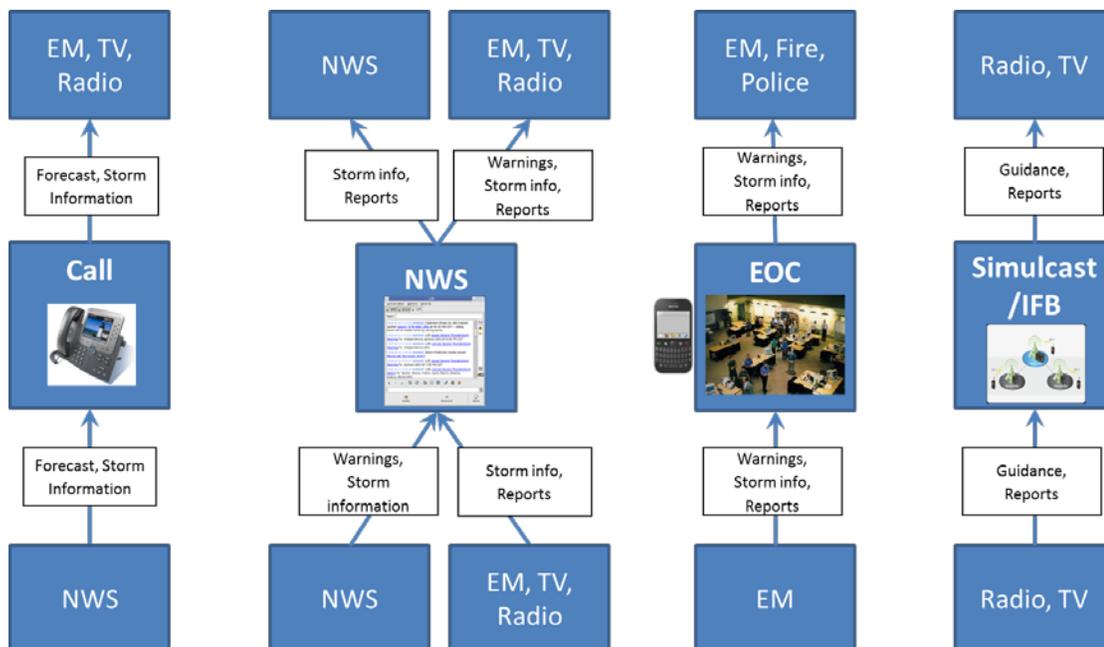
Figure 1:    Wichita Communication Methods and Structure – Graphic shows the most common/popular communication methods among the organizations, who provides and receives the information, and the content of the information itself.

### 4.2.3.1  Conference Call

Earlier in the event, before the weather would begin affecting the area, NWS would generally initiate a conference call to brief the other organizations on what to expect.  Of the organizations interviewed, the EMs and media were the only ones to explicitly mention being a part of these calls.  In particular, the EMs 'logged into' the briefing at the EOC so a multitude of individuals and organizations could be present.

> EM: "I can pass around a microphone and the EOC partners can ask a question, the NWS folks can hear them over the telephone and then in turn respond which gets relayed over the room audio system."

Representatives present at the EOC seemed to vary depending on the event, but could include schools, DOT, or state emergency management.  The conference call itself

entailed a multimedia briefing that the WCM would click through describing details on timing, severity, and uncertainty. This provided key organizations with more forecast explanation and an opportunity to ask questions. NWS highlighted the conference call as a particularly important communication method. Specifically they emphasized its usefulness in explaining the severity of the event and ensuring that all partners are on the same page. They express that it's difficult to convey what makes each event's severity and nature different from the next, especially without feedback. A conference call allows that two-way briefing earlier in the event. NWS did note that on more routine days, they may email the briefing presentation in lieu of the call.

> NWS: "I think that's one of the more important things that we do here is have those conference calls and get everyone together like that."

### 4.2.3.2 NWS Chat

No communication method was more widely discussed and favored than NWS chat. As the weather is affecting the area, it's impractical to take time away from crucial tasks for long discussions or explanations. Chat provided a central tool for frequent, quick interactions between organizations. While the fire and police had actually never heard of NWS chat, NWS, EMs, and the media used it extensively. In fact, each of these organizations even imbedded monitoring of the chatroom into the duties of at least one staff member during a severe weather event. The chat was a hub to share a variety of information helpful to each organization in different ways.

NWS not only used chat to issue or update a warning, but also to provide more detailed explanation on the storm system. A forecaster describes the utility of chat:

> NWS: "the warnings are in a template format…but to get more specific you can just go over to NWS chat and provide some more information."

The EMs seemed to appreciate the expanded discussion, specifically commenting on the usefulness of 'behind the scenes' information such as whether a storm is showing signs of weakening or that the warning will be updated or discontinued within the next ten minutes.  The media also noted that they tend to receive warnings several minutes sooner on chat than through the normal warning dissemination channels.

NWS particularly emphasized their use of chat to communicate with media. They found it "a lot easier to quickly type in the chatroom as opposed to picking up a phone and calling."  Similarly, the EMs also appreciated the direct link to media. They were able to provide detailed information for the media to share on air without taking significant time away from forecasting or emergency response and planning.  In turn, the media agreed this was a particularly useful tool for them:

> TV: "Then once things really get going we rely heavily on the NWS chat to communicate with [NWS]… when we get information from them we can pass it along through the chat and obviously warnings themselves come over it."

Aside from disseminating updates and analysis to other organizations, NWS also received valuable information back.  The media and EMs were able to quickly update NWS on incoming reports from the spotter network and mobile units.  While this was not the sole means of receiving reports, it was an important, efficient method. Additionally, NWS highlighted how helpful it was when the TV station alerted them before shooting live on location.  This way they knew to direct their attention to the TV to get a visual on the storm, providing ground truth to a warning or aiding in forecasting.  Overall the chatroom provided the organizations with an efficient, central method of communication.  It also allowed a 'backstage' look into operations without taking time away from crucial tasks.

NWS: "And we found it very nice, because they'll go into the chat and say 'hey were getting ready to shoot live at such and such location to let you see what's going on' and then we can turn the TV over to see exactly what's going on out there."

### 4.2.3.3 EOC/E-log

In most severe weather events, the EOC will be activated and operated by the EMs. Using a more technical definition provided by an EM, the EOC is "a physical facility where all the traditional front-line emergency responders and support staff gather to coordinate a jurisdictional response to the emergency." Given this, it's not surprising that much of the interactions between EM, fire, and police were done through the EOC. It's important to note that many other organizations beyond those interviewed may also be at the EOC, generally by sending a representative to be present at the physical location.

EM: "Our primary function … becomes a coordination point, an information sharing point … between the different agencies that are involved in the response."

They provide warning updates, general storm information, and damage reports either in person or through an e-log website. While the e-log tool was a public information website, it could also be updated with internal information to be shared only among EOC organizations.

The EOC and in turn the EMs are the main bridge between NWS and organizations present at the EOC. While warnings are ongoing, the EMs use the EOC to keep all relevant organizations updated on the weather, plan for response, and in some cases execute limited response and rescues. After the threat has passed, they move to coordination of rescues and response to damage, a phase that is not covered in this study.

#### 4.2.3.4   Simulcast/IFB

The TV and radio stations partnered with one another particularly in severe weather situations.  The TV station would actually assign a meteorologist to coordinate with the radio station throughout the event.  The radio anchor would have that meteorologist available on cue through an earpiece.  They could feed them information to share on air or allow the TV meteorologists to talk directly over the radio.  This seemed to be the main form of communication between the stations, since phone or in person conversations were impractical during continuous coverage.  The relationship between the radio and TV stations appeared symbiotic.

> TV: "We'll put the mobile units on our air and they will put our meteorologists on their air so it's a give and take."

In addition to using each other as 'guest appearances' during broadcasts, the radio station would also simulcast the TV station coverage.  By doing this, the radio station was simultaneously disseminating to the public and receiving helpful information and updates from the TV station.

### 4.2.4   Inter-organizational Roles and Relationships

#### 4.2.4.1   Feelings and Opinions toward other Organizations

Beyond necessary or formal communications during a warning situation, many of those interviewed expressed feelings toward other organizations and their relationships with them.  In general, the importance of relationship building was a common theme.  NWS stressed the importance of strengthening the bond between themselves and the EMs and media in particular.

> NWS: "It's extremely important to have the relationships remain strong and fresh, so therefore I stay in constant communication throughout the

week be it slow weather or busy weather with our media partners and our emergency managers."

A similar sentiment was expressed by the media and EMs in return.

Radio: "Yea, we all stop by the NWS … and converse during times when there's no severe weather."

EM: "We communicate and work extremely closely with NWS."

During most of the interviews positive feelings and experiences with the other organizations were expressed freely and frequently; this was not an area of discussion that required further probing. Many strong working and personal relationships seemed to be preexisting for the area.

TV: "We've got a terrific and always have had a terrific working relationship with the NWS and the same thing with the emergency managers."

Trainings, workshops, and casual meetings developed relationships throughout the year. NWS, EMs, and the media all emphasized year-round relationships with the other organizations and some even provided multiple examples of interactions. For instance, throughout the year NWS would go to the media stations to provide private spotter trainings.

EM: "There are relationships that evolve over time of course. So some of us are not only professional colleagues, but friends."

NWS: "I try to remain as fresh in their mind as I possibly can so that they, we have that great working relationship, so that they'll more freely share information with us."

In contrast, the fire and police stations did not speak extensively about their relationships with other organizations. They focused more heavily on tasks and formal interactions. Though feelings toward other organizations was not a theme for

fire and police, it's important to note that the police chief did briefly mention a strong bond between the response organizations (fire, police, EM).

Any feelings shared regarding other organizations or their relationships with them were overwhelmingly positive. In fact, no negative comments were offered up without further probing. When asked specifically about conflicts, some struggles emerged, but did not seem to affect overall relationships. The TV stations was the only organization to discuss a disagreement, the rest simply stated that they couldn't think of any conflicts and some even reiterated how well they all work together. The TV station provided a specific example which dealt with circumstantial difficulties rather than any wrongdoing:

> TV: "It can get a little difficult because say you call a county that just had a storm pass through and you're asking them for information … but the dispatcher and sheriff's department is answering the phone saying 'I'm really busy, I can't talk to you right now'."
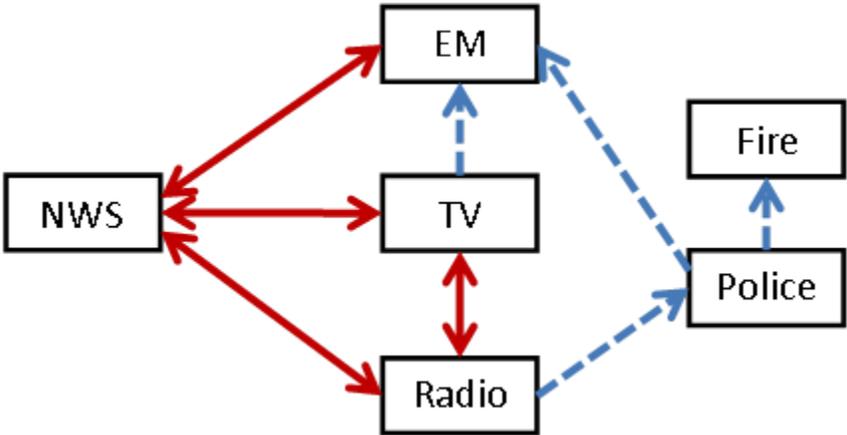


Figure 2:    Feelings toward other organizations - Red double arrows signifying mutual positive feelings/opinions; blue dashed arrows signifying one-sided positive feelings/opinions (the other organization made no mention one way or the other).

**4.2.4.2   Warning 'Team' and Roles within the System**

Closely related to the positive feelings toward other organizations and relationship building, teamwork also emerged as a theme.  Many of the organizations indirectly expressed this by referring to other organizations as 'partners' or members of a 'team' throughout the interviews.  NWS expressed this sentiment more directly:

> NWS: "Generally it's not just the weather service and everybody else. We work very closely as a team and all the folks I'm going to be mentioning are a part of that team."

In addition, many recognized the importance of the roles played by other organizations within the system.  The EMs and radio station both mentioned the significance of NWS as an official warning source.  They emphasized their trust in NWS as the leading weather provider.

> EM: "When you talk about public warning, the Weather Service does a very good job of it.  And obviously they have a lot more clout overall, and everybody pays attention to them."

Similarly, NWS realizes the necessity of the media and EMs; they even go so far as to say they are crucial to the process.  NWS understood that they were unable to visually confirm during the weather event and must have 'eyes and ears' in the field.  They also emphasized the media's role as direct disseminators to the public.

> NWS: "If we're not getting the information we can't relay it to the TV and the radio folks and therefore the public isn't going to have the information.  So, the emergency managers and their spotters are crucial to our warning decision process."

Not only did interviewees express a conceptualization of other organization's roles, some were also very clear on what was within and beyond their own organization's responsibility.  The emergency organizations (EM, fire, police) all emphasized their limited role in forecasting and warning explanation.  The fire and police stations both explained that their typical role was not in warning dissemination;

their focus remained on response. On the other hand, the role of the EMs did include

dissemination of weather information, but they conceded that their expertise was

limited and they were unable to provide detailed explanations.

> EM: "Were dispensing the information provided to us by the NWS, the folks that we're dispensing it to may ask some clarification questions, but naturally our role with respect to that is extremely limited because we're not meteorologists. What we can do is say here's what the NWS has said or we can say the NWS has not addressed that question specifically."

NWS was also clear on what they can and cannot do; they emphasized that they're

decision support rather than decision makers for the community. They explained that

they're role is in forecasting and they are able to provide guidance and relevant

weather information, but it is up to community decision makers and private companies

to make decisions based on that information.

> NWS: "I can't tell them to evacuate or not, I can't tell schools to close, that's their decision that they make based on the information I provide."

Traditionally, the main role of the media is getting information directly to the public as

quickly as possible. While they did indeed state this as their formal role, they also

stressed how comfortable they were in dealing with severe weather in particular. As a

Midwestern station, they understood the importance of focusing their attention and

expertise toward severe weather.

> Radio: "The station that I work for has such a tradition for severe weather that when somebody asks me what I do for a living, I say well I work for [X] news, and they say "Oh, you're one of those tornado chasers!"

In understanding each other's expertise and the limitations of their own roles, they

seemed better able to avoid conflicts and work as a team.

### 4.2.5   Intra-organizational Communications and Roles

### 4.2.5.1   NWS

When asked about communications within their office, both the WCM and forecaster focused their discussion to the time when the weather had already begun affecting their area.  The forecaster painted a hectic and loud picture where they're all speaking to each other regularly.  S/he expressed that the most communications are generally between those doing the analysis and those keeping in contact with the outside world either receiving or requesting information.  To a slightly lesser extent, those doing the analysis would be sharing opinions and discussing the data with one another.  When asked about guidance from leadership, the forecaster mentioned that particularly for more severe events they would assign a warning coordinator from the staff to oversee operations.  This may suggest that the WCM is away from the office on these sort of days.

The WCM focused more on communication with other organizations, but when asked specifically about interactions with staff s/he did go into some detail.  Counter to the forecaster's comments, the WCM actually said it will sometimes get quiet within the office as the forecasters focus in on analysis.  On the other hand, s/he later mentioned there is discussion back and forth on the forecast and warnings.  The WCM also suggested that instead of providing guidance on the forecast, s/he focused their advice on how and what information to provide to partner organizations.

This interactive environment aligns well with the feelings of teamwork and fluidity of roles expressed by both the forecaster and WCM.  Both consistently used the terms 'team' and 'we' when describing their within office environment.  Similarly

both we were willing to step into any role needed.  The WCM felt no role was

'beneath him/her' and many times specific roles among staff changed each event.

> WCM: "My role varies, I'm a team member.  I'm not just a WCM, I will be utilized in any role that the staff feels that they need to use me for."

Though the WCM is willing to accept any role needed, s/he also understands and

trusts the strengths of his/her team.

> WCM: "Usually I try and stay away from the forecasting aspect of it.  The meteorologists that are on the floor are out there 24/7 365.  They're more up to speed on the new meteorology and forecasting and so I leave it to them."

The forecaster in particular emphasized the importance of collaboration.  S/he was

clear that the interactive atmosphere enhanced their job.

> Forecaster: "We work together as a team just to make sure we have a consistent message going out… it would be impossible to not have those communications.  They're so important, because if I was in a vacuum, just issuing warnings and not getting any information on what's going on out there, and no one else is talking to me, it would be very difficult for me to do my job."

Despite their strong teamwork and collaboration, conflicts did occur.  Neither

the WCM nor forecaster described them as serious, but rather differences of opinion

that usually naturally worked themselves out.  These disagreements usually stemmed

from decision on warnings, how much information to share with other organizations,

and the accuracy or incoming storm reports.

### 4.2.5.2  EM

From the perspective of the county director, interactions seemed to be

somewhat structured or rigid.  They relied mainly on automated systems to receive

watches or forecasts, but they also checked in with one another to ensure all

information was received.  Once the weather moved into the area, communications involved distributing information to staff, such as reports from spotters, and confirming that everything was received correctly.  These interactions did not seem overly collaborative, but rather necessity.

> Director: "The person with the information… would start out sharing that information and then at some point in the process we'd ask questions to verify that we had correctly received the information and understood it."

According to the deputy director, much of the conversations happened before the event was in full swing.  They discussed the weather amongst each other and kept everyone on the same page.

> Deputy: "We share what we see on radar, we share what intel we get from the Weather Service…we try to keep those that may not be in the office appraised of what's going on."

Once warnings were occurring and the EOC was activated or upgraded, staff seemed to work more independently.

> Deputy: "We pretty much know the routine well enough amongst all of us that we pretty much can just operate independent of each other."

When asked about conflicts, the director discussed the way they handled these situations.  S/he was clear that leadership was very willing to consider differing opinions, but generally only during normal times.  For instance, a disagreement had recently occurred about the timing of EOC activation levels.  This was resolved during staff meetings, rather than during an event.  The deputy director also used this example and described it in a similar manner when asked about conflicts.

> Director: "My staff as professionals have strong opinions and we don't always necessarily agree with one another, but we do always discuss the issue."

### 4.2.5.3  TV

For the executive producer of the TV station, much of their communication with coworkers occurred in the control room once they had begun broadcasting about the storm system.

> Producer: "You're seeing me in the control room really talking to the people who are on the air and planning the next move for what the viewers will see on the air coming up next like in the next 5 minutes."

Not only is the producer collaborating constantly with other producers and anchors, but they are also interacting with the storm chase coordinator, a meteorologist assigned to coordinate the mobile units.  The coordinator aids the producer in determining when and if they need to bring a mobile unit on air.  Since the weather center is in a separate section of the building, the storm chase coordinator also acted as a bridge between the meteorologists and the broadcast crew.

Though the producer didn't feel they had any major conflict within their station, s/he did mention that there may be some heated discussion on when to drop off of continuous coverage.  With consultation from the meteorologist, the lead producer will make the call.

The TV meteorologist had quite a different experience with coworker interactions.  The meteorologists are removed from the control room and tend to focus on the forecasting and communications with organizations.  The meteorologists rely on the storm chase coordinator to alert production of the possibility of severe weather and represent them in the broadcast room.  Any further discussion with production is done beforehand during regularly scheduled staff meetings so decisions can be quick and seamless during the warning time.

> TV meteorologist: "When we see something gets going we make sure production people are ready, so that when a warning comes out and we

need to get right on the air we've got everybody in place and we can get on as quickly as possible."

Both the producer and TV meteorologist agreed that the meteorologists in the station take the lead during a weather event.  They decide when to go on air and control much of what goes on during that time.  Guidance from the producer is on the style and format of the broadcast rather than the content.

> Producer: "Yes, the meteorologists have the lead, but once we're in a continuous coverage situation when we're on the air continuously that's when they kind of get some guidance from me, whether to do an airborne report or a reporter-like shot or get the anchors involved at the time."

### 4.2.5.4   Radio

Most discussion in the news department seemed to be collaborative and conversational rather than guidance and direction.

> Director: "When it comes to the people in the news department, we talk a lot about what's going on, but in a severe weather event we have to move quickly.  There's not a lot of explanation, the explanation on what exactly to do that's already been done."

The director generally acted as a coordinator for the broadcast so s/he will also be having quick exchanges with anchors and the mobile unit coordinator to determine who will be on air next.  Similar to the TV station, the radio station assigned one person to travel with the mobile units, direct them, and act as a liaison for the station.

Similar to the director's sentiments, the on-air anchor also suggested there's little guidance or instruction, but rather informal conversations.  S/he is clear that those at the station are accustomed to severe weather and little changes from their daily routine until the event begins impacting their area.

> Anchor: "No one needs to be told what to do, but we do coordinate what our activities are for that day.  For instance, it might just be

something as simple as if you're in your meeting today, keep your cell phone next to you because you may have to leave your meeting to go chase something today."

For the anchor, the most interactions seemed to occur once they were in the field chasing the storms. At that point, they would discuss the weather and often get advice from more senior members.

> Anchor: "With smart phones and laptops and that sort of thing that we can have in our cars we can pull over and look at those things, and give each other advice."

### 4.2.5.5 Fire

The fire chief focused his/her discussion on interactions with other leadership prior to the weather affecting the area. Executive staff met to discuss forecast timing and severity as well as needed resources and how they might use them. In this environment, the chief mentioned that it was a two-way discussion. Later in the day the chief would direct staff directly under him/her on where they could be most helpful, thus interactions seemed to transition to one-way exchanges. When asked about conflicts, the chief did describe an example of disagreements over reallocation of resources such as fire trucks. S/he commented that the chief always made the final decision in this matter.

The fire fighter provided an extremely brief interview in which he stressed that the station does not become involved until after the event when rescue operations are underway. During this time, the fire fighters would receive guidance from leadership.

### 4.2.5.6 Police

As I was only able to obtain an interview from the police captain, I can only provide a leadership perspective of within office interactions among the police station.

The captain spoke little of the communications between his staff, but s/he did emphasize that he would be sure to forward all information s/he received on to his/her coworkers. S/he also suggested that most exchanges between him/herself and staff were one-way, rather than collaborative.

## 4.3 Nashville Case

### 4.3.1 Introduction

Nashville, TN represents one of the two frequent hazard cases, ranking 15th for number of tornadoes by area over the past 20 years. Additionally, it is the top State for number of strong tornadoes (EF3 to EF5) by area (National Climatic Data Center). Tennessee also ranks 8th for tornado fatalities per capita and 12th for tornado injuries per capita (Geography Statistics). The city of Nashville also meets the population criteria with approximately 620,000 people residing in it.

I was able to conduct interviews with all but one of my chosen organizations. The fire station declined a phone interview, but did consent to a brief, open-ended email survey. For each of the organizations except the radio station, I was able to speak with a leader and general employee. The program director of the radio station spoke for the whole organization, so I was only able to obtain a leadership perspective. A list of specific titles is shown in Table 9. The office of emergency management served both the city of Nashville and the county. The police and fire officials were all at the city level. The TV and radio stations broadcast throughout the WFO region and were chosen due to their reputation for severe weather coverage.

Table 10:    List of Nashville Actors Interviewed (Leadership bolded)

| |
|---|
| **NWS - Leader** |
| NWS - Forecaster |
| **Senior Emergency Manager** |
| EM - Operations Officer |
| **Police Supervisor** |
| Police Officer |
| **Fire Chief – email interview** |
| TV - News Director |
| TV - Meteorologist |
| **Radio - Program Director** |

## 4.3.2   Tasks and Activities

Table 11:    Nashville Tasks and Communication Methods

| Assessment | | Dissemination | |
|---|---|---|---|
| **Task** | **Comm Method** | **Task** | **Comm Method** |
| *Gathering weather/situation info* - on own - receiving from | Radio, Chat, Phone, Social media, Conference call | *To coworkers* - guidance - collaboration | Calls, In person, Radio |
| *Preparing workplace* | In person | *To other organizations* - briefing - updating | Chat, Phone, Conference call, Radio, Social media |
| *Coordinating workplace* - operations - staff | In person, Radio | *To public* - alerts - general info | Social media, Broadcasting, EAS, Website |
| *Analyzing weather data/info* | In person | | |

### 4.3.2.1    Gathering Weather/Situation Information

Largely, the gathering of information involved receiving it from another organization or coworker, but the actors did do some active searching of their own. For instance, interviewees from all organizations mention monitoring the weather and/or situation.  Monitoring generally occurred early in the event before the weather was fully impacting their area.  The most popular methods of monitoring were through displaying radar or forecast websites on their computer.  These methods were mentioned by most of the organizations, but NWS and the TV station put the most emphasis on them.  Later in the event, once the weather was affecting the area most organizations mentioned the continued use of radar to gather storm information.  In addition, the radio station discussed on-scene reporting and social media as ways to actively retrieve their own information on the event.

> TV: "I have several different sites that I get model information, to get the forecast.  Obviously I'm checking in with SPC to see what they're saying, also our local NWS to see what they're saying as well.  So I'm using a very broad spectrum of information to try to make sure I know what's going on."

> NWS: "When you're working the radar you are looking for severe storms, or tornadic cells."

Receipt of information from another person or organization largely came in the form of reports.  The NWS, EM, and media all mention receiving storm reports from outside their organization.  The majority of these reports were transferred through NWS chat or amateur radios.  The TV station also mentioned receiving reports from the public through phone calls.

NWS: "So there's an expectation then that when someone in the local area hears a damage report they get it to us as fast as they practical can."

Prior to the weather impacting the area, the EMs mentioned receiving valuable information from the NWS through a conference call. This seemed to be a regular activity during times when severe weather was likely. The EMs would receive a daily forecast discussion including possible upcoming severe situations.

Information was also being received from coworkers during an event. For instance, the EMs gathered situational information from coworkers in the field either through two-way radios or brief phone calls. The TV and radio stations received forecast and storm information from their station meteorologists.

### 4.3.2.2 Preparing Workplace

The nature of the preparation varied greatly by organization. Preparatory activities were most prevalent for EMs. They dealt with activating the EOC, calling in relevant actors, and receiving them into the physical location. Both the EMs and NWS mentioned staffing considerations; in some case they needed to call in more employees to deal with the event. The fire and police stations focused their preparation on checking equipment and prepositioning resources such as personnel or response tools.

EM: "[We] try to be proactive and putting some people in place even if were just on standby. Getting them in the shop, getting them ready to get out there."

Fire: "We revisit our current status with response capabilities."

A variety of organizations (EM, NWS, Police, TV) mentioned setting up or developing a plan for the day. The nature of this plan varied though. For the EM and police station, creating plans generally occurred during normal times throughout the

year.  More specific to the situation rather than general planning, the TV station discussed setting up a "game plan" early in the event focused on staffing and broadcast decisions.  Likewise, the NWS planning dealt with assigning responsibilities and workload for the day.

> NWS: "We will geographically separate our warning area into two, the radar operator number 1 will get half of the area and radar operator number 2 will get the other half."

### 4.3.2.3   Coordinating Workplace

For the police and TV stations, much of their staff coordination occurred between employees in the main location and those in the field.  When the event was in full swing, the TV station had to guide the field crews reporting on scene.  Similarly, the police station assisted with incident command ensuring that patrols in the field received what they needed.  Generally occurring before the weather had begun impacting their area, the fire station and EMs had staff meetings to discuss the details of the upcoming event and if necessary assign tasks and roles to employees.

> Police: "We would assist with the incident command, we wouldn't actually be the incident command, we would have the patrol supervisors in the field."

> Fire: "We would have an informational staff meeting with staff receiving assignments."

In order to coordinate their workplace operations, NWS considered who would be focusing on what and organized their seating arrangement accordingly.  Additionally, the employee assigned as warning coordinator for the day would need to coordinate overall operations.

> NWS: "It's important, the way the office is set up, it's very important that you have the radar operators working next to each other and then

the HAM radar operators near the intern and the person doing the reports."

For the media, coordination of operations mainly involved coordinating the broadcast of information. The radio station spoke generally about ensuring the procedures were being followed and warnings were being correctly transmitted. Broadcasting seemed much more active and intense for the TV station. Coordination of broadcast and staff overlapped significantly. Producers were required to manage field crews by deciding when to bring them on air. They also guided the meteorologists while on air ensuring that they were providing comprehensive coverage.

> TV: "I've been relayed the information to, 'Be sure and reset.' What they're trying to tell me is make sure that you pull back out and show the bigger perspective because … you want [the audience] to see where they are."

### 4.3.2.4   Analyzing Weather Data/Information

While other organizations such as the EMs and fire station monitored radar to track locations of storms, NWS and the TV station were the only organizations to discuss analysis of weather data. The daily jobs of NWS forecasters and TV meteorologists require the analysis of weather data and information. This is only enhanced during a severe weather event. Interestingly, neither the NWS WCM nor forecaster spent much time discussing analysis of data. They discussed it broadly mentioning that analyzing the radar and issuing warnings were a priority.

> NWS: "Now when you're working the radar you are looking for severe storms, or tornadic cells, your issuing short-fused warnings for those storms you deem to be severe."

In other words it was clear they were analyzing data, but gave little details or explanation. The forecaster discussion was actually focused more on office and

alerting procedures such as splitting up the forecast area, logging calls, and warning wording.

> NWS: "We would then make sure that our, the hazardous outlook, we would want to make sure that that product is in line with what SPC thinking is in terms of our severe weather threat."

The TV meteorologist discussed analysis in a bit more detail. Their analysis was done both privately and publicly. In other words, the meteorologist would be both examining weather models to create forecasts off screen and explaining various products and tools on air.

> TV: "Were doing storm tracking using some of our analysis tools on the air to take a look at wind products, just every kind of facet that we can use to see what's going on."

### 4.3.2.5    Dissemination to Coworkers

Dissemination of information to coworkers generally came in the form of briefing, collaboration, or guidance. Briefing was the most frequently mentioned type of exchange among coworkers. All organizations except NWS directly discussed this form of interaction. Briefing mainly occurred before the weather had begun impacting the area and was generally a similar type of information across organizations. The TV station meteorologist mentioned alerting the newsroom and producers of the possibility of severe weather so they could prepare on their end. Similarly, the radio station discussed alerting the control room

> Radio: "We make sure, you know say, 'hey heads up, we got a chance for some severe weather tonight, make sure you stay on top of what the TV stations are doing, pay attention to the EAS messages if they come down,' that sort of thing."

TV: "Make sure that our managers and our newsroom knows what's happening with the weather and as far in advance as possible, so we can plan to react."

The EMs, police station, and fire station would also give officers and staff a 'head's up' on the upcoming weather. For the police, this sometimes included issuing extra supplies to their officers ahead of time. Generally briefing was fairly casual although staff meetings were sometimes held particularly among the emergency response type organizations.

EM: "I probably stuck my head in one of their offices earlier in the day and said, "Looks like towards the end of rush hour, we'll have some storms in the area".

NWS and the TV station seemed to be the most collaborative organizations. NWS forecasters were incredibly vocal to one another during the warning process, but generally in the form of guidance rather than extensive collaborative discussion. In particular, the forecasters may get advice from the warning coordinator or the actually WCM. They remind staff of the 'bigger picture' and occasionally offer scientific guidance.

NWS: "As an example we've issued 25 tornado warnings and haven't had a single tornado, an event coordinator might mention that let's take a closer look at the environment before we issue any more tornado warnings. Something like that, but overall it's bits of information that are blasted out with occasional interactions."

The TV station mentioned a lot of back and forth conversation between coworkers while on air. Since they are generally analyzing data while broadcasting, discussion of the forecast and products occurs frequently.

TV: "In the middle of the event were talking because we're live the whole time, we'll talk on the air about what we may be seeing and we do pass it back and forth."

97

Additionally, a producer may offer guidance to those on air generally regarding the style of the broadcast rather than the meteorological content.  For EMs, staff meetings may cross over from one-way briefing to more two-way collaboration regarding the severity of the event and whether to activate the EOC.

> EM: "We'd talk about the severity of what was coming up and the partial activation of our EOC."

### 4.3.2.6   Dissemination to another Organization

Most dissemination to other organizations came in the form of briefing and collaborative updates and discussion.  Before the weather was affecting the area, NWS would hold a conference call and brief EMs on the forecast and event.  The EMs would in turn alert other emergency response and community organizations as well as city/county officials.  NWS would continue to provide warning and forecast updates to organizations through NWS chat as weather impacted the area.

> NWS: "A lot of the times an emergency manager is the person that the county mayor and the superintendent and everyone else is calling, they're calling on that person during severe weather so that person is in turn calling us so we're supporting their decisions at the county level with weather information to best of our ability."

Once the EOC was activated the EMs continued briefing organizations on any storm updates.  Interactions between organizations organized through the EOC became more collaborative as they prepared for response.  In fact, NWS and the fire and police stations all mentioned sending a representative to the EOC.  Overall, EMs seemed to facilitate discussions centered on coordination of response.  In this instance, collaboration may also entail the dissemination of material resources to aid in response.

EM: "Water department they play a key role, especially in a flooding situation. Is it going to be severe enough that it might contaminate our pumping station or treatment plant? If there are power outages happening, can we get the power company out there restoring power?"

Primarily through phone calls and NWS chat, the EMs and TV station would provide storm and damage reports to NWS as well as each other. Beyond this one-way transmission of reports, more collaborative efforts would also occur. The EMs would often verify incoming reports and share their findings with NWS and the TV station.

EM: "Occasionally you'll see something that's just erroneous and we'll get somebody to run out and verify that and make sure that really happened. We can say 'Hey we verified that it's not happening at that location'."

### 4.3.2.7 Dissemination to the Public

NWS and media were the only organizations to mention disseminating to the public. NWS frequently mentioned issuing of warnings and statements as a general activity, but the forecaster also extensively discussed the NWS-wide alerting procedures. They focused on the formal operations including automatic watch text and storm based warning polygons. Beyond this, s/he also went into some detail describing wording decisions within warnings and statements.

NWS: "It's up to forecaster discretion really if were in a slight risk, but there's the option to include severe weather wording, such as 'thunderstorms likely, some thunderstorms may be severe'."

For the TV and radio stations, dissemination was a bit more direct in that their main audience was the public and they spoke to them through their broadcast. As may be expected, the TV station provided extensive coverage of the weather event on air. They discussed the general activity of broadcasting information to the public, but also went into greater detail on the type of information.

TV: "Without a doubt I think we are obligated to our viewers to keep them updated on what's going  on, where a storm is, where it's going next, and what they need to do to prepare for it, or how they need to act at this moment to get themselves ready and to protect themselves and their family."

The radio station ensured that EAS messages were consistently transmitted over the air during an event.  They considered this bare minimum and strived to provide more detailed information.  In fact many times they would already be discussing a warning on air before it came through on EAS.  Instead of allowing the information to be repeated, they'd simply remove the EAS message.

Radio: "It's also our failsafe in terms of maintaining our commitment to the public, that is our EAS… If we get warnings once we've gone into full long-form coverage mode, we will frequently delete the EAS messages because we'll get notification or changes in warning before the EAS system is engaged."

The radio station also mentioned that they may conduct some on-scene reporting if the opportunity presented itself.  It was not as formal as arranged mobile units, but it allowed them to present something extra beyond reading warning text.

Radio: "I wasn't at the station and we launch our continuous coverage and I just go to the nearest spot where a tornado had been if I was closest to it and do some on-the-scene reporting."

### 4.3.3 Inter-organizational Communications
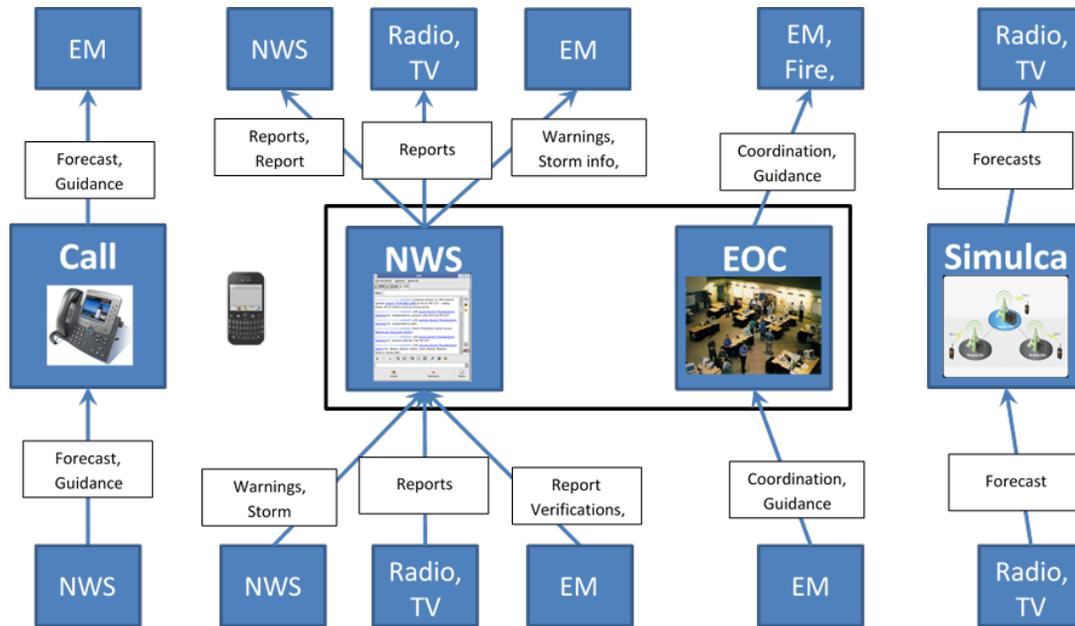


Figure 3:    Nashville Communication Methods and Structure – Graphic shows the most common/popular communication methods among the organizations, who provides and receives the information, and the content of the information itself.

#### 4.3.3.1 Conference Call

Though conference calls were discussed only by NWS and the EMs, they were an important communication tool for these organizations.  The NWS forecaster highlighted SPC as a source and partner.  While it is not local to their specific WFO, it is important to note that the forecaster described the conference call with SPC prior to a watch being issued.  Because watches encompass a large area and are official issued by SPC, they described it as an important process for ensuring everyone is on the same page.

NWS: "As we get closer to the event, SPC will have a conference call with surrounding weather service offices… and we will discuss the watch area, the timing, as well as the geographic area, what counties we want included and that kind of thing, so that were all in agreement."

Brief conference calls between EMs and NWS occurred daily during the season in which severe weather was expected.  During or just prior to an actual event, the calls would be modified for the situation and include other organizations.  Neither the EMs nor NWS went into detail regarding the information provided or who else was included.

EM: "Every day we'll do a call, a conference call at 11 am.  Forecasters and emergency managers will call in and basically do a weather briefing, looking ahead at the week, any severe potential, or situations."

### 4.3.3.2   NWS Chat

NWS chat was the most frequently mentioned communication method among the organizations; NWS, the EMs, and the media discussed it.  NWS highlighted chat as an excellent means for communicating a great deal of information to a variety of partner organizations.  Specifically they listed many of the organizations including amateur radio operators, EMs, public works and more.

NWS: "It's a broad cross-section of customers at multiple levels of government and it's a key part of our ability to get and give information."

They not only utilize chat to explain their thinking and disseminate warnings, but also to receive storm and damage reports from a variety of sources.

NWS: "It's a great chance for us to kind of lay it all out there, what we thinks happening and get information from them."

The EMs utilize NWS chat in a unique way by displaying it on the big screen within their EOC.  In this way all representatives present at the EOC can view storm

and damage reports coming in through the chat.  The EMs will also contribute to the

chat by verifying questionable or erroneous reports.

> EM: "We put it on our large screen at the EOC so everybody can read
> it.  We actually sit there and watch reports come in on the chatroom…
> You'll get information about damage, flooding."

> The radio station observes chat in conjunction with calls from listeners in order

to collect storm reports. While they did not mention contributing to chat, they did

emphasize its utility in keeping the station updated on the situation.

> Radio: "I've found it to be absolutely one of the best, most efficient
> ways to stay on top of things."

> Radio: "Honestly, we'll get a sense that there are new warnings coming
> sooner from the NWS chat so we're ready for it."

On the other hand, the TV station appeared to be fully engaged in NWS chat, sharing

and receiving information not only from NWS, but also the EMs.  They provided

information from viewers and received storm reports from the chat as well.

Additionally, they emphasized the importance of NWS chat for detailed information

on the warning and forecast.

> TV: "We take advantage of the NWS chat line and we can give them
> tidbits that we might get from viewers or storm spotters and they also
> share information with us back and forth.  The emergency managers are
> also on that chat line as well.  That's a great way to share information
> during a storm to see what they're thinking, if they're thinking about
> issuing a warning, we could see those kinds of information ahead of
> time.  They're really key to what we do."

Strangely, the director did not emphasize chat; s/he explained that the meteorologists

were the only staff in the station to use it and that was usually to observe.

### 4.3.3.3   EOC

While the EMs activated and ran the EOC, many organizations participated. By including a variety of representatives and displaying NWS chat, the EOC became an interactive mechanism for gathering information about the situation and organizing response.

> EM: "We'll get a representative from each of those agencies in the same room that way we can monitor it all together and coordinate it together in person."

Unsurprisingly, as response organizations the fire and police both sent representatives to the EOC. In fact, much of the weather and situational information received by the fire and police came from the EMs through the EOC.

> Police: "We have a war room, our office of emergency management, we have a police representative go up there and work out of the EOC."

In addition to response organizations and community officials, the EMs also invited a forecaster from NWS to act as a liaison at the EOC. This allowed the EOC to have a direct link with the NWS and ensured accurate weather and forecast information.

> EM: "When we activate our EOC we have a meteorologist from the NWS come out and they'll have their own seat. They're sitting there with the rest of us. Any information going in or coming out there verifying back at their office."

The NWS corroborated this practice and commented on its effectiveness in developing relationships and allowing them to become more involved in response and coordination efforts.

> NWS: "We're frequently deployed to EOC here in Nashville… Those are great ways to be in embedded in their operations and really cement that relationship and help it out."

### 4.3.3.4 Simulcasting

The radio station emphasized their partnership with the TV station and the effectiveness of simulcasting. Due to their small size and lack of resources, the radio station relied on the TV coverage to provide valuable forecast and storm information to their listeners. They even mentioned a business benefit of simulcasting; this practice seemed to increase their viewership dramatically.

> Radio: "I've had situations where just simulcasting the TV feed gets exponentially-at least twice if not up to 5 times more listening during that period."

As with any partnership, some issues did arise. Due to the visual nature of TV coverage, the simulcasted information did not always translate well over radio. The radio station consequently mentioned a need for more descriptive wording while simulcasting is ongoing. Regardless of these challenges, they continually emphasized the benefits of their partnership.

> Radio: "When we join the TV station for continuous long-form coverage of some weather event, is that they are all geared towards visual references."

In contrast, the TV station did not highlight their relationship with the radio station and only mentioned it when prompted. They did note that the radio station would simulcast their coverage on occasion, but did not go into detail on the subject.

> TV: "We do have a network of radio stations owned by a group. If there was a big event in Nashville… they have taken our coverage live."

### 4.3.4 Inter-organizational Roles and Relationships

### 4.3.4.1 Feelings and Opinions toward other Organizations

For nearly all organizations, interactions went beyond necessary warning time communications; they developed opinions of and relationships with one another. In particular, positive feelings and strong bonds between organizations emerged as a theme. NWS specifically mentioned frequent contact and good relations with the EMs and the TV station. In both cases, NWS mainly focused on the development of normal time relationships, though they did mention the effectiveness of liaising at the EOC in cementing their relationship with the EMs. NWS emphasized the importance of building strong relationships during off times through trainings, workshops, and casual meetings.

> NWS: "As far as relationships I think a big part of my job is maintaining good relationships when the weather is fine, so I use [those days] for providing the best service we can to our customers and providing a good relationship because you don't have the time to build a relationship during severe weather it has to be ahead of time."

The EMs expressed positive feelings toward NWS in return, referring to one another as a team. They seemed to trust the expertise of NWS and appreciate their explanations and advice.

> EM: "We would follow their guidance, pretty good working relationship between our office and [NWS]. So they'd be glad to share their advice, together were a pretty good team."

Unsurprisingly, the EMs frequently worked with the fire and police stations, but their relationships seemed to go beyond necessary interactions. They expressed how well the response organizations work together during a severe weather event, referring to their relationship as supportive.

106

EM: "We're unique; we really work together so often, we have a supportive relationship."

In agreement with this, the police station also noted strong working relationships with the EMs and fire station.

Police: "There's several committees were on with the fire department. I think we have a really good working relationship with them and their special operations group."

Broadly, the TV station continued to reiterate the synergy of the system; they felt the organizations were ultimately all working toward the same goal. In agreement with NWS, the TV station also highlighted their strong working relationship. They tended to defer to NWS as the weather experts, but also saw their relationship as very collaborative. Many of the TV staff and NWS officials seemed to know each other on a personal level rather than just professionally.

TV: "We have a great working relationship with our local NWS office... everybody knows each other by name"

Additionally, the TV station briefly mentioned the importance of the EMs, particularly directly communicating with them through NWS chat. Though they spoke positively about their interactions with the EMs, they did not specifically describe their relationship with the organization.

TV: "The emergency managers are also on that chat line as well... they're really key to what we do."

The radio station continually spoke highly of the TV station. Rather than emphasizing their relationship, they highlighted their regard and respect for the TV station. Though interactions between the stations were not frequent, the radio station was clear on the importance and effectiveness of their partnership with the TV station.

Radio: "We don't have a huge staff and so we really depend on our TV partner a lot... It's just the credibility that the TV stations work so hard to maintain tends to follow them."

Similarly, while they didn't discuss direct interactions with NWS, they did note their trust in them as a professional and accurate group.

When organizations work frequently with one another, conflict is generally inevitable. While the organizations did not discuss disagreements unprompted, some did express some minor issues when asked directly. The TV station mentioned instances in which their meteorologists may not agree with the warning or forecast being presented by NWS. They treated this more as an occasional difference of opinion rather than a major, reoccurring conflict.

> TV: "It's pretty seamless, I think like anything when it comes to meteorology there might be times when you may not agree with maybe a warning they issued, but that's not really our place to say that on the air."

NWS was the only other organization to mention strained relations with another organization. Though they didn't go into detail on specific conflicts or explanations, it was clear they did not have a close relationship with the police.

> NWS: "No, police are funny, we have we do not have a lot of relationships with local police. They are not, I don't want to say they're standoff-ish, but they simply have other I think they feel like they have bigger fish to fry than preparedness"

Additionally, NWS discussed the occasional misinterpretation of forecast or warning information and the friction that can cause. This was especially pertinent in situations in which time was spent preparing in advance for a severe weather event.

> NWS: "Occasionally information can be misinterpreted, you know forecasting weather is not exact science and occasionally there's some frustration when a forecast doesn't go a way that it's expected to. We're fortunate with our relationships here that we can usually resolve that in a good natured way."

As shown in the quote above, while some organizations were willing to admit struggles, they emphasized the issues were minor and did not interfere with their overall relationship.
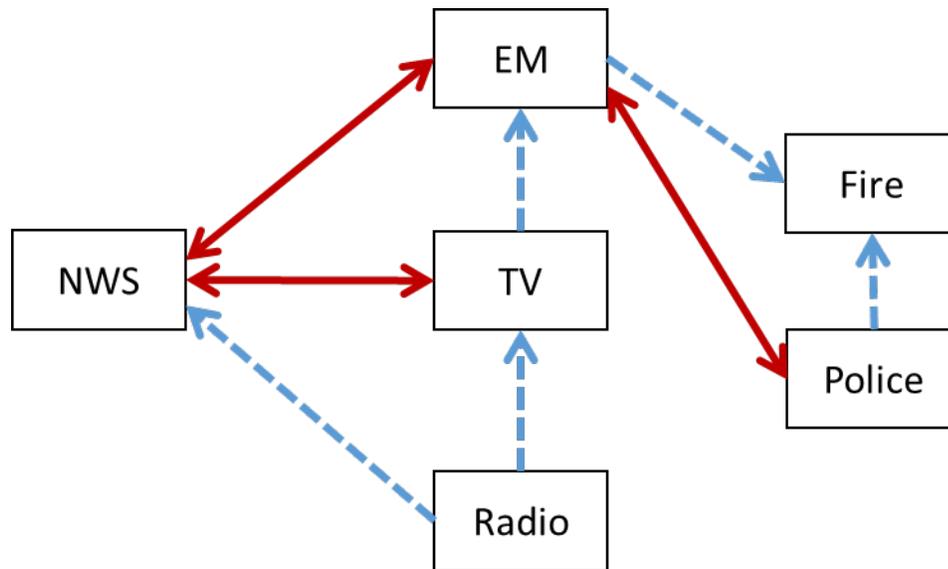


Figure 4:    Feelings toward other organizations - Red double arrows signifying mutual positive feelings/opinions; blue dashed arrows signifying one-sided positive feelings/opinions (the other organization made no mention one way or the other).

**4.3.4.2    Confidence and Roles within the System**

Nearly all of the organizations either specifically described their role or expressed confidence in their ability to offer support in the warning system.  For instance, NWS directly stressed that their role was of a supportive nature.  They expressed a clear understanding of their customers' needs; they understood that state and local officials, as well as community organizations required accurate weather information in order to properly do their job.

NWS: "We're the go-to office for the state as well. We really view them as our high level customer and we understand their role. A big part of their role is community preparedness. We view our role as supporting their role at the local and state level."

NWS felt it was beyond their role to make decisions for the community, instead they noted their expertise was in supporting those decisions by providing severe weather information.

NWS: "Yea, we do decision support we don't make decisions. So you know occasionally I'll be asked a question 'should I send the kids home from school?' And I can't give advice on that, but I can say that there's a likelihood that you're going to have significant severe weather in your county from 2 and 4pm and that can help that person make that decision."

The media stations both emphasized their active role in the warning system, implying that they went beyond what was necessary or required to provide the best coverage possible. For the radio station, they discussed how extensive experience in severe weather events had built confidence and a strong reputation.

Radio: "I've been involved in I don't even how many tornado warnings back in the days before we started declaring tornado warnings and went with confirmed sightings."

Radio: "I think we have a higher news image and I think there's an expectation there that we're going to be one of the primary sources."

The TV station also noted their reputation as an important source, commenting that they were "known for their severe weather coverage." They were also clear that they were willing to go beyond what was required of their organization to ensure their viewers were informed.

TV: "We even had other people in other parts of the station who had nothing to do with the news aspect of the station will still act as support during big events… we blow out commercials and lose a lot of revenue just to make sure we've got weather covered."

Similar to the media stations, an EM also expressed how comfortable they were with severe weather. S/he was confident in their ability to understand the weather situation and prepare effectively.

> EM: "I've been doing this all my life, so I can pretty much tell by looking at the radar, knowing what time of year it is, the terrain how bad it's going to get."

Overall, the organizations seemed to emphasize the importance of their role in severe weather events and their willingness to go above and beyond if needed. Though the police station had a more rigid structure than some of the other organizations, they still expressed a willingness to go beyond normal operations.

> Police: "We had a major flood event here and none of our officers were trained to do anything around the water, that's our special operations crew. We had to learn quickly, to do stuff we weren't prepared to do... we kind of stepped outside our boundary of what we were trained and our scope of work because we wanted to rescue lives."

## 4.3.5   Intra-organizational Communications and Roles

### 4.3.5.1   NWS

NWS seemed to be an office built on communication and fluidity. Despite this flexible environment, a leader was always assigned to manage the event. This warning coordinator ensured that all staff were remaining situationally aware and operations were running smoothly. Despite the similar name, the warning coordinator was not always the WCM.

> NWS WCM: "Whoever's working as the coordinator, if it's me, occasionally just saying, just trying to make sure everyone is situationally aware and we'll make a statement about the status of the event."

111

Both the WCM and forecaster mentioned the fluidity of roles within the office, both directly and indirectly. The WCM, though typically acting in the role of a leader or coordinator, would be willing to take over any role needed within the office.

> NWS WCM: "Occasionally I'm the warning operator, occasionally I'm someone that's actually in one of the desks, in one of the roles, I could be a forecaster or I could be something else. Typically my role tends to be one of coordinating the actions of all the people working the event."

Depending on the severity, staffing, and other considerations, the roles vary from event to event and even throughout the day. It did not appear that any one staff member remained in the same position for long.

> NWS forecaster: "The roles can vary, you know a lot of it will depend on the number of people we have on the shift to work the event."

The forecaster especially emphasized how important staff interactions were within their office. In fact, s/he even noted that they reorganized their office several years ago to foster more effective communications. The forecaster explained in detail how complementary certain roles were and the importance of those individuals working in tandem with one another.

> NWS forecaster: "It's important, the way the office is set up, it's very important that you have the radar operators working next to each other and then the HAM radio operators near the intern and the person doing the reports."

Though in lesser detail, the WCM also mentioned the interactive environment of their office, commenting on how "hectic" it could become with staff shouting back and forth. In agreement, the forecaster, explained this further; s/he described the process of keeping each other informed on important updates.

> NWS forecaster: "It's important for the radar operator when he/she is issuing a warning to kind of say what you're doing. 'OK I gotta issue a severe thunderstorm warning for the cell over southwest Williamson

County'… Anyone who receives a report, they'll announce the report, but they'll also give the hand-written report to the person doing the reports."

Conflicts within the office were not discussed until prompted. When asked specifically about disagreements over warning, both the forecaster and WCM admitted this occurred, but felt it was easily resolved.

> NWS WCM: "Yea, that's the one place it can occasionally get a little bit contentious, but it's usually resolved between the individuals or with the help of a coordinator."

> NWS forecaster: "Communication it's very important and so through that training, I think it teaches us early on that it's better to respect people when there's a difference."

### 4.3.5.2   EM

Overall, the EMs did not emphasize interactions within their organization. They focused less on the frequency or importance of the communications and more on the nature of information. EM operations staff would be in contact with those in the field, receiving storm and damage reports. Dispatch would then be relaying information and updates to those at the physical EOC location.

> EM operations officer: "Were going to have people out in the field, so we're going to be interacting with them over the radio and they're going to be sending us information as to road conditions or road closures or things like that and then also my dispatch would be in contact with the people that are activated down in the war room so they can brief the mayor and media and things like that."

Due to well established procedures, staff among the EMs seemed to have specific roles. Guidance from leadership didn't seem to be frequent; it occurred in the form of formal procedures and instructions given during staff meetings ahead of the event

> Senior EM: "If there was something that needed to be done, instructions given for an upcoming weather event. We would have meetings here."

113

EM operations officer: "I try and help them before, but you know we have standard operating procedures so for the most part that's going to be in writing for what you need to do for each particular incident."

Conflict also seemed to be infrequent. In fact, the operations officer could not remember any instances when asked directly. The senior EM noted occasional disagreements over radar interpretation, but they seemed respectful of all opinions and willing to work out the differences.

Senior EM: "Well you're always going to have differences of opinion. You can take 3 people all looking at the same radar picture and you're going to get different answers from all 3 people, based on experience... There's no wrong answer, we take everybody's opinion and we consider it."

### 4.3.5.3   TV

The director was constantly in contact with the meteorologists receiving information about the storm system and ensuring that all information was being covered on air. S/he worked with the meteorologists to ensure that the mobile units were in place and safe. The director might also provide some guidance to the meteorologists while on air regarding the style of the broadcast, but in general everyone seemed accustomed to the procedures.

TV meteorologists: "Usually it's the same, we pretty much got our pattern down on how we do things, but occasionally they might speak to me through a system in my ear and give me some specific direction."

The TV meteorologist emphasized communications particularly among those on air. They seemed to use the broadcast to not only interact with the public, but also each other by discussing the situation and their opinions.

TV meteorologist: "I'm usually on the most, but then I'll toss it over to a coworker, maybe they've got something they want to show or share and we'll do that. Were really talking about what's going on, what we need to be doing and where the storms are headed."

The meteorologist also described a supportive environment before the event through the actual broadcast. S/he would ensure that the newsroom and leadership within the station were aware and prepared for the upcoming weather. Though s/he would be leading the broadcast, the meteorologist relied on coworkers to run equipment and display graphics.

> TV meteorologist: "I make sure that our managers and our newsroom knows what's happening with the weather and as far in advance as possible, so we can plan to react. That's a really important part of my job is getting that forecast information to them."

> TV meteorologist: "I have to have help from my coworkers who are actually running the equipment and were doing storm tracking using some of our analysis tools on the air."

Also indicative of a supportive environment, when asked directly about conflicts within their station, both the meteorologist and director responded similarly, commenting they all have the same mission and work well as a team.

> TV meteorologist: "We have a pretty tight team. We don't really have any big issues. I think we all just know our role and I think we work really well as a team."

### 4.3.5.4   Radio

Since I was only able to speak with the program director of the radio station, I'm only able to discuss office interactions from a leadership perspective. The director focused more heavily on dissemination to the public through their broadcast and simulcasting, only briefly mentioning within station communications. Overall the environment did not seem to be overly interactive, with already set up procedures guiding most operations. The director did mention that s/he would update the control room to ensure they were aware of the severe potential.

115

Radio director: "Basically, it just has to do- I mean we have stated policies and procedures on how things progress."

Radio director: "We just kind of touch base particularly as we go into the evenings with the technicians in the control room."

When asked directly about conflicts, the director again reiterated that operations tended to run smoothly, but did admit some friction with sales management over commercials during weather events.

Radio director: "I think we have it all pretty worked out, the only one is that when we go into continuous coverage, I think the sales managers wince just a little bit because we don't run commercials during that time."

#### 4.3.5.5 Fire

Unfortunately, I was unable to obtain a phone interview from the fire station. On the other hand, they did consent to a short email survey with four open ended questions. Answers to these questions were very brief and did not go into detail on communications or roles within their station. The only mentions of interactions were meetings ahead of the event to provide staff with assignments.

#### 4.3.5.6 Police

While the police officer did not mention interactions with coworkers, the police supervisor went into some detail regarding communications with his/her staff. S/he emphasized his/her role as in support of the officers in the field. In fact, the supervisor felt it was their primary role to "communicate with the officers, what is going on, how to deal with it, things they can do to prepare." Specifically, their division within the station would assist with incident command.

> Police supervisor: "We would go ahead and make sure they set up the incident command and its run right and help them the logistics of getting in anything they needed."

No conflicts were mentioned by the police officer or supervisor. When asked directly both simply said 'no'.

## 4.4 Raleigh Case

### 4.4.1 Introduction

Raleigh, NC represents one of the two non-frequent hazard cases, with no one damaging hazard occurring continually. While it does receive its fair share of tornadoes, they are generally weaker with minimal damage (National Climatic Data Center). Additionally, even though North Carolina experiences tropical systems, it is ranked as one of the lowest States for hurricane impacts. Furthermore, the Raleigh WFO is entirely inland and thus does not generally experience the level of surge and wind impacts felt by the coastal areas. The city of Raleigh meets the population criteria with approximately 400,000 people residing in it.

I was able to conduct interviews with all but one of my chosen organizations. The city and county level police both declined participation in the study. For each of the organizations I was able to speak with a leader and general employee. A list of specific titles is shown in Table 12. The office of emergency management was at a county level. The TV and radio stations broadcast throughout the WFO region and were chosen due to their reputation for severe weather coverage.

Table 12:     List of Raleigh Actors Interviewed (Leadership bolded)

| **NWS - Leader** |
| --- |
| NWS - Forecaster |

| EM - County Director |
|---|
| EM - Specialist |
| **Fire Chief** |
| Fire Fighter |
| TV - News Producer |
| TV - Meteorologist |
| **Radio - Leader** |
| Radio – Assistant Program Director |

## 4.4.2   Tasks and Activities

Table 13:      Raleigh Tasks and Communication Methods

| Assessment | | Dissemination | |
|---|---|---|---|
| **Task** | **Comm Method** | **Task** | **Comm Method** |
| *Gathering weather/storm info*<br>- on own<br>- receiving from | Radio, Chat, Phone, Conference call, Email, Social Media | *To coworkers*<br>- guidance<br>- briefing | In person, Radio, Email, Phone |
| *Preparing workplace* | In person | *To other organizations*<br>- briefing | Chat, Phone, Conference call, Email |
| *Coordinating workplace*<br>- operations<br>- staff | In person, Radio, Email | | |
| *Analyzing weather data/info* | In person, Chat | *To public*<br>- alerts<br>- general info | Broadcasting, Website |

### 4.4.2.1  Gathering Weather/Situation Information

All organizations interviewed discussed gathering information about the
weather or situation either by receiving it from another person or organization or
searching for it on their own.  All organizations gathered some amount of information
on the weather, but NWS and the TV station focused in on more detailed, technical
information.  NWS mentioned gathering model data and displaying radar imagery.

> NWS: "Usually what I would be doing is watching the radar,
> maintaining a weather watch, looking at all observational and
> numerical weather prediction model forecast data."

At the TV station, the meteorologists gathered similar types of weather data,
specifically mentioning their own radar systems.

> TV: "We have 6 degree meteorologists on staff that look at the weather
> and are constantly keeping an eye on things… we have 2 live radar
> systems that we own, maintain, and operate, one of those being the new
> dual-pol radars."

Though the TV station meteorologists focused on weather information, other staff
such as producers gathered more situational information.  They actively listened to
police scanners and watched social media to learn about storm and damage updates.

> TV: "And our producers are looking for data, information, making calls
> to police officers and sheriff's dispatch, all that kind of stuff to try and
> get information."

Similar to this, the EMs and fire station focused on gathering information on
preparations and damages throughout the community.

> EM: "So it's my job to collect all the information from the
> municipalities, roll it up, hand that information to the state… so I'm
> going out and finding out, are you closing any roads, are you getting
> piles ready, are you salting, are you watching any trouble spots?"

The EMs, fire station, and radio station all gathered more basic weather
information rather than the technical data used by NWS and the TV station.  This

helped them understand and prepare for the situation. All discussed watching local TV, but the radio and fire stations also mentioned automated systems that gave them information on the severe weather. The radio station used a calling system run by the TV station and the fire fighters received information through the emergency managers.

> Radio: "I look anywhere I can to get the information - whether I have CNN or the Weather Channel on in the studio or I've got my laptop or other computers in the studio."

> Fire: "We monitor through the communication center Wake County emergency management; we have a notification process to warn all of our command staff that are on duty."

In addition, the EMs and TV station receive briefings from and participate in conference calls with NWS prior to a severe weather event. These calls provided them with more detailed information on what to expect with the upcoming storm system.

> EM: "Every Monday morning at 2:30 we have a conference call for the weekly weather update from the NWS office. So they give us a preview of what's going to happen in our area… then every morning we're watching the local weather just to see if anything has changed."

Storm and damage reports were also frequently received from other organizations throughout the event. NWS, EMs, fire station, and the TV station mention receiving official and unofficial reports through a variety of methods including NWS chat, phone calls, and emails.

### 4.4.2.2   Preparing Workplace

Prior to the weather affecting the area, many of the organizations performed a variety of preparation activities. The fire station and NWS would increase their staffing, even doubling the amount of people in some cases. This may also mean bringing in those off duty and paying overtime.

NWS: "Well typically have at least 3 people here at all times and during the higher severe weather events we'll usually have 2, 3, 5 additional people here."

Fire: "What we will do if we have enough warning, we will augment our manpower, we'll pay overtime and bring in off duty members to beef up each of our companies because manpower is critical."

Staff meetings were then used by NWS, EMs, and the TV station to brief everyone on the event and potentially set up informal plans for the day. The fire station also frequently mentioned planning, but generally in the context of response following the event. They discussed how many trucks to send to each call, prioritization of resources, and other response issues.

EM: "Every so often in the morning we'll have a face to face meeting where we'll go back and forth and we'll discuss what are we actually going to do today, what are we going to do if things get to this certain stage."

If deemed necessary, the EMs prepared for the event by activating the main EOC for the county and calling in representatives from the community and response organizations.

EM: "If we think it's going to have a significant impact it's up to us to notify the county and activate the EOC for response."

As may be expected, the fire station mentioned sending a representative to the EOC, but interestingly also discussed activating their own. It was not clear how often this occurred or how it connected to the main EOC.

Discussed most frequently by the fire station, checking equipment was also an important preparation activity. They went into detail regarding their procedures for ensuring all trucks and equipment were operational and ready for use.

Fire: "As a weather event goes on, you want to maintain a state of readiness and that's going to require making sure the apparatus is full of fuel because you're going to be running a lot of calls. You want to

make sure your equipment is operational and full of tools such as chain saw and generators and things of that nature, fans and so forth."

The TV station also discussed preparing equipment within their office. They talked about checking computers, software, and radar systems to ensure all data and information was coming in correctly. NWS also briefly mentioned setting up computers before the event began.

> TV: "I also spend a lot of time making sure all the gears works, worrying about computers, making sure that we're getting data, making sure the radar is running in the right mode, and letting people know if something isn't working 100%"

### 4.4.2.3  Coordinating Workplace

Coordinating the workplace involved many different activities and varied by organization. For NWS and EMs, a large part of this task was coordinating staff. Within NWS, the WCM or an assigned forecaster took the role of storm coordinator for the event. They oversaw operations and guided the staff, ensuring that everyone was aware of updates and all activities were being completed. Throughout an event, NWS employees also had to coordinate staff changes by briefing and assigning tasks to those just coming in.

> NWS: "I would say most often the WCM if they're here during an event, they'll usually be the storm coordinator. A storm coordinator is in charge of making sure everybody has their role and is sticking to that role and they keep everyone's situational awareness up and encourage communication amongst the staff."

> NWS: "Some people may have been here for 10 or 12 hours and were trying to get them out of here and then say the incoming shift is coming in, we try to mesh them into the operations and sort of bring them in to the previous person's role."

For EMs, leadership had to make sure the staff member assigned as duty officer for the day was accomplishing all that needed to be done. In general,

leadership also ensured that all staff stayed well informed throughout the event. In many cases some employees were in the field requiring coordination from the EOC on locations and tasks.

> EM: "So, making sure that the staff duty officer is doing what they need to do and monitoring, keeping people informed."

> EM: "For example, we'll start moving equipment and pointing staff towards shelter locations in case we need to shelter citizens, including transit population."

Unique to media, coordination of broadcast staff and materials was a common topic of discussion for the TV station. This entailed coordinating communications with the meteorologists, producers, reporters, and field teams and ensuring everyone remained updated on the situation. The actual broadcast required collaboration with the meteorologists and producers to determine content, style, timing, and other factors. This involved not only decisions on forecast wording and graphics, but also arrangement of the show.

> TV: "I'm directing/jockeying, what have you, sort of coordinating back and forth between the meteorologist who would be on the air and the other members of our team, anchors, reporters, that sort of thing, making sure that our producers know what's happening."

It was crucial to position and direct mobile units to be in the best location for video, reporting, and most importantly safety. Those at the station needed to coordinate these field crews to ensure they were providing the best information and visuals.

> TV: "You're directing crews in the fields: reporters, photographers, telling them where to go, what to look for, what they should be focusing on."

For the fire station and EMs coordination of response began during the event and continued after. The EMs focused most on coordination between organizations and overseeing overall community operations. Many of the times this involved

keeping everyone informed and directing resources.  Fire on the other hand focused

more internally, coordinating resources for their station.  They had to consider the

amount of staff to bring on, the number of fire trucks to send to each call, and

> EM: "Much of our job is coordinating and watching and waiting and if
> problems emerge, specific problems on roadways, we'll notify the
> department of transportation, the utility groups to help work on those."

> Fire: "Anything that's going on at the time, progress reports, do we
> anticipate the need for additional resources to move, what news is
> coming in, in addition then we're trying to anticipate our needs over the
> next operational hour, the next operational five hour period."

### 4.4.2.4   Analyzing Weather Data/Information

Given their background and job responsibilities, it's unsurprising that NWS

and the TV station were the only organizations to discuss analysis of weather data and

information.  The majority of NWS activities revolved around understanding and

forecasting the weather situation.  They described their processes, use of data, and

knowledge of the science.  They emphasized that forecasting required a variety of

tools and it was important to "utilize all data sources and be able to back out and not

get so drawn in to just staring at the radar."  For NWS, analysis required collaboration

with other WFOs and coworkers in many cases.  They found it useful to bounce ideas

off each other and learn what others are seeing.

> NWS: "…issuing warnings based on storm signatures that we see on
> the radar, that were trained to know, trained to infer what's going on at
> the ground from what's going on aloft."

> NWS: "Were looking at the near-storm environment and trying to
> assess the most likely hazards, so trying to brief ourselves I guess you
> could say by looking at the data, both observational and the model
> data."

For the TV station, their meteorologists generally interpreted data under different circumstances. Many times they had a live audience watching and had to analyze information quickly and express it clearly. They relied heavily on their station's dual-pol radar, storm reports, and observations from their mobile units to successfully analyze and forecast the weather situation. The TV meteorologists had to analyze data not only to forecast, but also to determine what would be important and appropriate for the broadcast.

> TV: "It may be as a member of the coverage team on the air, interpreting data on the fly, talking to the public and telling people where the storm is and who's affected, who's not, that sort of thing."

> TV: "We can interpret radar imagery and can interpret reports and things like that that come in on real-time."

### 4.4.2.5 Dissemination to Coworkers

Most dissemination of information to coworkers was done in the form of briefing or guidance. For the EMs it was generally a mixture of both. Leadership offered guidance to officers in the field, particularly the assigned duty officer that day. They provided information and advice to help them respond to the situation. The duty officer would in turn be briefing the office on what to expect for the upcoming event.

> EM: "They'll shoot out a quick update, usually through email, 'This is where we stand, this is what you can expect tonight.'"

The TV station also disseminated information to coworkers through a mixture of briefing, guidance, and updating. The meteorologists worked to brief producers and newsroom staff on the upcoming weather situation. Similarly, those listening to emergency dispatch and scanners updated and briefed management on reports. Staff

in the station would also be guiding mobile units by providing advice on locations and spotting.

> TV: "We're also dealing with our reporters and photographers on the field, letting them know that where they are is safe or where they are is not safe. And obviously guide them to where they might get the best pictures, where the damage might be, that kind of thing."

Unlike the TV station, the radio station focused most discussion on briefing coworkers. This occurred during shift changes as they worked to inform the incoming staff of the situation and any important updates.

> Radio: "Those will be the ones that I would keep in communication with just to let them know what I had done already or what was coming."

Overall, the radio station emphasized a fairly pre-planned environment with set procedures rather than frequent communications and discussion. Much dissemination between coworkers centered around ensuring that everyone was aware of the situation and on alert.

> Radio: "It's more of just making sure that everybody's aware that there could be the chance of something going on so that you're in tune to that."

Information exchange in NWS was typically less guidance and briefing and more collaborative discussion. They discussed and relayed reports to one another and shared forecast information and opinions. Similar to the radio station, some briefing did occur when shifts changed and the incoming staff member needed information on the situation.

In contrast to the other organizations, the fire station actually discussed dissemination of material resources. Leadership within the station provided staff in

the field with resources as they were needed.  As with the radio station, procedures were well established and little instruction and dissemination was needed.

> Fire: "I'm basically the logistics officer, feeding resources into my local commanders based on their assessment of what their needs are to mitigate any threats that have affected them."

### 4.4.2.6   Dissemination to other Organizations

Dissemination of information to other organizations generally came in the form of briefing and some collaborative updating.  Briefing was especially prominent for EMs and NWS.  NWS initiated conference calls and briefed the EMs and 911 centers on the upcoming weather event to help them prepare the community.  While the weather was affecting the area, NWS would continue to provide information through updates on NWS chat.  They provided updates, warnings, and forecast explanations, but did note that this depended on staffing and time.

> NWS: "Well also be in contact with county emergency management and those sorts of people, getting them a heads up and the 911 centers, so we'll give the county 911 centers a heads up call."

The EMs disseminated information briefed to them by NWS to local and state community organizations.  This included fire, police, elected officials, utility companies and other such organizations.  Early in the event the EMs were simply alerting these organizations of the threat of severe weather.  As the event unfolded, they would be providing weather and situational updates to help plan for and organize response.

> EM: "Once we determine that there is a warning or we think a warning is imminent, most of our effort is spent notifying staff across the county and across our municipal agencies that we partner with."

The EMs also provided the media with updates on county decisions and response activities so this information could be broadcast over the air.

> EM: "We provide them [media] information on what we're doing and what decisions have been made and we feed them information about shelter openings."

The TV station provided information to NWS usually in the form of storm reports or forecast data. Since they operated their own radar system, they would share collaborative updates as they noticed interesting phenomena in the radar imagery. The TV station also disseminated storm reports as they received them from their viewers and mobile units.

> TV: "So if we saw something in our dual pole radar data that we thought might be interesting then I might share an image or two."

### 4.4.2.7 Dissemination to Public

NWS and media were the only organizations to discuss disseminating information to the public. When asked about tasks, NWS frequently mentioned issuing warnings as an important activity, but did not specifically label the general public as their intended audiences. In addition to initially issuing the warnings, NWS also discussed updating their forecasts and warnings throughout the event.

> NWS: "It's important to update the grids to remove the probability of precipitation on the back edge of that line of storms to reflect the most up-to-date forecast possible."

Not only did they need to issue and update warnings for the current event, but also keep up with their normal daily and weekly forecasts simultaneously.

The TV and radio stations focused their discussion heavily on dissemination of information to the public through broadcasting. Despite this, the TV station also emphasized the variety of methods they used to alert the public.

TV: "When there's dangerous weather we're going to use everything we have to notify people. And that's not only on television, but we can enter our programming or run the little ticker or crawl at the bottom of the screen and that also involves telling people on social media, on our website."

During a severe weather event, the TV station was usually in continuous coverage, broadcasting information about the storm, protective actions, and damages. They also implied a continual process of determining and improving the best wording, graphics, and tools to present to the public.

TV: "…help our meteorologists communicate better and more effectively in those situations and make sure we're telling people what they need to know when they need to know it and nothing more, so they have the information they need to make a good decision."

The radio station focused less on wording decisions and dissemination methods. They emphasized quickly broadcasting warnings and initiating simulcasting with the TV station.

Radio: "NWS issues a severe thunderstorm warning for our county or any county in our listening area, I have an alert in my email system right away so I can go on the air with it the next chance I get. So that's my first duty."

Radio: "That's when we go and do full simulcast of our sister television station, which also will go in with the continuous coverage. That's probably the extreme, but any time there's any threatening weather, we're always talking it up on the air."

### 4.4.3 Inter-organizational Communications
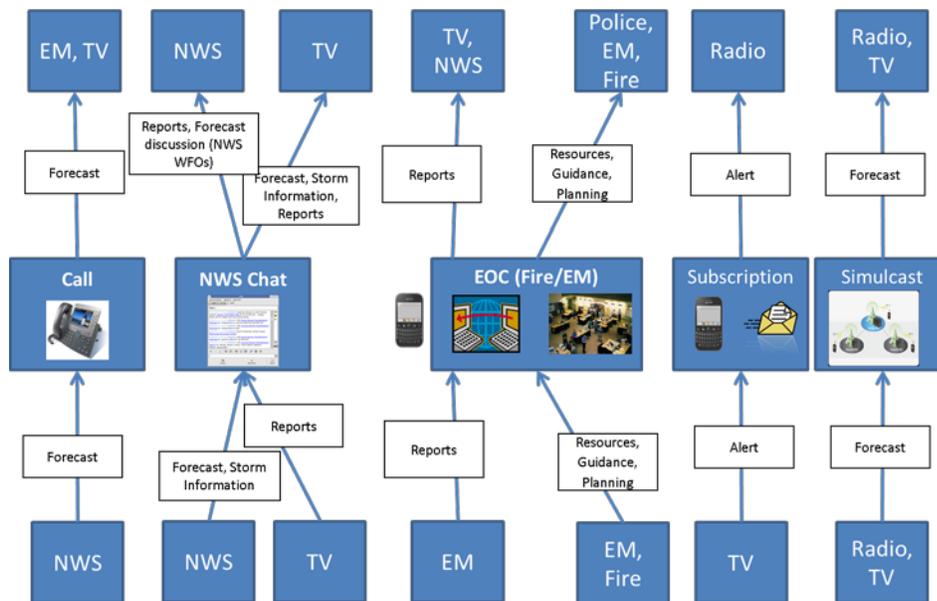


Figure 5: Raleigh Communication Methods and Structure – Graphic shows the most common/popular communication methods among the organizations, who provides and receives the information, and the content of the information itself.

### 4.4.3.1 Conference Call/Briefings

Conference calls were an important method of communication for NWS, EMs, and the TV station. Though not unique to their area, NWS mentioned their initial conference call with SPC and surrounding offices prior to a watch issuance. This nationally occurring practice gave the office a chance to offer opinions on the watch box.

> NWS: "They'll initiate a conference call with the local offices that are impacted by that proposed watch area and just try and pick the brains of the individuals at the local offices and try and coordinate where we're going to draw the box, the tornado watch box."

130

Locally, NWS initiated conference calls with some of the other organizations. Though they did not expand on who would be involved, the EMs and TV station both mentioned their participation.

The TV station mentioned the multi-media briefings they'd receive from NWS prior to the weather impacting the area. Accompanying conference calls or sometimes as a standalone product, these briefings provided the station with detailed information and graphics explaining the forecast for the event. They also mentioned that these briefings would be sent to other media partners and DOT.

> TV: "Their forecasters e-mail us with a briefing ahead of big weather events… they'll put some graphics together that will summarize the event from their perspective and their thinking behind it, and they'll send those to media and DOT's, all that kind of stuff, so we'll receive those, sometimes we'll have conference calls about those."

Similarly, the EMs also discussed participation in conference calls with NWS. They actually attended calls on a weekly basis regardless of the weather. Further calls would occur specific to the situation during a severe weather event. They 'repackaged' the information provided by NWS and disseminated it to community organizations.

> EM: "We're participating in calls with our local NWS office and then from there we take whatever information they've given us and put it in a format that our folks are used to. We give our viewpoint of it, not only on the weather, but on what the county is going to do in response to it."

### 4.4.3.2   NWS Chat

NWS chat was a popular tool for NWS and the TV station. Though the extent of chat use for NWS was dependent on staffing for the day, they did use it to collaborate with neighboring office and share information with the media. They

would use chat to alert surrounding WFOs regarding weather transitioning from one forecast area to another.

> NWS: "We might give a neighboring office a call or a chat sort of like instant messenger chat, 'hey we just received a report of wide spread wind damage from this storm, it's getting ready to move into your county warning area, just a heads up'."

Though chat use was discussed briefly and only by the WCM, s/he did mention that they would provide warnings, updates, and behind the scenes explanations of forecasts. Additionally, NWS would sometimes put out requests for storm reports.

The TV station discussed NWS chat in more detail. They emphasized its usefulness in providing them with more detailed forecast explanations and advanced warning. In fact, they found chat more helpful and effective than traditional NWS products.

> TV: "A lot of times it's they're telling us what they're thinking: they're looking at a storm and they're giving us the heads up that they're probably going to issue a warning on it or maybe why they're not going to issue a warning on it, that sort of thing. A lot of that stuff that doesn't communicate very well in products - the NWS is a very product-heavy group, so a lot of times the NWS chat is what we use for the most part during an event."

While they primarily used it for receiving weather and situational information, the TV station also provided storm reports through chat.

> TV: "They do have somebody from that group listening to that [EM radio] frequency and then relaying reports back and forth from the weather service chat."

### 4.4.3.3 EOC/WebEOC

Both the fire station and the EMs painted the EOC as a dynamic, fast-paced tool for communications and coordination. Initially, the EMs had to review the

information provided to them by NWS and make a decision regarding activation of the EOC.

> EM: "Our job as a specialist is to evaluate the warning, make a determination on the impact to the local government, continuity of government, and the impact of our ability to provide services. If we think it's going to have a significant impact it's up to us to notify the county and activate the EOC for response."

Once in the EOC, the EMs emphasized how crucial it was for all representatives to be prepared to be effective decision makers. They expected all EOC participants to make fast, sometimes difficult decisions on their own.

> EM: "We only permit decision makers to be in the Emergency Operation Center. We do not tolerate the mother-may-I attitude, so if I look to the sheriff's captain that's sitting there and saying 'I need 6 deputies to go here,' he's not permitted to pick up the phone and call the mayor, call the sheriff, and ask permission. He does that, I tell them to get out and go find someone that can make a decision."

All response coordination and dissemination of information from the EMs went through the EOC. Similar to the NWS chat, they discussed a messaging tool, 'WebEOC', that allowed the EMs to communicate with the municipalities within their county. Through this platform they were able to coordinate resources and disseminate storm reports.

> EM: "Of course, all our 12 municipalities within the county, we're in constant communication with them through our information sharing platform which we use, 'WebEOC'; not sure if you're familiar with that. It's just a platform where we can send messages back and forth, including requests for resources and to report significant events."

As a response organization, the fire station would send representatives to the county EOC. In addition, they mentioned activating their own EOC as well. While they didn't expand on this, their EOC seemed to be meant for fire station specific needs and coordination.

Fire: "During a weather event, my responsibility is to be in, to have two officers over in the EOC to coordinate with other city departments. Normally I would be there with two other representatives. We also have at our headquarters, a fire department EOC that we can manage our own resources and my responsibility is to be in the command post, to operate as the central incident commander."

Regarding the county EOC, the fire station mentioned a variety of organizations that they'd be coordinating with including DOT, hospitals, and police. They reiterated that all preparations and response coordination is done through the EOC.

Fire: "We'll know if they've [DOT] got their salt trucks out, their plows out, they know that were taking precautions and preparations so it's usually managed through the EOC."

Communications from the EOC back to their own organizations occurred through phone and radio discussion. This helped representatives within the EOC guide and advise those in the field.

Fire: "So at that point everybody starts to converge, sends their representatives there and we start to do face to face, then we have both telephone and radio communications with our own organizations and then we actually have a band that we can all use that we can talk to each other if we have to inter-operate on the emergency scene."

#### 4.4.3.4 Simulcasting/Subscription

While simulcasting of TV coverage over radio air was a method for dissemination to the public, it also acted as an indirect communication tool between the radio and TV station. Admittedly, the TV station didn't have much direct contact with their partner radio station given the automated nature of their simulcasting.

TV: "And then during the event, we don't pay them any attention at all, which is good and bad. It's good because they've got people on their end who are watching the weather, and if they need to simulcast our coverage they can do that very easily. On the other hand, we do try to be mindful that even though we are on television, we may also be on radio and that dictates to a certain extent what you should be saying."

On the other hand, the radio station relied on the pre-recorded broadcasts and

simulcasted coverage provided by the TV station. They appreciated the automated

nature of the process explaining that it allowed them to quickly provide useful

information to their listeners. The radio station also lacked the capacity of the TV

station and thus benefited from the partnership and extra resources. As the TV station

mentioned above, they did however comment on the occasional issues that would

arise.

> Radio: "If there's a tornado warning for any of those 23 counties, they
> immediately go into long-form coverage and we begin to broadcast
> their audio straight over our airwaves."

> Radio: "And there's so many people over there [TV station] during a
> weather event that there's always somebody that's available for us that
> can do something a little extra for us. It's nice, so it gives us that
> opportunity."

In addition to simulcasting, the radio station was initially alerted to severe weather

through the TV station's subscription service. Radio station staff would receive a

phone call and email notifying them of incoming weather or an active alert.

> Radio: "Here in this town, it's kind of unique; the TV station we own
> has a system called Weather Call. So, I have signed up for Weather
> Call, and so if there's anything that's- any kind of tornado warnings or
> severe thunderstorm warnings I'm able to get a call from them on my
> cell phone."

### 4.4.4   Inter-organizational Roles and Relationships

### 4.4.4.1   Feelings and Opinions toward other Organizations

Nearly all organizations interviewed discussed their relationships with and/or

feelings toward other organizations. The EMs described a strong working relationship

with NWS and the TV station. Not only did they have great admiration for their local

weather office, but they also relied heavily on their service. Their communications with NWS were frequent during weather events, both as scheduled and impromptu interactions.

> EM: "The Raleigh weather service… we've had a great benefit in having them here, and not only them but the personnel associated with that office do a fantastic job."

> EM: "NWS is key. We're in constant communication with them, and when I say constant, they're available at any given time but we usually have regular scheduled interaction with them about every 4 hours."

The EMs also mentioned their good relations with the TV station. Their public information officer worked directly with the station to disseminate response and damage information to the public.

The TV station confirmed strong working relationships with all response organizations. Throughout the year they build these relationships with the fire, police, and EMs by covering a variety of stories. They also expressed mutual trust between themselves and these organizations that extended through to severe weather events.

> TV: "It's some weird wacky fundraiser to raise money for the police department, and they want us to cover it, we have to have a good working relationship with them. We trust them, we're covering all the sometimes hectic stories that they have to deal with."

In addition, the TV station described their unique relationship and interactions with NWS. Periodically during severe weather events their station and the local forecast offices exchange forecasters in an effort to 'shadow' and learn from one another.

> TV: "With the Weather Service, we have a pretty unique program in which we will do forecaster swaps where they've had people come and shadow us, we've had our people shadowing them… I have a very good relationship with the local offices."

When asked directly about conflict with the other organizations, only the TV station mentioned some issues. They discussed the strain and stress of a severe weather day and the resulting tensions. Some 911 dispatcher occasionally lost patience with media due to the hectic nature of the day.

> TV: "And so, not only are you going through a really tough day, they're going through a really rough day. So sometimes you get dispatchers who are very short with you, and they're just blunt."

The EMs also discussed conflict, but within various levels of their organization rather than with other organizations. For instance, they briefly mention some issues with state and local level EM policies. On a local level, they feel that one position in particular has not been as successful as it could be.

> EM: "For the city of Raleigh, even though they have an emergency management coordinator, that role doesn't really fulfill the roles and responsibilities of emergency management. They've created that position to be more of a risk manager type person. For example, that person's not supposed to be involved with the Raleigh police or fire department and emergency planning. Doesn't really make sense to me…"
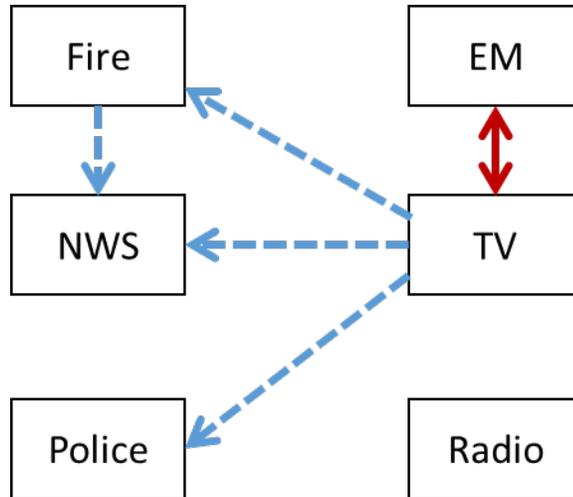
Figure 6:    Feelings toward other organizations - Red double arrows signifying
             mutual positive feelings/opinions; blue dashed arrows signifying one-
             sided positive feelings/opinions (the other organization made no mention
             one way or the other).

### 4.4.4.2   Roles within the System

Many of the organizations expressed opinions and thoughts on their own role

and that of other organizations in the warning system overall.  The EMs implied their

central role in the community.  Once the EOC was activated, the EMs took on a

leadership role with an operations section chief receiving reports from the various

municipalities.  They expected these municipalities to take responsibility for their own

jurisdictions, but as EMs they coordinated all efforts across the city.

> EM: "Once we make the decision to activate the EOC, and under the
> State of Emergency Declaration, the structure of our whole
> organization changes, in that I become the lead person for the county in
> and all decisions go through me."

> EM: "Municipalities have their own jurisdiction and their own
> responsibilities and their own authorities.  I have certain people that
> report to me and one of those is the operations section chief."

138

Both the EMs and fire station made clear they relied on and considered NWS as the weather experts. The EMs depended on weekly forecasts from NWS along with more immediate briefings and conference calls during events. They utilized the expertise of NWS and the local media to guide their decision making.

> EM: "Most of what we do is based on that Monday morning forecast with the NWS and then every morning we're watching the local weather just to see if anything has changed. We're relying heavily on somebody else's expertise to tell us that this is problem or this is not a problem for us."

The fire station, on the other hand, solely relied on NWS expressing that they view them as more authoritative than the local media. Interestingly, they also explained that NWS weather information came indirectly through the EMs; the EMs actually received information from both NWS and media.

> Fire: "I can tell you this; we do not rely on the local weatherman… We have more authoritative contacts and we use the NWS."

Similar to the EMs, NWS expected each organization to take care of their own 'customers'. They viewed their own responsibility as dissemination of weather information and decision making within their own office only. In general, they implied that they can provide information, but cannot make decisions for the community.

### 4.4.5 Intra-organizational Communications and Roles

### 4.4.5.1 NWS

Both the WCM and forecaster emphasized the interactive nature of their office. In particular the forecaster discussed the placement of workstations in their office specifically designed to foster effective communication.

> NWS Forecaster: "We've got those 5 workstations and they're
> strategically clustered in the center of our operations floor which
> fosters good communication amongst the folks at each one of those
> work stations."

S/he also described how successful forecasting required collaboration among staff. It was helpful to get others opinions, utilize those with more experience, and simply 'talk it out'. Additionally, each staff member was assigned to a particular area for the day making it vital that they communicate updates from their respective tasks.

> NWS Forecaster: "I might say, 'Hey so and so what do you think of
> this storm, I've been watching it, it's been pretty steady-state. It's got
> this signature on radar, but I'm not really seeing anything else, what do
> you think about that?' So we kind of bounce ideas off one another
> throughout the event."

While each forecaster was assigned a task for the event, NWS emphasized the fluidity of these roles. Each staff member was willing and able to perform any of the tasks if needed. Not only could they help out when someone became overwhelmed, but also fully take over a role.

> NWS Forecaster: "Even the warning operators and those working the
> aviation desk will also take storm reports for example because there are
> times when multiple phone lines are ringing at once and that one or two
> people that are dedicated to receiving the reports cannot keep up with
> the reports, so other folks jump in so that would be another role, again
> showing our versatility, being able to do one another's job at any given
> time."

The WCM also emphasized the fluidity and supportiveness of his/her role, but as the forecaster mentions they're usually in a leadership position if they are present in the office during an event. Much of the time WCM activities involve collaboration with community stakeholders, but when s/he is in the office they tend to act as storm coordinator and/or filling in roles as needed.

> NWS Forecaster: "When management is on the operations floor they
> usually are the storm coordinator most of the time. There are times

when we don't need management; we can cover it with the forecasters out there."

Though the WCM did not mention any conflicts within their office, the forecaster did discuss some minor issues. S/he explained that each shift was assigned a supervisor regardless of the weather and this individual had finally say on difficult decisions. On severe weather days this sometimes caused friction since each forecaster may have differing opinions on storm development and warnings. The forecaster framed these issues not as conflicts, but as inevitable disagreements given the nature of the work.

### 4.4.5.2   EM

The EM director, as expected, took on a leadership role within the office and even community during a severe weather event. Though s/he has staff above him/her in rank, they rely on the director to take control in these situations.

> EM Director: "I become the lead person for the county and all decisions go through me. Our county manager has even stated openly that during disasters, 'I take my direction from [interviewee name],' even though he's my boss."

The director led briefings in the morning, informing the office of the weather event and making plans for the day. Beyond that, most staff within the organization tended to continue in their normal roles, while one person was assigned to take the lead on dissemination of weather information to colleagues.

> EM Specialist: "We'll do a briefing in the morning and then most of the rest of the day we have one primary person that's on call. That primary will take the lead on it and any forecast that comes through."

Despite a rather para-military structure during severe weather events especially, fluid roles and two-way discussion did occur. Roles within the office seemed variable and flexible during the day with staff able to work on a variety of

tasks depending on what was needed at the time. For instance, the director may have acted as an overall coordinator during some instances, but other times s/he supported specific activities.

> EM Director: "Our job, we have to fill in where we're needed, depending how the incident progresses. During the last bit of weather we had here just a couple weeks ago, I started out the day patching on the warnings, coordinating with the different agencies, and the day went on and the weather actually hit us, I was responded to actually incident scenes to support response."

Discussion generally came prior to the weather impacting the area. They utilized these 'calmer' circumstances to discuss opinions and questions. Generally this was when some conflict occurred. The specialist explained that they may have heated debates with one another regarding the situation or forecast, but ultimately understand they are working toward the same goal.

> EM Specialist: "There is constantly different opinions, we're all very opinionated and we all come from different backgrounds… but fundamental when it gets down to it, ultimately were doing the same thing."

As the weather was occurring and through response phase, the director made clear s/he expected all EOC members within and outside their organization to follow orders, rather than question decision or discuss opinion. On the other hand, s/he also relied on them to act as autonomous decision makers since little time was available to ask for permission.

### 4.4.5.3 TV

Much of the communication occurring within the TV station seemed to revolve around balancing meteorological knowledge and broadcasting logistics. While the

meteorologist was given control over what information goes on air during severe weather events, those in the newsroom still led the coordination of the broadcast.

> TV Producer: "A producer does not tell the meteorologist what to air. The meteorologist knows what they need to be talking about. When it becomes a major weather scenario, like we're on the air for tornado watches or actual tornadoes are touching down, or hurricane coverage: there's a lot of talks back-and-forth between producers and meteorologists because the producer really wants to know what's happening."

The producer needed to be in constant communication with the meteorologists in order to make informed decisions on how to structure and lead the broadcast. They relied on them to update the newsroom of what and when weather information needed to air.

> TV Producer: "I'm grabbing all the personnel that it is going to take to get on the air, which is not a small feat. I've got to get the director, crew members, audio guy."

Expectedly, this 'dance' did not always run smoothly. The meteorologist described the difficulty of sharing data very familiar to them, but foreign to the rest of the station. They had to translate it into not only understandable, but also usable information for the producers and newsroom.

> TV Meteorologist: "Misunderstandings happen, I mean we talk, obviously it's easy for me to look at data and have a mental image of what I think's going to happen… It requires more than just walking in, giving a forecast, and leaving. Sometimes there's some, to get a little technical, there's a little creation of shared meaning that has to happen there, so that's something that I think we struggle with a little bit."

Despite meteorologists' expertise in forecasting, they're roles remained fluid throughout the station. Staffing seemed to dictate what tasks they may be involved with for the day. They emphasized they were both a communicator and a meteorologist, comfortable with filling both roles.

TV Meteorologist: "During the event, my job depending on who's staffed on what day, it may be as a member of the coverage team on the air… Other days, I'm maybe a step removed from that and I'm directing/jockeying."

### 4.4.5.4   Radio

Overall, the radio station interviewees did not focus on office communications or roles.  Because most of their systems for alerting the public were automated (i.e. Simulcasting and EAS), they generally did not have a need for extensive discussion.

Radio Program Director: "It's basically a carbon copy.  It's such a simple system, we all know what to do and everybody does their job."

Usually the only main communications involved alerting staff of the upcoming weather and updating those coming in on a new shift.  Beyond this, employees seemed to reserve most of their discussion of the weather event for on air times.  In this way they're updating and informing the public while sharing their thoughts with each other.

Radio Program Director: "It's just more of a reminder via e-mail of, 'hey, here's the heads up, this is on the horizon, let's talk about this,' the weather chatter will be more on the air."

### 4.4.5.5   Fire

Communications within the fire department generally consisted of response preparations and coordination.  Interactions were in the form of information exchange or orders rather than two-way discussion.  They shared information on progress reports, needed resources, and updates on damages.  The structure of the organization led to more formal and brief communications.  Roles and plans were formed ahead of time and remained structured through a severe weather event.

144

Fire Chief: "At that point were trained to know what we need to do, orders are given from the top command of what has to be done, even if they're just a local command, they know what's being done. There's not a lot of discussion, there's just orders and information back and forth."

The fire captain saw his/her role as manager of the firehouse, ensuring that all equipment was prepared for the event.

Fire Captain: "The captain, my responsibility is I'm kind of the manager of the firehouse and I've got quite a bit of work to do in the mornings… You want to make sure your equipment is operational and full of tools such as chain saw and generators and things of that nature, fans and so forth."

S/he did not discuss within station communications in detail. The captain explained that their overall structure and activities did not change during severe weather days beyond simply being busier. Rather than discussing what interactions were due to the weather event, s/he focused on the general nature of communications in the office.

Fire Captain: "Some fire fighters are talkative, some are quiet, people go about their jobs different ways, some people are vocal, and some more focused. So it all depends on the individual."

The fire chief's role was primarily as a representative at the county EOC, but s/he also sometimes ran a separate fire department EOC. Despite his/her leadership position within the fire department overall, the chief's role did vary throughout the day during a severe weather event. His/her role seemed flexible, in that s/he could lead different types of operations depending on the need at the time.

Fire Chief: "So prior to the event, I'm the planning officer, during the event I'm the operations incident officer and commander, after the event I'm basically the logistics officer, feeding resources into my local commanders."

## 4.5 Portland Case

### 4.5.1 Introduction

Portland, OR represents one of the two non-frequent hazard cases because like Raleigh it does not experience one particular damaging hazard on a regular basis. When normalized by area, Oregon has received the second lowest amount of tornadoes over the past 20 years (National Climatic Data Center). In addition, ties several other states for the least number of tornado injuries and fatalities per capita (Geography Statistics). Although it does rank slightly above average for total flood damage, this is primarily due to a single flood event rather than repeated impacts. If this year is excluded from the average, Oregon ranks in the bottom 25% for total flood damage when compared to the other states (States Data Set). The city of Portland also meets the population criteria with approximately 600,000 people residing in it.

I was able to conduct interviews with all but one of my chosen organizations. I was never able to reach a radio station in the region. I was only able to speak with a leader and general employee from NWS, the EM office, and the fire station. The public information officer for the police station spoke for the whole organization and the TV meteorologist chose to represent the station individually. A list of specific titles is shown in Table 14. The office of emergency management served the city rather than the entire county or region. The TV station broadcast throughout the WFO region and were chosen due to their reputation for severe weather coverage.

Table 14:    List of Portland Actors Interviewed (Leadership Bolded)

| **NWS - WCM** |
| --- |
| NWS - Forecaster |
| **EM – Operations Manager** |

| | |
|---|---|
| EM – Software Administrator | |
| **Police – Public Information Officer** | |
| **Fire – Public Information Officer** | |
| Fire Fighter | |
| TV - Meteorologist | |

## 4.5.2   Tasks and Activities

Table 15:    Portland Tasks and Communication Methods

| Assessment | | Dissemination | |
|---|---|---|---|
| **Task** | **Comm Method** | **Task** | **Comm Method** |
| *Gathering weather/storm info* <br> - on own <br> - receiving from | Social media, Conference call, Phone, Radio, Chat | *To coworkers* <br> - briefing <br> - collaboration | In person, Email |
| *Preparing workplace* | In person | *To other organizations* <br> - briefing <br> - collaboration <br> - updating | Phone, Email, Chat, Conference call |
| *Coordinating workplace* <br> - operations <br> - staff | In person | *To public* <br> - alerts <br> - general info | Social media, Website, Broadcast, Automated systems |
| *Analyzing weather data/info* | In person, Conference call | | |

## 4.5.2.1   Gathering Weather/Storm Information

NWS and the TV station focused on gathering their own meteorological data and receiving reports from outside their organization.  Both mentioned utilizing radar

to forecast and track storms.  They also discussed the variety of methods for receiving

storm reports.  The TV station emphasized how useful and remarkable Twitter and

Facebook were as tools for receiving information from the public.

> TV: "I'll tell you another thing that's awesome, is- and I just can't even
> believe how great it is-is tracking everything on Twitter, and looking
> into reports from people.  That is so sweet.  I mean, that's real nice
> feedback.  And the other thing is on the Facebook weather page, 'hey
> okay, I need your help on this as we go through this together, what are
> you seeing right now?'  And we instantly get 50, 75, whatever
> responses.  It's like having a 100 people call you and tell you what's
> happening.  It's just so sweet.   So that's during the event, that's what's
> going on, and it's just kind of monitoring the situation and for more
> tracking the radar of course is a key part of my job as well."

Similarly, NWS assigned staff to focus on collecting reports from phone calls and

social media. They also got situational information from the EMs and public works

mainly regarding damages and on-site updates.

> NWS: "Then we're also, the extra people are also doing things like
> collecting data, doing reports, storm reports, contacting people,
> answering a lot of phone calls from people coming in, media reports,
> reports from the public, were involved in social media exchange."

> NWS: "We're having a lot of communications with emergency
> managers, public works folks about what roads are getting flooded now
> or what areas are getting floods or small streams are getting flooded."

The EMs and fire station tended to receive more general forecast information

about the upcoming event from NWS, then gather more specific data on their own.

Even during normal times, checking the NWS website was a regular activity for the

EMs.  During a weather event this is increased to email notifications, webinars, and

sometimes conference calls explaining the nuances of the forecast. The duty officer

will in turn alert all staff of the incoming weather event.

> EM: "One of the routine things that we do on a daily basis is we check
> the weather service site and we look at the forecast, our daily forecast.

We try to check that every morning before 9am. So we look at the forecast, see what's going on right now, look at any watches or warnings going on, we look at the forecast discussion and review the hourly weather graph that's on there."

Throughout the event, the EMs continued to monitor the forecast, particularly for flood and winter events. During cold weather, they checked wind chill values and notified the Housing Bureau if necessary. During flood events, they monitored the flood gauges particularly in known problems areas.

EM: "So in an extreme cold weather event our responsibility is to monitor the forecast and then in the event of certain triggers met in terms of wind chill or cold temperature we alert the Portland housing Bureau."

The fire station initially got information from the EMs and fire department leadership. They continued to monitor the weather themselves through the NWS website and a WeatherBug network. Their PIO gathered situational updates rather than weather data in an effort to pass along damage and response information to media.

Fire: "So the first thing that we do is get that information about the weather from emergency management then monitor groups like the NWS."

Fire: "We actually have a WeatherBug network here at station 1, which is tied into one of the local news channels, I believe its KGW, the NBC affiliate here. It's got barometer, humidity, temperature, wind chill, dewpoint and all those things. So were usually pretty on top of what's happening outside."

Fire: "As the public information officer, I really sit in a room and watch this all unfold. And then they update on how we're going to function, what the threat is, what the conditions are around the city."

While the police did not gather much of their own information, they did watch local TV and visit relevant websites to learn more about the weather event. Much of

their information about the weather or overall situation came through the EMs and/or EOC.

> Police: "We would get it indirectly through local news or websites or something like that, but we don't chat with [NWS] them about it."

### 4.5.2.2 Preparing Workplace

Overall, preparation of the workplace was not widely discussed by the organizations. Preparation activities seemed to be most prevalent for the fire station. Since they generally did not respond during the actual weather impact, the fire station had to ensure that all personnel had a safe shelter available to them. They also prepared their equipment and vehicles depending on the type of event. For instance, they put chains on their tires prior to a winter storm.

> Fire: "The first priority with us is the ability of our crews to have safe shelter if the event involves the destruction of shelter. And then two, that our response vehicles are able to operate in whatever weather it is."

If needed, the fire station also prepared the area around their station in advance of the weather. In the instance of a winter event, they salted sidewalks and driveways.

> Fire: "When it gets snowy and icy out we try and keep sidewalks clear around our station, try and put the de-ice on them and things like that."

> The main preparatory activity for the EMs was the decision to open the ECC

(EOC). This brought all necessary representatives and staff to one physical location.

> EM: "Incident commander or someone makes a determination that our own ECC needs to be opened up."

Similarly, NWS and the TV station prepared for the event by bringing in more staff. For NWS this simply meant bringing more forecasters on duty if the normal shift wouldn't be able to handle the event. In some instances they also split the forecast area distribute the work load more evenly.

NWS: "We see that there's going to be some significant weather that might entail the need for extra help, the two staff forecasters on duty might not be able to handle all of that and the normal work load… we often times call in an extra person or more if we need to do that."

NWS: "We might actually break up our area into more than one area, what we call sectorizing and I have heard of us doing that on a couple of occasions, where somebody might do one part of the forecast and another do another part or maybe somebody do the coastal waters and somebody do on land."

The TV station brought in an extra meteorologist to fill in as needed and maintain communication with the producers.

TV: "A lot of times the situation is we'll have another meteorologist come in, and that person will help with a number of things."

### 4.5.2.3   Coordinating Workplace

NWS spoke most extensively about coordinating both operations and staff within their office.  The lead forecaster guided coordination of staff within the office for the day.  They assigned roles, briefed the other forecasters, and set an overall plan for the event.

NWS: "I make the decisions and set the tone and do what's necessary to take us whatever direction I think we need to go… and make decisions on who is going to do what role and what role I'm going to take."

If in the office, the WCM coordinated forecasting through offering advice and facilitating discussion.  During the event, the forecasters worked as a team led by the WCM or lead forecaster to coordinate the products and forecasts going out of their office.  This involved collaboration across roles to ensure were continually updated and accurate.

151

NWS: "How the forecast is panning out, are things going as we planned? Sometimes we have to think about are those particular areas getting heavier rain or more snow than we anticipated, so were kind of modifying, make sure, amending products if need be, updating the forecast accordingly to whatever direction the forecast is gonna go."

While management was in the office, they also dealt with any technical problems such as equipment malfunction.

NWS: "Sometimes you we get involved in trouble shooting and stuff too, 'Hey this procedures not working or this piece of equipment's having problems' and we deal with, take care of those types of things too."

For EMs coordination of the workplace was synonymous with coordination of response. Once the ECC was activated, they collaborated with other bureaus such as the department of transportation and housing bureau to ensure response ran smoothly. They also coordinated information exchange through WebEOC software. The EMs used the software to document the event and share updates within and outside their organization.

EM: "So basically making sure that everything is running smoothly in the ECC and making sure we're there for staffing and that kind of stuff."

EM: "There are a lot of folks on our system, so I oversee that software and make sure it works and am the main point of contact for agencies using the software and the vendor."

The remaining organizations spoke very little about workplace coordination. For the TV station, this may be due to the fact that I was not able to speak with a representative from the newsroom who could discuss the broadcasting process more extensively. The TV meteorologist did mention the coordination involved with maintaining his/her own situational awareness while ensuring the entire station is updated and informed.

152

TV: "I've got to figure what's going to be happening. So I'm trying to monitor that while doing all these other items and then keeping everybody in the loop at the station."

Much of the coordination in the fire station seemed to be organization of their capabilities and operations. This involved determining what was needed given the type of weather and severity; further into the event and after they moved into coordination of response with other fire stations.

Fire: "Once we've received that information, then there is kind of a process of deciding how big of threat it is and what our capabilities and functions are in that weather."

### 4.5.2.4   Analyzing Weather Data/Information

NWS and the TV station were the only organizations to discuss analysis of weather data. Neither went into great detail on this subject, but NWS discussed it more extensively. They mentioned their broader, more general analysis ahead of the event and then went on to describe their process as the weather was impacting the area. NWS forecasters used radar data, surface observations, and other meteorological data to pinpoint particularly severe section of the storm system.

NWS: "We anticipated this by our analysis of the large scale and the synoptic situation leading into the event and then we're watching the radar, we have different radar procedures and groups of products that we might use to monitor and pick out more significant storms and then other ways of looking at the data to interrogate individual storms and the storm structure and make decisions if we need to."

For both NWS and the TV station, analysis and ultimately alerting decisions were done in collaboration with fellow forecasters. Particularly within NWS, each person was looking at a different piece of information so coordination and discussion was required. For the TV station analysis seemed to involve dissecting past experiences, reviewing social media reports, and watching the radar.

NWS: "So there's a lot of talking, coordinating, collaborating with people so that we make the right decision."

TV: "It's just kind of like you're brainstorming some ideas by yourself… But you might miss a really awesome idea, and that's the cool thing about having another person in there is one of you might go, 'This looks a lot like that storm 5 years ago, do you remember what happened? Yes, that's it!'"

### 4.5.2.5   Dissemination to Coworkers

Briefing was the most prevalent form of dissemination to coworkers and generally came through automated systems, email, and staff meetings.  Every organization mentioned briefing to some extent, usually before the weather began impacting the area.  The fire station seemed to have a fairly automated system in which leadership within the department sent out an email alerting fire fighters of the severe weather.

Fire: "So, at the fire station level, what will happen is once that weather advisory comes out, e-mails go to all the fire stations… An announcement will come over our dispatch system to check our e-mail about a weather warning."

Similarly, the EMs had an automated system that alerted staff within their Bureau when an NWS conference call was initiated.  In addition to this, the duty officer for the day sent an email to EM staff with information gathered from the NWS website.

EM: "I also have some internal triggers within my Bureau that when we do have a weather conference call that triggers a few actions within our Bureau in terms of distributing the notes and letting some people know, so we've been able to use that as a pretty reliable trigger for us, which is great."

EM: "Every morning our duty officer takes a look at the website and then distributes a forecast summary each morning and it's a combination of copy and paste and also some analysis."

For the TV station, the meteorologists briefed the newsroom staff on the upcoming

weather event and forecast.  This allowed producers to plan their broadcasting

accordingly.  Beyond this, the meteorologist emphasized that there was little time to

speak with the newsroom staff in person.  Instead, conversations seemed to be brief

emails or phone calls providing guidance based on the weather conditions.

> TV: "I usually don't have time to go out in the newsroom because we're
> on all the time, so I might send a quick e-mail and say, 'Hey you guys,
> here's the situation, you might want to call this sheriff's department
> because I've seen really heavy snow over this part of town.'"

The fire station and NWS had more collaborative information exchange within

their organizations.  The fire department leadership and fire station captains discussed

the weather and situation and various points throughout the day.  Before the event they

deliberated the best course of action for the day regarding preparedness and response

timing.  As the weather affected the area and directly after the event, leadership would

discuss damage and needed response.

> Fire: "He'll contact his next tier, the battalion chief, who is in charge of
> maybe 4 or 5 fire stations, and say 'Hey C3, do me a favor and drive
> around your area there and give me a report as to what conditions are
> like and how you think we should proceed.'"

In a similar manner dissemination to coworkers within NWS came primarily in the

form of collaboration.  While briefings did occur through staff meetings and map

discussions, they tended to evolve into two-way discussions in which various opinions

were provided.

> NWS: "We put that kind of information out then we'll go through map
> discussion, talk about this with everybody including management, so
> that everybody's on the same page and knows what's coming.  And
> then in general because were ramping up and anticipating what's going
> on we might already choose someone to monitor the radar at some
> point."

Leadership provided collaborative guidance throughout the day. Instead of one-way instructions, they tended to facilitate forecaster discussion and offer advice on more difficult scenarios.

> NWS: "A lot of times we're coordinating the forecasters, or with the forecast team just, 'hey it looks like this is going to be a close call for maybe going to freezing rain' or something like that and we have this team discussion if you will."

### 4.5.2.6   Dissemination to other Organizations

NWS and the EMs spoke most extensively about dissemination to other organizations. It was clear that this was one of their most important tasks throughout the warning process. For all organizations, dissemination came primarily in the form of one-way briefings and updates, though at some points it became more collaborative. Prior to the weather affecting the area, the EMs gathered the forecast information from NWS and distributed it to partners within their city.

> EM: "So we use that internal, the stuff from the NWS we'll take the forecast information from the NWS and then distribute that and discuss that internally within the city."

More specifically, they directly contacted fire and police department leadership depending on the severity.

> EM: "We also will push out information if it's severe enough, to some of their [fire and police departments] commanders and command staff so that the senior leadership is aware that a weather phenomenon is coming."

Further into the event, the EMs summarized the city's preparation, response, and damages. They sent this information out to relevant decisions makers and leadership.

> EM: "Summarizing what's happening by Bureau, kicking out the situation report to keep decision makers, Bureau heads, and executives, and doing that sort of sharing."

In addition, they would generally prepare a statement for the media regarding their view of the weather event and the status of preparations and response.

> EM: "We'll prepare a statement and record sound bites about what we think about the weather and/or what is the city doing."

Initially, NWS reached out to partner organizations and disseminated forecast information through scheduled briefings or phone calls.

> NWS: "Getting that information out there that could be doing multimedia briefings, picking up a phone call and talking to one of our core partners in the area that's going to be affected, giving them a head's up, 'Hey just wanted to make sure you were aware of this particular weather situation coming your way and what it could mean to you'."

While these interactions were meant to ensure everyone was at least aware of the upcoming event, NWS also spent time discussing their confidence in more detail. They provided explanations on uncertainty and described possible impacts.

> NWS: "We typically in those interactions try and explain to them our confidence level in a particular forecast and what type of uncertainties there might be, 'if this frontal boundary moves 50 miles to the south then instead of these particular areas getting hit then these particular areas are going to get hit' and then we talk about some potential impacts."

As the weather began affecting their area, some interactions became more collaborative. NWS exchanged storm reports, damage updates and weather information with partner organizations such as EMs and public works. Instead of simply providing weather information, NWS discussed the overall situation with relevant organizations.

> NWS: "We exchange a lot of reports, reports from our customers, what's happening out in the community, like today we got some reports through NWS chat from a few folks that it's snowing."

Their most constant contact with a specific organization seemed to be with a unique customer, the Columbia River bar pilots. NWS explained that these partners required very specific weather information particularly during severe situations.

> NWS: "Across the Columbia River bar any container ship has to be piloted by a Columbia River bar pilot, so they have certain thresholds, sea conditions, wind conditions, maintain, stay within their operating envelopes for safety reasons. So were in constant contact with those folks and doing a lot of one on one consultations and decision support services with those folks."

The fire and police stations only discussed disseminating information to the media. Generally it was department or station level PIOs who gathered information regarding plans, preparedness, and community conditions and distributed it to the media. While they spoke directly with radio and TV stations through phone calls or interviews, they implied their main goal was reaching the public.

> Fire: "If it is severe to the point that we're concerned about people surviving, then I'm giving the public some type of emergency announcement… instructing people that very easily they could lose their core services."

> Police: "In major snow events, we might talk about traffic, traffic safety, or ice… we may talk with them [media] about response times and stuff like that."

### 4.5.2.7   Dissemination to Public

Dissemination directly to the public was a sparsely discussed topic among the organizations. NWS spoke generally regarding their suite of products such as watches, warnings, and statements, but did not go into detail on the wording or dissemination of these.

> NWS: "And then were also doing the same type of thing for the general public, getting that information out to our various dissemination

systems and our different products, whether it is statements, watches, warnings, advisories those types of things."

They did mention that with adequate staffing a forecaster was assigned to ensure that their warnings were correctly disseminated through automated systems such as NOAA Weather Radio and NAWAS.

> NWS: "There's usually one person who's helping to disseminate the warnings and that's usually is to verify that the warning got onto our NOAA Weather Radio and then made the calls to the NAWAS which connects us with the counties and the individual state warning points."

> For the TV station, it was immediately clear that dissemination to the public was important to their operations.

> TV: "The number one goal is to try and keep people in the know during a developing event."

Expectedly this primarily involved broadcasting forecast and damage information over the air. The TV meteorologist did mention going into wall-to-wall coverage, gathering information for the broadcast, and coordinating with the newsroom, but s/he did not go into extensive detail regarding the information they provided to the public.

> TV: "We might break into programming and depending on the severity of the situation, we could have what we call wall-to-wall coverage."

> The police station and EMs only briefly mentioned dissemination of information to the public. The police recently began updating their Twitter feed during some instances to alert the public of adverse weather conditions in the near future.

> Police: "What we've done more recently is, we will share weather service information via Twitter. If it's something particularly concerning for, it might be talking about lots of rain in the forecast, or give yourself lots of extra time to get to work tonight."

Similarly, the EMs set up an automated system synced with NOAA products. This system disseminated alerts through Twitter and EM public websites.

> EM: "So we have automatic retweeting and posting, twitter and public alerts websites for any weather product."

### 4.5.3   Inter-organizational Communications/Interactions
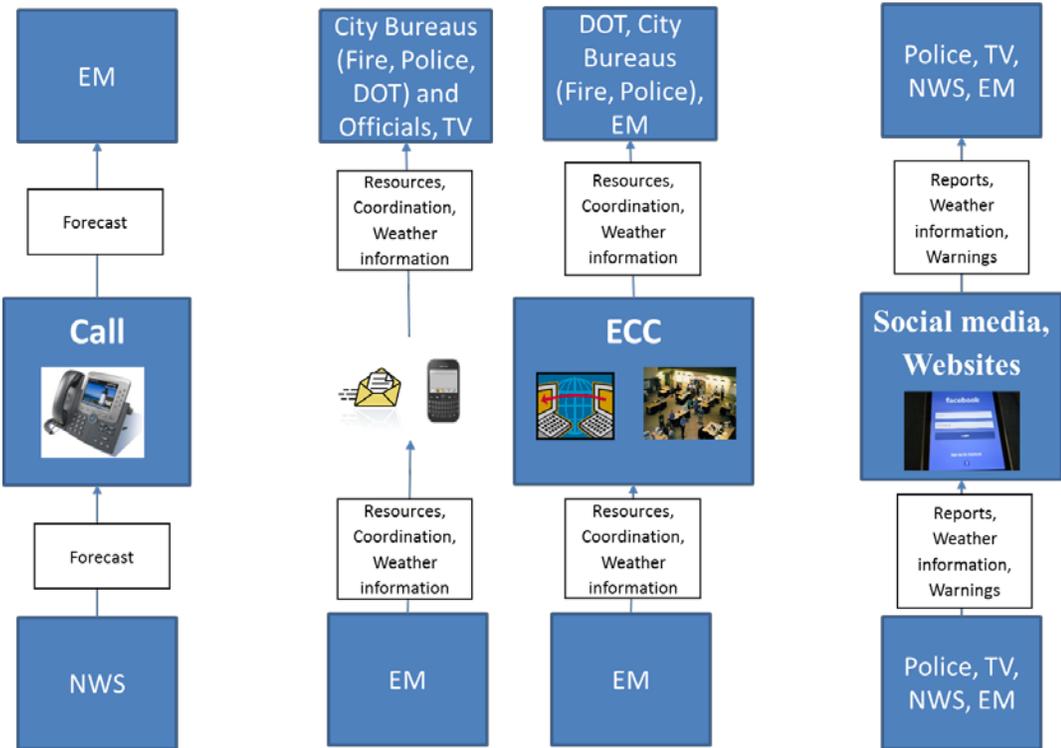


Figure 7:   Portland Communication Methods and Structure – Graphic shows the most common/popular communication methods among the organizations, who provides and receives the information, and the content of the information itself.

### 4.5.3.1   Conference Call

Though only the EMs and NWS mentioned conference calls, they were a key interaction tool.  NWS initiated a conference call and provided an online webinar briefing.

> NWS: "One of the things we'll do is provide a briefing to our customers.  So pull together a briefing and do what we call a webinar so it's basically what we call a teleconference briefing."

The audience for these calls seemed to vary.  For normal severe weather events, NWS described participants as core partners.  In other instances, they invite very specific organizations.

> NWS: "Were probably anticipating some air stagnation conditions and some pollution problems so we had a conference call with all the air quality agencies this morning."

The EMs emphasized the utility of the call as a unique opportunity to hear a detailed discussion of the NWS forecast and expected impacts.  Interestingly, they called it an emergency management conference call implying that its primary purpose was informing city and regional EMs.

> EM: "They'll actually call for an emergency management conference call which is a pretty useful tool out here so then all the emergency managers in the city and in the region hop on the phone and they give a detailed webinar that goes through the forecast, by zone, and by city and then kind of calls out the impacts by major metropolitan area, region and then we have an opportunity to ask questions."

In addition to participation in the NWS call, the EMs also initiated their own conference calls when needed.  While they didn't go into detail on this, it seemed certain types of events required specific regional coordination.

> EM: "If you hear something on that call that you feel like you need regional or partner type coordination, you would hop off the call and then call another conference call with those specific people."

### 4.5.3.2  ECC (EOC) and Phone/Email

Equivalent to an EOC, the EMs typically opened an ECC (Emergency Coordination Center) during a severe weather event.  Though it wasn't clear which organizations and representatives were physically brought to the ECC, it did seem to be a conduit for coordination and communication between various city Bureaus.

> EM: "If it's a severe weather event or something like a flood in the main stem Willamette, then we would probably activate our city's ECC.  People call it an EOC, we call it an ECC."

Within the ECC, EMs utilized WebEOC software to communicate primarily internally.  They explained that the software was originally intended for within city use, but has since expanded to neighboring counties and external organizations.  The EMs use it as a communication and documentation tool in which they share forecast updates, resource needs, and other important event information.

> EM: "I'm an administrator for software called WebEOC… that was originally purchased for the city but is now expanded to a lot of other counties in our area and our external partner agencies."

In essence, the EMs gathered weather and situational information to relay to other city Bureaus and sometimes surrounding counties.  For example, their main goal during the NWS conference calls was to sufficiently understand the weather situation in order to relay it out to the community.

> EM: "So I guess the purpose of these conference calls is to get enough information to brief the mayor and other Bureaus of the weather situation."

If the ECC was not activated or the representatives were not at the location, the EMs used phone and email to contact a variety of organizations.  Specifically, they mentioned reaching out to other emergency organizations, Housing Bureau, DOT, air quality agencies, and elected officials.

EM: "So we actually monitor the flood gauge… if it reaches a certain benchmark we notify a bunch of people by phone and by email."

### 4.5.3.3    Social Media/Websites

Perhaps the most widely used information exchange and dissemination tool was social media, mentioned by every organization.  For most it was a way to disseminate to and exchange information with the public and other organizations.  In addition to their WebEOC, the EMs also updated Twitter, Facebook, and their public websites with similar weather and situational information.

EM: "We do a lot with social media, Twitter, Facebook, and website and we really actually, we have two websites, our Portland Bureau of emergency management homepage and we also have a site called public alert."

Similarly, the police station uses an automated system that disseminates their news releases directly to their website and social media.

Police: "If we were to send a news release, the service we use automatically populates to Twitter and Facebook, as well as our subscribers that sign up on the police Bureau website and it's posted to our website."

NWS: "Were involved in social media exchange, getting our information out to the social media channels, then monitoring those channels for reports."

The TV meteorologist especially expressed a strong affinity for social media both as a dissemination tool and an information source.  S/he coupled their broadcast with regular updates and alerts on Twitter and Facebook.  They also emphasized the benefit of social media as a source, commenting that they no longer have to wait for NWS forecasts and warnings.

TV: "I'll be on Twitter and Facebook posting to let everybody know 'keep an eye on the weather, it could be a wild afternoon,' for example."

> TV: "It used to be we waited for a report from the weather service…
> But now, with social media, boy, we are just right on it and it's really
> awesome."

The fire station shared this sentiment, mentioning that social media is effectively able

to reach a large audience.

> Fire: "In this day and age, social media is so much more effective in
> notifying a lot of people at once."

### 4.5.4 Inter-organizational Roles and Relationships

### 4.5.4.1 Feelings and Opinions toward other Organizations

Most of those interviewed expressed positive feelings toward at least one other

organization. Both the TV station and NWS expanded on their great working

relationship with one another. The TV station emphasized how well NWS understood

their need for fast, reliable information. Likewise, NWS described follow-up

meetings with the media to ensure that they received and understood all information

during the event. Their open lines of communication and sensitivity to strengths and

limitations seemed to foster strong relationships between the two organizations.

> NWS: "It goes back to having good relationships with the media, we
> have those open dialogues. After a big event sometimes we'll go visit
> with them and ask 'was everything clear in this particular situation,
> anything that we need to clarify or anything like that.'"

> TV: "Our weather service, great relationship, I know all of the people
> and our station has interviewed them for stories many, many times. A
> pretty good working relationship in the most places. I would say it's
> pretty amicable and they understand that we've got deadlines and need
> information, and they also understand we're very quick to get
> information out to the public, so I'd say that's a pretty good
> relationship."

Similar to the TV station, the EMs also emphasized how well NWS "kept them in the loop" throughout an event. Though they periodically check the forecast on their own, the EMs also relied on NWS emails and conference calls to stay informed.

> EM: "So I check the weather. You know we're kind of weather junkies just by nature anyway in this business, you check the weather. The weather service here is very good at doing that as well. They'll put out an email notice that something's coming up…"

> EM: "And just from a general severe weather standpoint the NWS in Portland is really good at giving us the head's up if there is any kind of weather coming in."

Additionally, the EMs kept in contact with the media through their PIO. S/he developed a strong relationship with TV and radio stations in the area by providing them with updates and participating in interviews.

> EM: "They will often ask for a sound bite or an interview. So we have a PIO that maintains a good relationship and contact with the media."

Though the fire station didn't go into detail regarding their opinions toward specific organizations, they did emphasize their good working relationship with the other emergency Bureaus overall. Even among the different levels, they seemed to operate effectively during severe weather events.

> Fire: "We have a really good relationship working with the other emergency bureaus. I know that in other parts of the country, that's not always the case. We definitely work very well at every level all the way up with the other bureaus."

Despite overall positive opinions and strong relationships, several of the organizations did discuss minor conflicts when prompted. Interestingly, all of the conflicts mentioned were regarding the same issue. According to the EMs, NWS, and the TV station some city and county Bureaus and organizations hire their own forecasters. Inevitably, these forecasts sometimes differ from those of NWS and the

TV station. While none of these organizations emphasized it as a major issue, they did

suggest that it occasionally caused some differences of opinion.

> EM: "I know that some of the other Bureau's do hire forecasters, so what we do is compare the NWS forecast with their forecast and we kind of meet in the middle.  I don't think they're ever drastically different, but they have caused Bureau's to lean in different directions."

> NWS: "We've got some organizations here in the Portland metro area that also get some forecasting services from a private meteorology company…  So sometimes we have those discussions, 'hey you guys are going for this, but our other firm is forecasting this.'  We kind of sort it out together but sometimes there are some differences, we have those types of discussions sometimes.

> TV: "Occasionally, let's say for example, the City of Portland has its own meteorologists.  And sometimes that forecast or some event which is big in Portland differs significantly from our forecast.  And so it's not like we're conflicting with them specifically, but the city might be saying, 'We're getting ready for a significant event,' and our weather team is saying, 'We're not getting ready for a significant event.'"
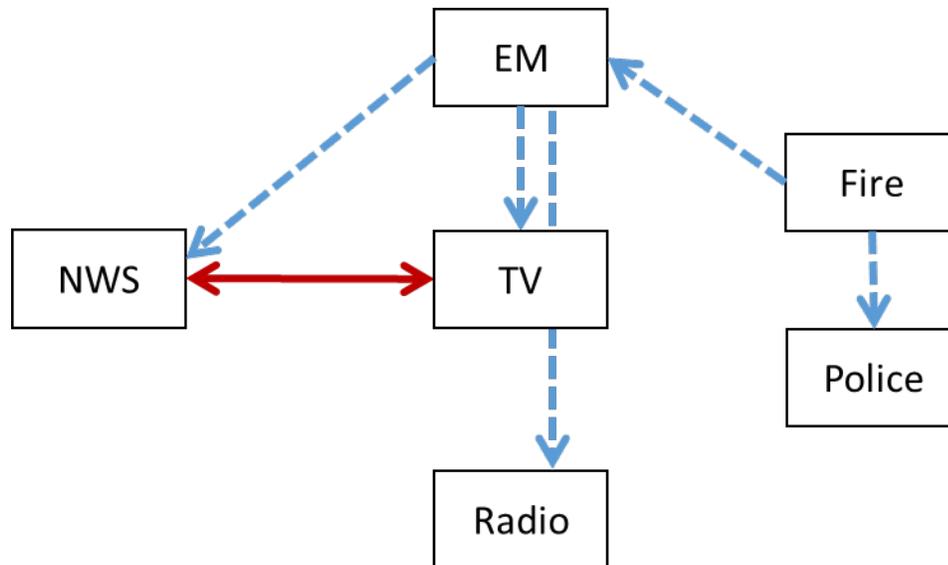
Figure 8:    Feelings toward other organizations - Red double arrows signifying mutual positive feelings/opinions; blue dashed arrows signifying one-sided positive feelings/opinions (the other organization made no mention one way or the other).

### 4.5.4.2   Roles within the System

Some of the organizations implied or directly discussed their views on organizational roles within the warning system.  The EMs and NWS both considered their organization's role to be of a supportive nature.  For instance, NWS felt their overall goal involved providing community stakeholders with enough weather information to sufficiently prepare for an upcoming event.

> NWS: "What we're trying to do is draw attention to the unusual if you will, in terms of weather or flood type situations and bring that attention to public safety officials so we can get the word out well ahead of time so they can prepare their own agencies and their own communities for these type of events."

167

More specifically, they also discussed their support for the Columbia River bar pilots and local law enforcement. Both organizations required specific forecasting and guidance to perform their work.

The EMs viewed their role as similar to that of NWS. They gathered weather information from NWS and used it to guide and support the other city Bureaus. As with NWS, it was not their place to make a decision for a specific Bureau, but rather to provide them with the tools necessary to make a sound decision.

> EM: "They [NWS] put the information out there and we make the decision. Kind of like what we do with the housing Bureau, we make sure they're aware, but they make the decision."

The EMs also emphasized their respect for NWS. They clearly viewed them as the primary weather authority.

> EM: "The weather service is our end all be all authority for the weather. There's a lot of other things, like there's WeatherBug and there's all kinds of other places out there, but we designated the NWS as our primary source of weather information. They're the end all authority on that, if they say it's going to be bad we listen to that."

The fire station's view of the EMs role aligned well with what the EMs themselves actually described. They explain that while the EMs were not meant to lead the city Bureaus, they did facilitate communications among them.

> Fire: "They [EMs] have no leadership over 6 bureaus, necessarily, but they provide the information and coordination of all the bureaus in the case of some kind of weather-related emergency that may qualify."

Though they did not go into detail regarding their own role, the fire station did describe their own limitations. They admitted that their expertise was not in weather and they relied on others to interpret and analyze the forecast.

> Fire: "None of us are meteorologists, obviously, so none of us are going to get into arena of trying to interpret what the weather."

### 4.5.5 Intra-organizational Communications and Roles

### 4.5.5.1 NWS

While NWS tended to interact most frequently with other organizations before the weather hit, their within office communications were most active further into the event. Both the forecaster and WCM described a highly interactive environment among the staff. During the forecasting and warning process they collaborated with one another by offering opinions and discussing alert updates. The WCM in particular worked with the forecasters to ensure that important activities weren't being overlooked.

> NWS WCM: "Might have to extend to another area, it might have to extend in time. We're having those types of communications. Were also just kind of monitoring and making sure everything's getting done if you will. Have we contacted agency 'such and such', we have to think about that."

> NWS Forecaster: "During the event they [interactions] can be ongoing because often times, me or another person we might see something on radar we might ask for second opinions, if they see something we're not seeing or we get ideas."

These frequent interactions seemed to stem from a culture of teamwork within the office. The WCM described forecasting and warning decisions as a discussion rather than an individual choice.

> NWS WCM: "We try to have an open discussion giving everybody thoughts and steer the, get the consensus of where we're going to move the forecast or warning in a certain direction. It's more interactive and teambuilding consensus type forecasting."

Rather than dictating office activities, the WCM saw her/himself as part of the overall forecasting team. Even though they were a leader within their organization, the WCM was willing to take on any role needed.

NWS WCM: "Also kind of an integral part of our operations team working out on the operations floor whatever duty they need me to do and just being a part of the forecast team and working through the event from start to finish."

In agreement, the forecaster described overall positive interactions with management. It was typical for the SOO and WCM to be in the office providing advice and filling in as needed. Overall management seemed to support and serve the staff rather than command.

NWS Forecaster: "I personally always have good interactions with them [management], they're often one of the people have come help us out on the operations floor and they're usually very willing to take the role that you ask them to do and they both have our SOO and our WCM both have a fair amount of severe weather experience and expertise so they're a valuable resource in whatever role we ask them to do."

The lead forecaster took on a leadership role within the office during most events, but as with management this role seemed fluid. While they generally acted as coordinator, they sometimes delegated this duty to another staff member.

NWS Forecaster: "Depending upon if I have someone take the coordinator role, then I'm going to let them make some decisions on helping the flow of the event so that everybody's made aware, but they're doing that at my direction."

### 4.5.5.2  EM

The EMs did not focus their discussion on within office communications. In fact they only briefly mentioned interactions with coworkers. The operations manager explained that the duty officer sends an email to the staff each morning summarizing the forecast. Similarly the general EM employee explained that when assigned as duty officer s/he and the backup officer discussed the situation and worked out decisions together. While they remained self-sufficient and avoided going to leadership with

issues, the employee also emphasized how comfortable they felt approaching management if necessary.

> EM general: "If I'm the duty officer, I'll contact my backup duty officer and we kind of work the decisions out together, especially on the weekends, we try real hard not to bug our folks in the chain of command."

### 4.5.5.3 TV

Unfortunately, I was not able to speak a representative from the newsroom, consequently office communications were only from the perspective of the TV meteorologist. S/he focused on alerting the station and collaborating with fellow meteorologists. In some instances they warned their newsroom of the severe weather potential before even arriving at the office. In addition to initial briefings, the meteorologist kept the newsroom informed on weather updates throughout the event.

> TV Meteorologist: "Definitely my boss is constantly coming into the studio and saying, 'What's the latest? What's going on?'"

Beyond frequent communications with the newsroom staff, the meteorologists would also be speaking with each other. S/he emphasized how useful multiple opinions and backgrounds were during an event.

> TV Meteorologist: "I'd say more than anything is bouncing ideas off each other, which is fantastic."

While communications seem to run smoothly overall, the meteorologist did note the occasional disagreement mainly regarding the extent of coverage.

> TV Meteorologist: "There have been times where you get debate on whether there should be wall-to-wall coverage or how long should you stay on."

Regardless, the meteorologist felt confident in their authority within the station during weather events. In fact, s/he implied a strong sense of responsibility and anxiety over effectively guiding the office.

> TV Meteorologist: "It is frightening to want to make the right call just from a personal standpoint."

### 4.5.5.4   Fire

At a wider fire department level, once an initial weather advisory was issued by NWS an email and dispatch was disseminated to all fire stations. Decisions were generally made on whether stations were able to respond during the weather event. These decisions relied on frequent communications among the various crews.

> Fire PIO: "Then we have to get that equipment in quick. So, the early communication amongst the crews about that weather is a big component of that."

During response preparations, the department leadership may also request information from local leadership regarding community conditions.

> Fire PIO: "What we have is this upper-tier and then tiers below it and depending on how that upper-tier wants to function, we may solicit information."

Regarding communications within specific fire stations, the fire fighter did not feel that interactions were notably different from the norm during a weather event. Aside from the occasional words of caution from leadership, fire station staff did not seem to discuss the weather.

### 4.5.5.5   Police

Unfortunately, I was only able to speak with the PIO who spoke on behalf of the chief. S/he did not discuss police department or station communications. When

probed regarding the chiefs interactions with officers, the PIO actually suggested that

they would have very little involvement unless the weather escalated into a major

event.

> Police PIO: "He probably wouldn't be involved at all unless the
> warnings were significant enough to be a threat to public safety, i.e.
> massive power outages or evacuations needed.  It's just not something
> he's going to be involved with on a day to day basis."

# Chapter 5

# CROSS-CASE COMPARISON AND ANALYSIS

## 5.1    Introduction

This dissertation sought to explore the assessment and dissemination phases of the current warning system in greater depth.  To guide this analysis and incorporate relevant knowledge and literature, I developed a conceptual model comprised of several broad tasks.  Additionally, I proposed that repetitive impacts from a damaging hazard can lead to an evolution of the inter- and intra-organizational culture.  Guided by organizational culture and disaster subculture literature, I formulated a set of propositions framed around communication, roles, and resources.

To explore the conceptual model and address the disaster subculture propositions, I used a qualitative multiple case study design that included 4 locations. Wichita and Nashville represented the 'frequent hazard' cases due to their repetitive impacts from tornadoes and Portland and Raleigh represented the 'non-frequent hazard' cases due to their lack of any one repetitive, damaging hazard.  My coding process involved an initial inductive approach followed by more deductive second round coding and pattern development.  Coding revealed several key topic areas (tasks and activities, inter-organizational communication, inter-organizational roles and relationships, and intra-organizational culture) from which to frame my individual case analyses.

The following chapter will synthesize these results in a cross-case analysis. The first section will describe the broad tasks and activities evident across cases, while

exploring how results diverged from the original conceptual model.  The next four
sections will compare organizational communications, roles, and relationships across
cases to determine the merit of each proposition and discuss the potential cultural
variations between non-frequent hazard and frequent hazard cases.  These sections are
separated by proposition 'category' (inter-organization communication; inter-
organization roles and relationships; Intra-organizational communication, roles, and
relationships; resources) and include emergent themes that were not addressed in the
propositions.  The next section provides a summary and discussion of findings in the
context of relevant literature.  The final section discusses limitations and future
opportunities for further research.

## 5.2    Conceptual Model

According to past research (Quarantelli 1990), the warning system is made up
of three main components, assessment, dissemination, and response.  My conceptual
model focused on the first two and, drawing from personal experience and relevant
literature, proposed six broad tasks (monitoring, interpreting, detecting, deciding,
constructing, and alerting) within these components.  The interviews revealed several
tasks associated with assessment, but they varied substantially from those originally
proposed.  These tasks involved mainly internal activities in which staff assessed the
weather, overall situation, and/or their own organizational operations.  A
dissemination component was also present in all cases, but also varied from my
original conceptualization.  Beyond dissemination to the public, dissemination to
coworkers and other organizations were core tasks across the cases.  These distinct
variations from the original conceptual model may be due in part to the hazard
context.  In other words, some of the literature this model is drawn from focused more

175

heavily on longer term hazards such as earthquakes. Short-fuse events such as tornadoes tend to have a more developed warning structure, occur more regularly, and are more readily forecasted. Hazards such as earthquakes, in which the science of forecasting is still young and the uncertainty still high, lend themselves to more complicated warning process and politics. These varying characteristics likely lead to slightly different tasks and activities within the warning system.

The following paragraphs describe how each task evolved and changed from the original model. Table 16 displays these changes and presents a revised conceptual model including each broad task, a selection of example activities and communication methods common across cases.

Table 16:    Final Conceptual Model – Original tasks noted with strike-through, final changes noted in red

| Component | Task | Activities | Communication Method |
|---|---|---|---|
| Assessment | **Monitoring** scientific situation/conditions → **Gathering** weather/situation information | • Monitoring radar<br>• Checking websites<br>• Receiving storm reports from another organization | • Radio<br>• NWS chat<br>• Phone<br>• Conference call |
| | **Detecting** the threat/hazard → Removed as a task | N/A | N/A |
| | **Deciding** to warn on the threat/hazard → Activity within 'coordinating workplace' and/or 'analyzing weather data/info' | N/A | N/A |
| | **Preparing** workplace | • Activate EOC<br>• Check equipment<br>• Set up plan | N/A |
| | **Coordinating** workplace | • Staff meeting<br>• Oversee staff<br>• Coordinate broadcast | • Radio<br>• Email |
| | **Interpreting** scientific information related to the environmental context → **Analyzing** weather data/info | • Forecast storm<br>• Interpret radar | • NWS chat |
| Dissemination | **Construction** of the warning message → Removed as a task | N/A | N/A |
| | **Disseminating** to coworkers | • Offer guidance<br>• Hold staff meeting | • Radio<br>• Email<br>• Phone |

| | **Disseminating** to other organizations | • Updating information<br>• Sharing reports<br>• Initiating conference call | • NWS chat<br>• Phone<br>• Conference call<br>• Email |
|---|---|---|---|
| | ~~**Alert** public of warnings~~ →<br>**Disseminating** to public | • Issue official alerts<br>• Broadcast general information | • Social media<br>• EAS<br>• Broadcasting<br>• Website |

In my original model I proposed 'monitoring' as the assessment of the overall conditions present in the atmosphere.  McLuckie (1970) conceptualized it similarly noting that it involved collecting and evaluating information.  On the other hand, Nigg (1995) discussed monitoring in the context of scientific modeling and observations. Following analysis, my interpretation of monitoring is still most closely aligned with McLuckie (1970) and remains similar to my original conceptualization.  However, my interviews demonstrated that monitoring weather conditions was just one activity within the broad task of 'gathering information'.  This task involved displaying and monitoring scientific weather data, determining the extent of preparation and damages in the community, and receiving forecast information and reports.  In essence, organizations performed this task to gain situational awareness and a better understanding of the event overall.

> Wichita (NWS): "I'm gathering all the information that I can on confirmation of reports: hail reports, tornado reports, wind reports, etc."

> Nashville (Radio): "I pay attention to the weather every day if there's anything threatening out there, and I'll make sure I've got weather radio running."

> Raleigh (TV): "A lot of times those anchors can ad-lib especially if we start getting damage photos in from viewers."

178

Portland (EM): "So what'll happen is we all monitor the forecast every morning, basically off the NWS website.  We just look at temperatures, wind, and precipitation."

I originally defined 'interpreting environmental context' as analysis of the environment in and around the potential threat area.  While other literature (Williams 1964, McLuckie 1970, Carter 1979) grouped this type of task with monitoring and/or evaluation, Nigg (1995) noted a separate process of interpreting data in real time to produce forecasts and alerts.  In my interviews, this type of scientific analysis and forecasting was discussed by NWS and TV meteorologists, but was distinct from the interpretation mentioned by other organizations.

Raleigh (NWS): "What I would be doing is watching the radar, maintaining a weather watch, looking at all observational and numerical weather predication model forecast data and issuing warnings based on storm signatures."

Nashville (TV): "We're doing storm tracking using some of our analysis tools on the air to take a look at wind products."

These other organizations did not analyze the environment in the same scientific sense, but rather discussed how they received weather information, who they passed it on to, and how they used it to coordinate their operations.

Wichita (EM): "We share what we see on radar, we share what intel we get from the Weather Service… if we're in the office and we're monitoring, we try to keep those that may not be in the office appraised of what's going on."

For this reason, I re-conceptualized this task as 'analyzing weather data and information' which encompassed only expert analysis done by those with meteorological training.  Interpretation activities performed by other organizations were grouped in with coordination, preparation, and dissemination tasks as appropriate.

Originally I proposed that 'detection of the hazard' was a broad task defined as officially understanding and labeling the phenomenon a real threat. Through the interviews it was clear that even before the event began, organizations already understood the hazard as a real threat usually due to advanced forecasting and/or the nature of their work.

> Nashville (EM): "We communicate days in advance if we see
> something like it's going to be a particularly dangerous situation."

Activities originally expected to be included in the broad task of detection, such as chasing storms, receiving storm reports, and analyzing radar were done not to be convinced the threat was valid, but to gather information about and understand the characteristics of the event.

> Nashville (TV): "And then of course we have our own radar here at our
> TV station and then we have the NWS radars as well. We use those
> tools to see where the storms are as they're getting closer to our area."

> Raleigh (Radio): "The storm systems move in from the west, so you
> can start seeing things happening in other counties and it's like, 'Okay,
> it's getting closer to our listening area.'"

These activities were actually more appropriately placed within the gathering and analyzing tasks. Overall, interviews showed that detection was less a separate task in and of itself and more an ongoing process. These results tend to align more with the existing literature than originally expected. Those that addressed detection (Williams 1964, Quarantelli 1990, Sorenson 2000) generally viewed it as a part of monitoring and/or interpreting.

The final hypothesized task within the assessment phase involved a conscious decision to warn the public of a hazard. Williams (1964) and McLuckie (1970) both agreed that this was a separate task in which the actors weighed consequences and

considered options. Carter (1979), Quarantelli (1990), and Nigg (1995) also mention the decision to warn, but group it under dissemination tasks. As expected, my interviews suggested that these important decisions were generally made by NWS forecasters and TV meteorologists. On the other hand, it was not the conscious decision itself that was being discussed, but rather the context it was being made in. For the TV stations it was a component of their workplace coordination. For instance, the meteorologists would coordinate the timing and nature of the broadcast with newsroom staff taking into account the weather and logistical issues.

> Wichita (TV): "I am usually in the control room, either by myself or with another producer and I am coordinating the on-air coverage so, for example: when do we break it, how long do we stay on, what do we do during that time that we're on the air."

In this regard, my results aligned well with Williams and McLuckie in that costs (i.e. Preempting shows, lost commercial revenue) and benefits (i.e. Lives saved, increased viewers) were weighed to make the decision to initially go on air. On the other hand, activities related to this were most appropriately categorized under the coordination task. Similarly, NWS forecasters did not specifically discuss their decision to warn, but rather noted that they would be reviewing radar and other data as they issued warnings.

> Raleigh (NWS): "What I would be doing is interrogating the radar data and issuing severe thunderstorm or tornado warnings."

In other words, it became difficult to separate out analysis activities and activities related to the decision to issue the warning. In this way, my results diverged from the literature because I no longer considered deciding as a separate task, but rather an activity within analysis and/or coordination.

Upon analysis of the interviews, two new tasks emerged within the assessment phase, coordinating and preparing the workplace. Under-represented by the original tasks in my model, many activities fell under the category of coordinating the workplace. Within this task, two types of coordination were occurring, coordination of staff and coordination of operations. It's important to note though that these were not mutually exclusive and often overlapped. This broad task involved activities such as staff meetings, management of the broadcast, and directing mobile units.

> Raleigh (TV): "I'm directing/jockeying, what have you, sort of coordinating back and forth between the meteorologist who would be on the air and the other members of our team, anchors, reporters, that sort of thing."

> Portland (NWS): "We might have a manager who keeps an eye on everything and alerts the individuals who are doing the different tasks if something's moving into their area."

As noted above, some activities associated with the interpreting and deciding tasks in the original model were incorporated into the coordination task.

While preparation and coordination could be thought of as quite similar, preparatory activities stood out as unique and conceptually different from the above types of coordinating. Preparation involved readying staff, resources, and/or the physical office setting. The essence of this is immediate preparation for an event rather than long term groundwork or training. For instance, it would not include yearly staff training, but would include checking equipment before the snow began.

> Portland (Fire): "Like we put, when it gets snowy and icy out we try and keep sidewalks clear around our station, try and put the de-ice on them and things like that."

Originally, my conceptual model focused on distributing information to the public within the dissemination component. The interviews proved that this

conceptualization was too narrow.  While dissemination to the public was an important task discussed across all cases, sharing information with coworkers and other organizations were equally significant. As shown in the previous case descriptions, the type of information varied slightly from case to case, but the nature of the exchanges were consistently in the form of briefing, collaboration, or guidance. Conceptually, briefing was considered predominantly one-way and meant to 'get everyone on the same page' by providing a broad overview of the forecast, damage, or other such topic.

> Portland (EM): "The field office here will actually start sending out briefing notes on it and it's usually a head's up type email."

Collaboration was typically a two-way exchange in which coworkers or partner organizations discussed the forecast or situation with one another.  They would share opinions and information typically on specific topics such as whether to warn or what graphic to put in a broadcast.  Even less interactive exchanges such as sharing storm reports were considered collaborative because they received information in return.

> Wichita (NWS): "So there's a lot of discussion among the staff about you know what are seeing how you feel this is going to unfold, when do you think it's going to happen.

Guidance while similar to collaboration was typically a one-way exchange in which staff offered a coworker or another organization advice.  While this could evolve into collaboration, the guidance itself was distinct.

> Raleigh (Fire): "We'll get advice from the police on our traffic accidents, on traffic especially if it occurs during a workday and people come to work and the event is sudden like a thunderstorm or a possible tornado."

Regarding dissemination to the public, I initially proposed a construction task in which the actors actually create the written, spoken, or drawn alert before it's given

to the public. While most of the warning system literature (McLuckie 1970, Carter 1979, Quarantelli 1990, Nigg 1995, Sorenson 2000) discussed construction of warning message, they addressed it in the context of public response focusing on effective wording and subsequent behavior. I wanted to consider the organizational activities involved in the actual creation of the message. Interestingly, the construction of the warning message was not consistently or frequently discussed across cases. Aside from a couple brief comments on broadcast wording which fit more appropriately into 'coordinating workplace', organizations did not describe activities associated with alert construction. Much of the discussion I expected from the NWS offices regarding their use of AWIPS and choice of wording in warnings was simply not a topic of conversation. Since this did not appear to be a major task at least as represented by the content of the interviews, I eliminated this task from the model.

In addition to the construction task, my original model also included an alert task with various subtasks which I described as the physical transmission of the message to the public. Many previous studies discuss alerting in some form, but it tended to vary. Nigg (1995) focused on the conversion of scientific information into more understandable messages. Sorenson (2000) considered the technologies and techniques available for alerting the public, while McLuckie (1970) and Williams (1964) discussed types of available channels for communication. Similar to the construction task, my conceptualization was most focused on the organizational activities involved in alerting rather than characteristics of communication methods and the public. Interviews did suggest a multitude of activities related to alerting, but to align with my new conceptualization of the dissemination component I redefined this task 'dissemination to the public.' Similar to what I had originally envisioned,

184

there were a variety of methods utilized to share information with the public, but instead of sub-tasks, use of these tools was actually activities within the broader dissemination task (i.e. 'utilizing NWS chat' or 'sending emails').

> Portland (Police): "If we were to send a news release, the service we use automatically populates to Twitter and Facebook, as well as our subscribers that sign up on the police Bureau website."

> Wichita (EM): "We also operate the public alert and warning system for Sedgwick County to notify the public in case of emergencies and disasters."

## 5.3 Inter-organizational Communication

### 5.3.1 Propositions

The intricacy of interactions between organizations is a key component of organizational culture. Consequently, five of my propositions focused on inter-organizational communications; I proposed that areas with a frequent hazard would have 1) more frequent communications during warning time, 2) more two-way communications during warning time, 3) more frequent communications during normal time, 4) a more developed plan of communications, 5) and this plan would be more known and used. Additionally, while proposition 16 was originally written in the context of resources, it's reasonable to include it in the discussion of communications: 16) Frequent hazard cases will have a greater transfer of intellectual resources. Though I cannot provide statistically significant numerical results, my coding process and analysis did offer some insights into the frequency of communications between organizations. As proposed, the frequent hazard cases did have more total communication codes than non-frequent hazard cases (93 vs 70, respectively) but this was due at least in part to the number of interviews (21 vs 18,

respectively) conducted.  In a more qualitative sense, dissemination to and collaboration with another organization was consistently a key component of the warning system across all cases.  Not only was 'dissemination to another organization' an important broad task in all cases, but the organizations also continually used language (i.e. constant, always) to denote how often communications occurred.

> Wichita (NWS): "We are always making calls outward as well, because I will turn to them and say, 'hey, can you call such-and-such county?'"

> Nashville (EM): "We communicate days in advance… everyday we'll do a conference call."

> Raleigh (TV): "…you're constantly in touch with all organizations in your viewing area."

> Portland (NWS): "We're in constant contact with those folks [Columbia River bar pilots] and doing a lot of one on one consultations and decision support services."

While my analysis could not agree that communications are more numerous in frequent hazard cases, I did notice case by case variations in the nature of these communications.  For Wichita and Nashville, the conference calls, EOC communications, and NWS chat exchanges were of a more two-way nature than as was the case in Raleigh and Portland.  Referring back to the 'Dissemination to another Organization' and 'Inter-organization Communications' sections, Wichita organizations emphasized the opportunity to share thoughts and ask questions during the conference calls.  The EMs even mentioned passing the microphone around to all EOC representatives.  Additionally, NWS chat was not simply an outlet for NWS to provide information and warnings; it also housed two-way collaborations between NWS, EMs, and media.  In fact, the EMs and media assigned staff specifically to contribute to and monitor the chat. Similarly, Nashville had a particularly active EOC

in which two-way communications were encouraged. The EMs projected NWS chat onto a large screen so it was available to view and discuss by all representatives. NWS also embedded a forecaster within the EOC to ensure two-way interaction between offices. Additionally, the EMs did not simply ingest information, but worked collaboratively to verify reports for NWS and the TV station. While organizations in non-frequent hazard cases did engage in two-way communications, it was distinctly less prevalent. Referring to the 'Dissemination to another Organization' sections of Portland and Raleigh, briefing was the most common type of interaction among organizations in those areas. Typically this type of communication was primarily one-way and focused more on getting information out rather than an active dialogue. The following two quotes highlight the difference in nature of communications between frequent and non-frequent hazard cases in the context of a conference call:

> Raleigh (EM): "So I guess the purpose of these conference calls is to get enough information to brief the mayor and other Bureaus of the weather situation."

> Wichita (EM): "Well at that point we have our audio set up, where basically I can pass around a microphone and the EOC partners can ask a question, the NWS folks can hear them over the telephone and then in turn respond."

Given these observations, there is some evidence to suggest that the transfer of intellectual resources was greater in frequent hazard cases (proposition 16). While the frequency of communications did not appear to be substantially different, there was more extensive two-way discussion and greater use of NWS chat. This assumes that the two-way exchange of ideas and dialogue resulted in more knowledge shared between the organizations, when compared to less interactive, more one-way communications.

187

While inter-organizational communications during warning times were consistently frequent across all cases, normal time communication did vary. As suggested by proposition 3, analysis did show more interactions and informal communication outside of warning events within the frequent hazard cases. In Wichita and Nashville, NWS interacted more extensively with other organizations, sharing membership in associations, planning seminar series, and working together on public outreach. They also worked with one another regularly on more mundane needs such as setting up a new NWS chat account.

> Wichita (NWS): "Oh absolutely, nonstop, just like today. I've had a gentleman trying to set up a couple extra NWS chat accounts and we've chatted. Yesterday, I had another emergency manager setting up Storm Fury on the Plains 2013, which is our training."

> Wichita (NWS): "I'll just provide them [TV station] little updates about the weather or just little chit chat about well 'here's something you all may like' or setting up meetings or this that and the other. I try to remain as fresh in their mind as I possibly can."

> Nashville (NWS): "As far as our media relationships go we do multiple media seminars each year where we train each other, we work together."

This frequent, informal communication between NWS and the media was also evident in the TV and radio station interviews. In fact, it was not unusual for friendships to develop outside the working environment.

> Nashville (TV): "We have a local chapter of the NWA [National Weather Association] and that's made up of people from local media and also the NWS, so we see them on that environment. Everybody knows each other by name and it's just a really good working relationship."

Portland had notably the least interactions outside of warning times, with only the EMs and NWS mentioning more formal communications due to trainings and city

planning. Despite these variations, consistencies across all cases did exist. NWS always had some contact with media agencies throughout the year and the EMs regularly worked with other emergency organizations through trainings and exercises.

Propositions 4 and 5 were not able to be adequately addressed by the data, but analysis did suggest that formal inter-organizational communication plans were lacking across cases. During the interviews I addressed this topic by directly asking, "Is there any sort of communication plan, informal or formal, that tends to guide communications between all the different organizations?" Many times this inquiry was met with confusion or irrelevant answers, but a couple interviewees did simply say 'no'. Emergency response organizations typically discussed state or national level emergency management planning documents such as NIMS, while NWS mentioned within office manuals that addressed communication. It's unclear whether the subpar responses were due to a poorly worded question, a true lack of formal plans, or a mixture of both. Despite this, analysis does points toward an informal structure of communication that emerges during a weather event, rather than a formal, documented system. The following section will discuss this in more detail.

### 5.3.2    Emergent Communication Structure

As noted above, my analysis suggested an informal communication structure evident across cases. While this was not explicitly discussed in the propositions, it developed as an important theme throughout the data and broadly relates to propositions 4 and 5 that dealt with a plan of communications. This structure seemed to develop around the key methods of communication. These tools emerged as a predominant topic of conversation within the majority of interviews. In fact, respondents in all four cases expressed strong feelings toward one or more of the tools.

As seen in the 'Inter-organizational Communications' sections, Wichita, Nashville, and Raleigh shared the same major communication tools (conference call, NWS chat, EOC, and simulcasting), while Portland diverged slightly (conference call, EOC, social media).  Across all cases, the conference calls were meant to distribute detailed forecast information from NWS to key partners (typically EMs), while taking advantage of the pre-impact 'calm' by allowing two-way dialogue.  In fact, it was emphasized as a crucial and valuable tool in Wichita and Portland.  The media also joined these calls in Wichita and Raleigh.

NWS chat was arguably the most popular and widely discussed communication tool.  In agreement with proposition 17, use of chat was much more prevalent in the frequent hazard cases.  In Wichita and Nashville the NWS, EM, TV, and radio all extensively used the software, with several of the respondents expressing positive feelings toward NWS chat.

> Wichita (NWS): "That's where I use that NWS chat.  That's probably one of my favorite tools to interact with the media.  It gives me the ability to put some more information in there."

> Nashville (Radio): "So that's one of the first things that I get fired when it looks like something's going to happen, is to get into the NWS chat."

Similar information was also exchanged in both cases: storm information, reports, and warnings.  On the other hand, the Raleigh NWS and TV station used chat to communicate, but to a lesser extent with it more dependent on adequate staffing.  Interestingly, Portland only mentioned NWS chat in passing upon being prompted.  For their area, chat was not a primary form of communication and was actually considered in somewhat of a 'beta' phase with it being tested only when staff was available.

Portland (EM): "We haven't moved to a point where that [NWS chat] is one of the more primary means of communication. Right now it's really, it's in a testing phase and, 'hey if you have time to chat' kind of thing."

While the EOC was not a physical 'tool' in the same sense as the others, it was indeed a consistent conduit of information exchange. In all cases, the EOC (or in the case of Portland the ECC) allowed the EMs to efficiently communicate with response organizations including the fire and police stations. They provided resource coordination and storm information generally through a WebEOC type software, though phone and email were popular in Portland. In a practice only discussed by Nashville, the EMs displayed the NWS chat on a large screen within the EOC so all representatives could read from it individually.

For all cases except Portland simulcasting was a crucial component of the communication and partnership between the TV and radio stations. This partnership appeared the most active in Wichita. Beyond simply providing a recording, the TV station actually assigned a meteorologist to remain 'connected' to the radio station through an IFB, sharing guidance and reports throughout the event. Nashville and Raleigh shared a similar set-up in which the radio station relied heavily on the TV station for forecast information and storm reports. Neither radio station had the meteorological expertise needed for an extensive broadcast nor the resources for mobile units. Simulcasting was not a method mentioned in Portland, but it is important to note that a representative from a radio station was not able to be interviewed.

While Portland did not have the same extensive use of NWS chat and simulcasting as did the other cases, social media was much more widely utilized. Every organization expressed positive feelings toward social media, commenting on

its speed and range.  Twitter, Facebook, and other public websites were used to mine for information and disseminate outward.  While it allowed for quick updates, it did not seem to foster two-way dialogue between the organizations.  Several of the organizations used automated systems to disseminate information over these websites allowing for more passive, one-way communication.

> Portland (EM): "So we have automatic retweeting and posting, twitter and public alerts websites for any weather product."

> Portland (Fire): "Social media is so much more effective in notifying a lot of people at once."

## 5.4    Inter-organizational Roles and Relationships

### 5.4.1    Propositions

Beyond the nature and frequency of communications, trust and mutual understanding are also key components of the culture between organizations.  Deeper, more unconditional trust should lead to a stronger understanding and agreement of roles among the organizations.  To address roles and influence within the warning system, I proposed that within frequent hazard cases 9) organizations will have a clearer understanding of the roles of the other organizations during the warning process, 10) organizations will feel more comfortable going beyond their normal time roles, 14) the NWS will have more influence over the other organizations during the warning process, 15) a specific organization will act as the leader or organizer for the storm spotter network.

My analysis could only partially agree with proposition 9.  Only one of the two frequent hazard cases, Wichita, demonstrated a notably stronger understanding of roles within the warning system when compared to the other three cases.  As discussed

in the 'Warning Team and Roles within the System' section, NWS describes their own role in the system as supportive, emphasizing that they provide the information necessary for effective decision making, but do not go beyond this role to actually make these decisions for the community.

> Wichita (NWS): "I can't tell them to evacuate or not, I can't tell schools to close, that's their decision that they make based on the information I provide."

They expanded on this by assigning that decision making role to the EMs. In agreement with this, the EMs noted their own limited role in forecasting, while highlighting their central position in community decisions and response.

> Wichita (EM): "Were dispensing the information provided to us by the NWS, the folks that we're dispensing it to may ask some clarification questions, but naturally our role with respect to that is extremely limited because we're not meteorologists."

Similarly, the fire and police stations also viewed forecasting and dissemination as beyond their role. The EMs and radio station also emphasized the expertise of NWS as a weather provider and scientific source. Overall, Wichita discussed roles frequently and nearly every organization expressed a clear understanding of the structure.

While Wichita stood out as unique, some common themes were present across cases as seen in the 'Inter-organization Roles and Relationships' sections. For instance, the NWS always described their own role as supportive, while noting that it was beyond their job to make community decisions. In all but Nashville, the EMs emphasized their central, supportive role among community stakeholders. Additionally, the fire station either described forecasting as beyond their own role or assigned this role to NWS, labeling them as weather experts. Interestingly, Nashville

stood out as an outlier in that most organizations discussed confidence in their abilities rather than specific roles. The EMs expressed confidence in their ability to understand the weather situation and make effective decisions due to extensive experience with severe weather events.

> Nashville (EM): "I've been doing this all my life, so I can pretty much tell by looking at the radar, knowing what time of year it is, the terrain how bad it's going to get."

Additionally, the radio and TV stations emphasized their role as extremely active during an event, highlighting that they were known for their severe weather coverage. Similar to this, in all but Portland, the media stations saw themselves as going 'above and beyond' the typical broadcaster role.

The above observation actually leads directly into proposition 10. While the media regularly expressed a willingness and ability to go beyond what was required of them, organizations across cases did not generally feel like they went beyond their 'normal time' role during weather events. When asked about going beyond their typical 'normal time' duties, I was frequently met with confusion because many felt that these typical duties included any necessary support during a weather event.

> Raleigh (Fire): "Fire department is the traditional name for us; fire department indicates that we put wet stuff on red stuff. I mean fire departments now control the hazardous material response units. We control the urban search and rescue units. We do an awful lot of emergency medical service."

> Wichita (EM): "Well, since our written roles are so wide, it would be very surprising to me if we did anything beyond those roles because … we're basically responsible for all phases, mitigation, preparedness, response and recovery."

While this confusion could be a product of a poorly worded question, it also highlights the dedication seen in all cases. Most organizations felt it was part of their duty rather than an extra effort to play a role in the warning system and support the community.

Related to proposition 9, proposition 14 deals with the role of NWS within the system. Upon completing analysis, I found that proposition 14 addressed a relevant concept, but was not worded in a way that represented the heart of the idea. Rather than exerting influence on the other organizations, NWS was respected as an expert and the leading weather provider. In disagreement with proposition 14, the 'Feelings and Opinions toward other Organizations' sections show that this observation was not unique to the frequent hazard cases. In all cases the EMs and at least one other organization emphasized their trust in and positive feelings toward NWS. This strong level of respect for NWS as an expert was also demonstrated by the reliance on their information.

> Nashville (EM): "The NWS here in Nashville, were fortunate to have a good group; they work very closely with emergency management."

> Raleigh (EM): "NWS is key. We're in constant communication with them."

Across all cases, many organizations participated in NWS led conference calls, retrieved information through NWS chat, and relied on NWS warnings during decision making. A potential exception to this was found in Portland, in which several organizations mentioned the use of private forecasting companies throughout the area. Though none of the organizations interviewed claimed to use these companies, they did discuss the tension sometimes created when other local agencies and groups relied on them.

To address the roles related to the storm spotter network (proposition 15), it's important to also consider the extent and structure of the network overall. Though it is difficult to make a claim regarding the number of spotters present in each case, my analysis did provide some evidence in agreement with proposition 19 that the network was more extensive and widely used in frequent hazard cases. In all cases NWS took the lead in training the spotters and receiving and organizing their reports. In Wichita and Nashville it was the EMs role to collect and relay reports to NWS. In contrast, the EMs were not involved in the network in non-frequent hazard cases. The spotter network in Raleigh was run mainly by volunteers throughout the community. It was not clear which organization directed and organized the spotters in Portland, but NWS was the only one to mention their use. In general, use of the network did not appear to be as streamlined or frequent; in fact until recently they relied mainly on direct phone calls from the public rather than electronic reporting.

> Portland (NWS): "We don't necessarily activate our spotter network
> like they do in the Midwest… but it's a mechanism to get reports in
> from the local community and they call us and sometimes we call them.
> And we're actually doing some electronic reporting now."

The structure appeared more established in the frequent hazard cases with the county EMs collecting reports for their area and relaying them to NWS through chat, radio, or phone. In particular, the network seemed deeply integrated into Wichita's warning system; their police, radio station, and EMs all mentioned that some or all of their staff were trained spotters.

> Wichita (Radio): "We have four people who are equipped and who are
> trained in severe weather spotting doing live reports from throughout
> the area."

> Wichita (EM): "I'm the one that is tasked with gathering the information from the spotter network and making sure that we appropriately notify the Weather Service."

Additionally, Wichita was the only case to discuss different types of spotters with distinct roles. For instance, they had community based spotters who reported from their home location, HAM radio operators who could quickly radio directly into the EMs or NWS, and more advanced chasers with a meteorological background or experience.

### 5.4.2 Role Structure

Despite the differences evident between frequent and non-frequent hazard locations, a common general structure of roles and interactions emerged across cases. This structure represents a synthesis of relevant results from the 'Inter-organizational Roles and Relationships' sections and is illustrated in Figure 9 below.
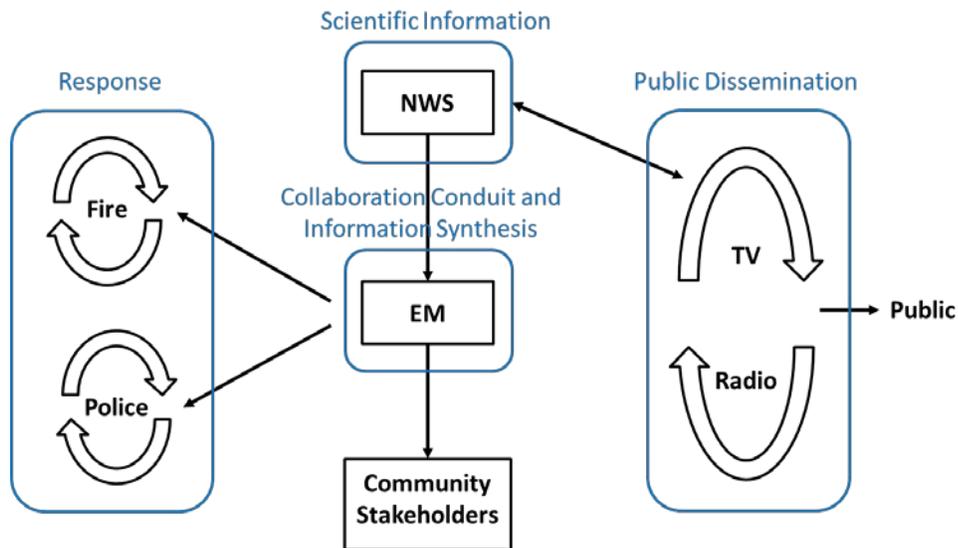
Figure 9:    Illustration of role and interaction structure among organizations in all cases. Blue boxes and text represent general roles. Smaller arrows show interactions evident in all cases. Larger curved arrows illustrate that the fire and police stations work mainly independently and the TV and radio station work primarily with each other.

NWS acted as scientific support illustrated by their own articulation of their supportive role within the system and the corresponding emphasis on NWS reliability and credibility expressed by the other organizations. The EMs acted as an information sharing conduit for the community synthesizing information from NWS and disseminating it to community organizations such as fire, police, utilities, and elected officials. As part of this they attended a conference call with NWS prior to the weather impact in all cases. The EMs general goal was providing situational awareness so these organizations could make informed decisions for the community. For the most part the fire and police stations worked independent of the other organizations, but received most of their weather information from the EMs. In all cases, an EOC was present and if activated information exchange between EMs and

198

other emergency organizations was mainly done through this Center. Overall, fire and police seemed to continue normal time operations with slightly increased preparation and more numerous emergency calls. The radio and TV station worked most closely with one another rather than the other organizations. Simulcasting between the two was present in all cases and appeared to be the most common way for the radio station to receive forecast information. Though the media's attention was most focused on dissemination to the public, the TV station also typically worked closely with NWS. The relationship across cases was collaborative rather than competitive with NWS and the TV stations working toward the same main goal.

> Raleigh (TV): "If we saw something in our dual pole radar data that we thought might be interesting then I might share an image or two with them just to say 'here's what I'm seeing on my tool, does this agree with what you're seeing on yours?'"

Additionally, conflict was minimal across all cases. Disagreements were only discussed when interviewees were directly asked about conflict. Issues across organizations were minor and many times they actually took the opportunity to emphasize how well they work together. The nature of the conflicts varied with no clear theme present when comparing frequent and non-frequent hazard cases. As mentioned above, Portland organizations tended to focus on the issues that arose with private forecasting companies. Raleigh's and Wichita's TV stations both complained about short-tempered emergency dispatchers. The NWS in Nashville indicated a deficient relationship with police and the occasional misinterpretation of their warnings throughout the community.

### 5.4.3  Relationships

While relationships were not explicitly addressed within the propositions, they emerged as a key component of analysis and are crucial to fully understanding the culture among organizations.  The propositions addressed above regarding the nature of communications among organizations, interactions outside of warning times, and structure of roles are at least in part a reflection of the relationships that have developed.  Beyond this, the organizations themselves more directly discussed their relationships with one another.  Overwhelmingly, feelings toward other organizations were positive across all cases.  In particular, the TV station and the EMs both described a strong relationship with NWS in every case, additionally citing their respect for and reliance on NWS expertise.

Aside from these similarities, the relationships among organizations varied case by case and are described in detail in the 'Feelings and Opinions toward other Organizations' sections.  The amount of discussion and opinions regarding relationships as well as relevant key themes set the frequent hazard cases apart during analysis.  In a more quantitative sense, there were over double the amount of cognition codes related to relationships in the frequent hazard areas.  Additionally, the importance of relationship building was a common theme throughout Wichita and many of the organizations regularly referred to each other as partners or team members.  They mentioned long standing, pre-existing relationships and some interviewees even saw members of other organizations as personal friends, rather than just colleagues.

> Wichita (NWS): "I feel it's extremely important to have the relationships remain strong and fresh."

> Wichita (EM): "There are relationships that evolve over time of course. So some of us are not only professional colleagues, but friends."

Similarly, in Nashville many of the organizations mentioned the importance of maintaining relationships outside of warning times. They emphasized working toward the same goal and felt they were part of a team. Much like Wichita, some interviewees also mentioned personal friendship with staff from other organizations.

> Nashville (EM): "We would follow their guidance, pretty good working relationship between our office and their office [NWS]. So they'd be glad to share their advice, together were a pretty good team."

In addition to these themes, figures 2, 4, 6, and 8 show that two-way feelings were much more prevalent in frequent hazard cases. In other words, when one organization mentioned a strong relationship the corresponding organization described it similarly.

The non-frequent hazard cases also demonstrated some strong relationships, but to a lesser extent. As noted above the two-way nature of these feelings was not as prevalent in Raleigh and Portland. In particular, one notable difference between frequent hazard and non-frequent hazard cases was NWS. While they spoke frequently and openly about positive feelings and relationships with other organizations in Nashville and Wichita, these opinions were absent in Raleigh and extremely limited in Portland. Overall, the importance of building and maintaining relationships was not as heavily stressed in Raleigh and Portland and relevant language such as 'team' and 'partner' were not used. While emotions toward relationships were limited in the non-frequent hazard cases, there was evidence of some strong partnerships. In Portland, NWS and the TV station described a relationship in which they were sensitive to one another's needs. In Raleigh, the TV station discussed a unique practice in which their office and NWS exchanged forecasters as a learning experience.

**5.5 Intra-organizational Communications, Roles, and Relationships**

**5.5.1 Propositions – Communications**

Organizational culture within a warning system is not limited to inter-organizational dynamics; it is also important to consider the culture that develops within offices. I proposed that for frequent hazard cases 6) communications within organizations will be more frequent, 7) communications within organizations will be more two-way rather than one-way, 8) members within each organization are more willing/capable of going beyond their normal/set roles, 11) TV station meteorologist/s will take on more of a leadership/expert role within the station during an event, 12) there will be less centralization of authority within each of the organizations during the warning process, 13) there will be more collaboration between actors within each organization especially during times of decision-making and interpretation. It's important to first note that despite specific questions meant to address intra-organizational dynamics, the conversation tended to naturally flow into other topics. Discussion within interviews focused most heavily on activities and inter-organizational interactions. Within office communications and roles were discussed, but answers were typically less extensive than with other inquiries. Subsequently, data and analyses for this topic were not as rich as other areas.

As with inter-organizational communications, the frequency of within office communications was similar for all cases and thus I was not able to find support for propositions 6 and 7. In fact, variations seemed to be most prevalent across organizations rather than across cases. While it is difficult to get a quantitative sense of the frequency, I was able to examine on a qualitative level how critical coworker interactions were to office activities and the emphasis placed on an interactive

environment. There was similar language spoken in all NWS offices denoting frequent dialogue between coworkers. Drawing from the 'Intra-organizational Communications and Roles' sections, similar phrases emphasizing the importance of a collaborative environment were seen across cases: "Impossible not to have those communications," "We kind of bounce ideas off one another," "Communication, it's very important," "Interactive and team-building consensus." Not only did communications appear frequent and crucial to NWS activities, but these interactions were generally two-way. In fact, two of the four cases actually mentioned rearranging their office set-up to promote more dialogue and idea sharing among employees.

For all cases, within office communications were not heavily emphasized by the EMs, fire, and police. Interactions were fairly structured and pre-planned. Again drawing from the same case description sections as above, comparable language was present across cases in these organizations: "We pretty much can just operate independent of each other," "We have standard operating procedures so for the most part that's going to be in writing for what you need to do," "There's not a lot of discussion, there's just orders and information." The lack of frequent, two-way type dialogue seemed to stem from the nature of the organizations as a quasi-militaristic structure, rather than a breakdown in relationships. Communications were flowing among staff in the EM offices, fire stations, and police stations, but it was typically in the form of one-way orders or information sharing.

Communication among coworkers in the TV stations was consistently frequent across cases. Each station discussed interactions in a similar manner, emphasizing the importance of communication: "in the control room really talking to the people who are on the air," "we're really talking about what's going on, what we need to be doing

and where the storms are headed," "there's a lot of talks back-and-forth between producers and meteorologists," "more than anything it's bouncing ideas off each other." Contrary to proposition 11, the meteorologists took on more of a leadership role during a weather event in both frequent and non-frequent hazard cases. They were trusted to control the content of on-air material and to initially alert the station ahead of incoming weather so proper preparations could take place. On the other hand, while the newsroom relied heavily on their meteorological expertise, the producers still ultimately regulated the timing and organization of the broadcast. This dynamic necessitated frequent, two-way communication between the meteorologists and the newsroom. Additionally, the meteorologists themselves shared opinions and bounced ideas off each other as they worked to forecast.

While the frequency and nature of intra-organizational communications did not generally vary dramatically across cases, the radio stations were an exception. Nashville and Raleigh both described fairly automated systems in which little interaction was required. Aside from occasionally touching bases with one another to ensure everything was working properly, both stations seemed to have set procedures: "I mean we have stated policies and procedures on how things progress," "It's basically a carbon copy. It's such a simple system; we all know what to do." On the other hand, Wichita's radio station displayed more frequent, two-way communications. Overall they were less reliant on the TV station and tended to produce their own forecasts and coverage. Additionally, they had mobile units that reported live. These led to a more interactive environment: "We're always talking back and forth with each other," "certainly frequent meetings and updating each other

on what our plans are." I was not able to reach a radio station in Portland, thus I'm not able to comment on the nature of communications within their organization.

### 5.5.2  Propositions – Roles and Relationships

Intra-organizational roles were not clearly defined or even implied with many of the interviews. Conversation did not naturally develop around this topic. Despite this, some insights can be gleaned. As with communications, internal operations and roles remained largely consistent across cases with most differences emerging between organizations. So, in disagreement with propositions 8, 12, and 13 there were few variations between frequent and non-frequent hazard cases. The degree of centralization (proposition 12) and the amount of collaboration (proposition 13) were highly dependent on the type of organization. Proposition 8 was difficult to address across cases *and* organizations because, similar to inter-organizational roles, interviewees didn't typically view themselves as doing things beyond their normal within office role. They defined them broadly and instead discussion generally focused on the fluidity of the roles. Overall, within office roles, centralization, and collaboration are best discussed for each organization separately.

The environment within NWS was highly interactive and dynamic with the forecasters working as a team rather than individuals. Language from the leadership across cases denoted less centralization of authority and more collaboration: "My role varies, I'm a team member. I'm not just a WCM," "just being a part of the forecast team and working through the event from start to finish." Similarly, roles were fluid and could be assigned on the fly depending on what was needed: "It just depends. Everyone has different roles, you don't know what your role is going to be until you get in there," "and the WCM would then start to cover the necessary jobs throughout

the office," "showing our versatility, being able to do one another's job at any given time."

Emergency response organizations (EM, police, fire) were highly structured with set procedures and policies to follow. In fact, these were some of the few interviewees to clearly state office roles: "I become the lead person for the county and all decisions go through me," "The captain, my responsibility is I'm kind of the manager of the firehouse." Discussion among coworkers generally occurred throughout the year during normal times rather than during an event. On a severe weather day staff followed orders and only shared pertinent information with one another instead of extensive two-way discussions. Across all cases, these organizations emphasized a need for fast actions and decisions during an event: "We only permit decision makers to be in the EOC. We do not tolerate the 'mother-may-I' attitude." While roles were mainly pre-planned and set, this need for quick action seemed to necessitate some flexibility in the system: "It really just depends on who's available at the time. We share so many duties when things go wrong."

Similar to NWS, the TV stations were interactive and collaborative offices. The newsroom and the meteorologists tended to be physically separated with each acting autonomously, but also interacting frequently. In general there was less centralization of authority and more collaborative efforts: "We even had other people in other parts of the station who had nothing to do with the news aspect of the station will still act as support" The meteorologists worked as a team to gather weather information and forecast while the newsroom focused on the structure and timing of the broadcast. These two 'groups' frequently coordinated during severe weather events since each brought different expertise: "sort of coordinating back and forth

between the meteorologist who would be on the air and the other members of our team." As noted above, the meteorologists were trusted as the weather authority within the stations and given control over broadcast information across all cases.

For Nashville and Raleigh, the radio stations used fairly automated systems for broadcasting and simulcasting: "I just make sure that the stations doing the defined policies" "We have the ability from home to be able to log into our control board and turn off the music and turn on the TV station [coverage]." Operations even on severe weather days required little interactions among the staff. This did not appear to be due to a rigid or centralized structure, but more the nature of their organizations role. Because these radio stations relied so heavily on TV simulcast, there was little need for frequent collaboration and discussion. Interactions were more frequent and operations more complex for the Wichita radio station mainly due to their team of mobile units. The structure and communications of their station was actually more closely aligned with that of the TV stations. While those at the station coordinated the mobile units, it did not appear to be a highly centralized system. Instead, it was a collaborative effort to position people around the storm and produce live coverage from the field: "more experienced people help the less experienced people position themselves in the storm," "He's the coordinator and everybody is welcome to provide feedback."

## 5.6   Resources

As noted earlier in section 3.5.1, the email surveys originally intended to address resources had a poor response and completion rate. This lack of data made several of the propositions difficult to discuss. I proposed that for frequent hazard cases 18) there will be more full time, rather than volunteer employees within the

OEMs and fire departments, 20) there will be more technological resources available to the OEM, 21) there will be a greater selection of warning channels available to each organization, 22) there will be a clearer understanding/agreement over how the warning channels are used and by whom.  In opposition to proposition 18, the EMs were full time staff rather than volunteers in all cases.  This was not as easy to decipher for the fire departments.  I only received two of the four fire station surveys; one clearly stated that there were no volunteers, but the other only provided a number without indicating whether they were paid or volunteer.

Regarding proposition 20, some insights can be gained on the use of technological resources at the OEM.  While Nashville EMs did not respond to the email survey, the other three cases all mentioned similar resources including pagers, radios, computers, and WebEOC software.  On the other hand, during interviews Wichita EMs spoke about their live video system installed to better communicate with and utilize their spotters.  Additionally, the Nashville EMs discussed big screens available to display NWS chat and other information.  Even with these insights, more data is needed to conclusively agree or disagree with proposition 20.

Overall, very similar systems and technologies were used to disseminate information to the public.  All cases discussed sending alerts via phone (Reverse 911 or subscription services), broadcasting over radio or TV including use of EAS, and posting on various websites and social media.  While each case tended to emphasize each of these methods differently, there was little evidence to suggest that frequent hazard cases had a greater selection of warning channels.  Subsequently, analysis did not offer support to proposition 21.

When asked about an understanding over the use of warning channels, there was some confusion across cases and thus some answers did not address the question. Of those that did, none suggested a formal, written agreement among organizations. NWS, the TV stations, and the EMs seemed able to offer the most information. For non-frequent hazard cases, NWS emphasized that there was no formal agreement, but the organizations did coordinate the EAS transmission. In the frequent hazard cases, each NWS went in a different direction when answering the question. Nashville actually chose a more specific example explaining their collaboration with the Park Service on the release of fire weather warnings. Wichita on the other hand was clear that a 'gentleman's agreement' was in place between themselves and the EMs.

> Wichita (EM): "There's nothing in writing however it's kind of an agreement, gentlemen's agreement, a handshake agreement that we do have is that if they think things are worse and our messages aren't the same they need to contact us immediately."

For all cases, the TV stations did not know of any written agreements, but did suggest that NWS provides them the information and trusts them to disseminate as they see fit.

> Raleigh (TV): "They don't put anything in the chat that they wouldn't want broadcast."

The EMs focused mainly on their own SOPs, generally diverging beyond the scope of the question into their organizations structure and policies. Across cases a formal, written agreement on use of warning channels did not appear to exist. Some common understandings were evident, but there was no clear distinction between frequent and non-frequent hazard cases. Consequently, my analysis was not able to conclusively agree with proposition 22.

## 5.7 Discussion and Conclusions

### 5.7.1 Components and Tasks of a Warning System

Broad tasks and many corresponding activities remained the same across cases. In other words, this lends credence to the idea that a consistent warning system model is present across areas with varying levels of hazard impacts. Assessment and dissemination components are evident as suggested by previous literature, but this dissertation discovered 7 unique tasks within these components: gathering, preparing, coordinating, analyzing, disseminating to public/coworkers/organizations. While some of these tasks are highly similar to those uncovered previously such as monitoring and interpreting, others such as preparing and coordinating are newly discovered in this dissertation. Similarly, I present an original conceptualization of dissemination as a 3 part component involving not only dissemination to the public as previous work has focused on, but also distribution of information to coworkers, and other organizations.

In addition, my original conceptual model was revised to include only the use of communication methods, rather than the full spectrum of resources. It was discovered that tools for interaction were the most frequently discussed resource. While other resources such as fire trucks and computers are clearly crucial to operations, the focus on communication methods suggests a reliance on these tools in particular to create an optimal integrated warning system. This finding aligns perfectly with Carter's (1979) assertion that an effective warning system is built around "reliable communication linkages." Furthermore, a host of literature (Sorenson 2000, Nigg 1995, Carter 1979) suggests that integration in which communications are frequent and tasks are an ongoing process rather than a linear

210

progression, is crucial to an effective warning system. My findings demonstrate this integration in all cases. Tasks were not completed in chronological order; in fact many were done simultaneously. For example, the NWS forecasters would regularly analyze radar data while gathering more information from a nearby computer or TV. TV station producers would coordinate the broadcast while disseminating information to the meteorologists regarding on-air timing. Dissemination to the public did not represent an end to the cycle, instead these tasks were part of an ongoing process in which the actors and organizations continually shared, managed, and updated information. In the same way, communications were frequent across organizations, as well as within offices. There did not appear to be boundaries in which two organizations did not feel comfortable interacting with each other. Likewise, few offices demonstrated structures unfavorable to at least some vertical communications.

### 5.7.2   Culture among Warning System Organizations and Actors

This leads into my initial assumption that a certain dynamic or culture already exists between and within warning system organizations regardless of the hazard frequency. I then used inter- and intra-organizational relationship literature to suggest more specific characteristics of this pre-existing culture. Weller and Kreps (1970) explain that organizations can have relationships built around coordination or facilitation. Coordination focuses on collaboration during decision-making, whereas facilitation involves more passive exchange of physical resources. As originally suggested, coordinating relationships were most prominent across all cases. Organizations generally relied on their own physical resources to perform their roles within the warning system (i.e. Fire stations used their own fire trucks, EMs used their own EOC), but collaborated often with one another by sharing information and

guidance (i.e. NWS sharing weather information through NWS chat). This was clear by the emphasis on communications and relationships with other organizations coupled with the distinct lack of discussion on the exchange of physical resources.

I also argued that an 'organizational set,' discussed by Weller and Kreps (1970) and explained as organizations connected by similar responsibilities and/or goals, would develop within the warning system. As expected, several broad tasks were shared by organizations across all cases. Additionally, there were regular interactions and exchanges among these organizations. Similar goals of protecting the public and preparing the community were consistent across organizations and cases. These findings suggest that there did seem to be an 'organizational set' in all cases.

Aligning with the idea that relationships among warning system organization are built on mutual goals and collaboration, Schmidt and Kochan (1977) proposed that inter-organizational relationships can develop to maximize one another's benefits and goal achievement. Schmidt and Kochan describe two types of theories, exchange and power-dependency. While power-dependency type relationships are based on organization's power or influence over one another, exchange oriented relationships tend to be voluntary and created based on mutual goals. As indicated above, findings did show similar goals that were more easily attainable with collaboration across organizations. Interviewees emphasized relationships and communications as crucial tools in fully understanding the weather situation and effectively preparing and responding to it.

While the above characteristics (coordinating relationships, exchange based relationships, and existence of organizational set) were proposed as features of a pre-existing culture consistent across cases, I also suggested that certain aspects of this

culture evolved depending on hazard occurrence. From this idea, I developed 22 propositions each addressing a certain aspect of the culture that I expected to vary depending on frequency of hazard impact. Additionally, there were concepts unaddressed by the propositions that emerged during analysis. Table 17 displays all original propositions and the corresponding general finding (supported, unsupported, inconclusive) as described in detail in the previous sections. From these propositions and emergent concepts, three categories of results are evident: 1) Supported propositions and emergent concepts that suggested an evolution of culture, 2) Unsupported propositions and emergent concepts in which all 4 cases had similar characteristics, demonstrating aspects of a pre-existing culture, and 3) Propositions needing further research in which data was insufficient and/or no discernable pattern was recognized. These categories of results are discussed and connected to relevant literature in the sections below.

Table 17: Summary of propositions with results

| Category | # | Proposition | Result |
|---|---|---|---|
| **Inter-organizational Communications** | 1 | More frequent communications during warning time | Unsupported - communications frequent across all cases |
| | 2 | More two-way communications during warning time | Supported |
| | 3 | More frequent communications during normal time | Supported |
| | 4 | More developed plan of communications | Inconclusive - confusion and inconsistent answers |
| | 5 | Plan would be more known and used | Inconclusive - confusion and inconsistent answers |
| | 16 | Greater transfer of intellectual resources | Supported |
| | 17 | Use of NWS chat more prevalent | Supported |
| **Inter-organizational Roles and Relationships** | 9 | Organizations will have a clearer understanding of the roles of the other organizations during the warning process | Inconclusive - aside from Wichita there was a lack of discussion on opinions and understanding of roles |
| | 10 | Organizations will feel more comfortable going beyond their normal time roles | Inconclusive - most did not feel anything was beyond their role |

| | | | |
|---|---|---|---|
| | 14 | NWS will have more influence over the other organizations during the warning process | Unsupported - role similar across all cases |
| | 15 | A specific organization will act as the leader or organizer for the storm spotter network | Supported |
| | 19 | Storm spotter network more extensive and widely used | Supported |
| **Intra-organizational Communications, Roles, and Relationships** | 6 | Communications within organizations will be more frequent | Unsupported - varied by organization rather than case |
| | 7 | Communications within organizations will be more two-way rather than one-way | Unsupported - varied by organization rather than case |
| | 8 | Members within each organization are more willing/capable of going beyond their normal/set roles | Inconclusive - most did not feel anything was beyond their role |
| | 11 | TV station meteorologist/s will take on more of a leadership/expert role within the station during an event | Unsupported - role similar across all cases |
| | 12 | Less centralization of authority within each of the organizations during the warning process | Unsupported - varied by organization rather than case |
| | 13 | More collaboration between actors within each organization especially during times of decision-making and interpretation | Unsupported - varied by organization rather than case |
| **Resources** | 18 | More full time, rather than volunteer employees within the OEMs and fire departments | Inconclusive - across all cases EMs full time; insufficient data for fire departments |

| | 20 | More technological resources available to the OEM | Inconclusive - insufficient data |
|---|---|---|---|
| | 21 | Greater selection of warning channels available to each organization | Inconclusive - insufficient data |
| | 22 | Clearer understanding/agreement over how the warning channels are used and by whom | Inconclusive - insufficient data |

### 5.7.2.1 Evolution of Cultural Characteristics

My analysis was able to find support for several of the propositions, suggesting they address aspects of organizational culture that evolve due to frequency of hazards. At the heart of this evolution appears to be more developed inter-organizational relationships. Pulling from the literature, I argued for the existence of an organizational CoP built on "mutual engagement, shared repertoire, and negotiation of a joint enterprise (Iverson 2011, p. 39)." A more developed CoP should have informal interactions with information and knowledge readily shared and discussed (Wenger et al 2002). As expected, I found that two-way communications were indeed more prevalent in frequent hazard areas. Beyond providing instructions and sending out information, many interactions also resembled dialogues in which actors discussed opinions and shared ideas. Additionally, while warning time communications were fairly similar across cases, normal time communications were more persistent and extensive in frequent hazard areas. Many of the organizations worked together on public outreach throughout the year, planned events, and even developed personal friendships. Simply put, their normal time interactions went beyond necessary

trainings and meetings. In essence, I found more developed collaborations in frequent hazard cases as would be expected in a strong CoP.

Expanding on the idea of personal friendships, feelings toward other organizations and relationships emerged as a theme. Though this was not addressed in the propositions, it is an important concept that enriches the exploration of culture. Jones and George (1998) discuss the idea of conditional and unconditional trust between organizations and actors. Unconditional trust develops from strong shared values and is characterized by "interpersonal cooperation and teamwork." Conditional trust allows for needed interactions during certain circumstances, but limits the development of strong relationships. In alignment with the more two-way nature of communications and extensive normal-time interactions found in frequent hazard cases, they also placed a stronger emphasis on relationships. While all cases discussed or implied relationships to some degree, it was heightened in frequent hazard cases. There was more discussion overall on feelings toward other organizations, an emphasis on the importance of relationship building, and the development of personal friendships. In agreement with Jones and George (1998), frequent hazard cases have evolved closer to unconditional trust.

Though I've discussed relationships and interactions separately at times, they are truly all inter-connected; stronger relationships are associated with more dialogue and personal friendships lend themselves to more normal-time interactions. None of these observations and characteristics can be separated, but rather as a whole demonstrate an evolved culture.

When discussing aspects of disaster subcultures, Wenger and Weller (1973) suggest refined technologies develop that help the community in the detection and

warning of hazards.  Related to this, I found more extensive use of NWS chat and the storm spotter network in areas with frequent hazards.  NWS chat was the most popular and widely discussed communication tool in frequent hazard cases.  It was used extensively to share and exchange reports, information, and opinions.  Nashville even integrated it into their EOC by displaying it on a big screen.  Additionally, the storm spotter network was notably more widely used in frequent hazard cases.  It also appeared more organized and structured with the EMs controlling the flow of reports and disseminating them to NWS.  Both the spotter network and chat were cited by respondents in frequent hazard areas as critical components of the warning process.  There was no such equivalent as highly developed in the non-frequent hazard cases.

### 5.7.2.2   Pre-existing Culture

As discussed in previous sections, results disagreed with several of the propositions because all 4 cases demonstrated similar characteristics with no clear differences between non-frequent and frequent hazard cases.  In other words, these propositions represented an aspect of a consistent pre-existing culture, rather than a characteristic that develops due to hazard occurrence.

Disaster subculture literature (Wenger and Weller 1973) has found that communities tend to develop similar values when faced with continual hazard impacts. Literature on organizational interactions (Levine and White 1961, Hall et al. 1977, Van De Ven et al. 1979, Van De Ven and Walker 1984) then suggests that similar goals and missions lead to more frequent communications both at an inter- and intra-organizational level.  Consequently, I proposed that organizations in areas with frequent hazards should have consistent ideologies shared within offices and among organizations thus leading to more frequent communications.  My results actually

demonstrated that the extent of inter and intra organizational interactions remained fairly similar regardless of hazard occurrence. In other words, frequent communications were an integral part of the warning system in all cases, with no one area standing out as an extreme. This result doesn't necessarily dispute the literature, but rather offers evidence that the overarching goal of protecting the community is well established across all warning systems. In support of this argument, Wenger et al (2002) suggested that shared values and goals lead to mutual respect for one another's expertise. This was illustrated across all cases by the consistent respect for NWS as a weather expert. They were trusted as the leading weather provider. Similarly, the TV stations deferred to their meteorologists when determining on air content. In all cases, they were given control of the weather aspects of the broadcast and trusted to inform the rest of the station.

Following the inter-organizational literature and logic summarized in the previous section, I proposed that within office communications would be more recurrent and two-way, authority would be more de-centralized, and collaborations would be more extensive in frequent hazard cases. In disagreement with this, I found that it was typical of the intra-organizational characteristics to vary by organization, but not by case. In fact, there was significant consistency across cases regarding intra-organizational communication, roles, and interactions. In other words, within offices dynamics seemed fairly unaffected by frequent hazard impacts, but was highly dependent on the type of organization. Organizational norms (i.e. EMs were highly structure, the media were more decentralized) dictated these dynamics in a similar way across cases.

There were also inter-organizational emergent concepts that remained consistent across cases. There was support for the idea that the general organizational role and communication structure were aspects of a pre-existing culture rather than an evolving culture. The basic role structure was highly similar with the NWS providing scientific information, the EMs acting as a collaboration conduit and information synthesizer, the fire and police station focusing mainly on response, and the media focusing on public dissemination. More detailed aspects of the organizational roles within the warning system did vary, with no pattern seen among cases. The basic communication structure was also comparable across cases. It seemed to develop around the communication tools with the conference calls allowing NWS to disseminate scientific information, the NWS chat (not a key component of Portland) supporting frequent exchange of various types of information, the EOC housing response coordination, and simulcasting assisting media coordination. While this basic structure remained the same, more detailed characteristics did reveal differences in non-frequent and frequent hazard cases as noted in the previous section.

### 5.7.2.3   Unconfirmed Propositions

Despite thorough interviews and rigorous analysis, some propositions couldn't be confirmed due to insufficient data or a lack of a discernable pattern (i.e. different in all cases). This suggests a need for further research and/or the existence of some unique characteristics that will differ at every location. When asked about a plan of communications among organizations within the warning system, many interviewees responded with confusion or unrelated answers. I conjectured that this was due to a general lack of plan in all cases or a poorly worded question. Looking at the data as a whole there were no indications that an informal or formal plan existed beyond the

220

basic communication structure that developed around the communication tools. This did not appear to be a weakness in the warning systems as collaborations in all cases, but in particular the frequent hazard cases, thrived.

Similar to this, when asked about an understanding or plan over use of warning channels, I was met with disparate answers and some confusion. It was clear no formal plan existed in any of the cases, but some organizations hinted that there were some agreed upon aspects of warning dissemination. For instance, NWS mentioned coordination of EAS transmission and TV stations suggested that NWS entrusts them with weather and warning information and expects them to disseminate as they see fit. Overall it seemed any plans or agreements remained unspoken and highly informal, perhaps allowing for flexibility. This lack of formality did not seem to cause conflict in any of the cases, but more work is needed to confirm this.

Despite a common basic role structure across cases, it was difficult to fully address the more detailed opinions within each case. Wichita remained an outlier in this area; there was substantially more discussion and clarity on roles than with the other cases. For instance, NWS saw themselves as supportive, while the EMs noted their limited role in forecasting and dominant role in community decisions and response. In the other 3 cases, discussion on roles was more sporadic and limited data made it difficult to surmise how clearly understood and defined they were. On the other hand, it was clear across all cases that organizations did not feel as if they went beyond their normal role. They defined their roles within the community and warning system as quite broad, emphasizing that they are willing to do what's necessary to help the community.

As noted previously, resources were originally meant to be primarily addressed by the email surveys. Poor rates of response and incomplete surveys made analysis around resources difficult. Through examination of the interviews, it did appear that the EMs generally had the same basic technological resources available to them (i.e. pagers, radios, computers), but more targeted work would be needed to confirm this. Likewise, there were very similar tools for public dissemination available within each case (i.e. phone, broadcast, websites). Few unique methods were discussed, suggesting that the same basic tools are used in all areas.

### 5.7.2.4 Summary

Overall, I found a surprising amount of similarities across cases even with some characteristics I expected and proposed would vary. This suggested that some aspects of the culture remain consistent across locations. While I originally proposed that a certain dynamic existed between warning system organizations regardless of hazard frequency, I did not predict the extent of it. Even though a substantial number of propositions were rejected, these 'insignificant' findings actually offer valuable insight into the multiple levels of culture present within and around each warning system. A variety of factors affect the organizational dynamic of the warning system well beyond simply the frequency of hazards. The considerable similarities across cases point to the idea that other layers of pre-existing culture affect this dynamic to a greater extent than hazard impact. For instance, the national structure of NWS and the internal cultures firmly rooted within each organization will influence the warning system.

The mission and structure of NWS has undoubtedly impacted the make-up and functioning of the system. NWS is a national level organization with the direct charge

to forecast and warn on regional and local weather. Additionally, they are the only organization legally able to issue an official watch or warning. As an organization, they are also guided by common criteria and technology. With NWS acting as the nucleus and warning authority, the system itself is also working under this broader context. This could contribute to some of the similarities evident across cases. Furthermore, each organization has developed its own internal organizational culture. For instance, the emergency management structure is typically quasi-militaristic with clear roles and formal plans. Additionally fire and police stations tend to share similar national level missions and structures. These commonalities seem to transcend hazard frequency as indicated by the intra-organizational interaction/communication findings discussed in previous sections.

The above observations do not diminish certain key differences between frequent and non-frequent hazard cases. When it comes to an evolution of culture due to frequent hazard impacts, a more established, integrated/interactive communication structure is at the core of this change. In other words, these areas develop deeper, more established relationships and exhibit collaborations rooted in exchange of opinions and ideas rather than just information. The frequency of hazard impacts adds yet another layer of cultural context to those already at work within the warning system.

There is also evidence to suggest a continuum of culture rather than a discrete frequent hazard vs non-frequent hazard difference. Wichita and Portland were the 'extremes' in regards to hazard frequency; reflective of this they were also consistently outliers in various areas of the analysis. Wichita demonstrated a much clearer understanding of inter-organizational roles within the warning system. They

also exhibited a much more established and integrated storm spotter network.  At least some staff from nearly all organizations were trained spotters and clear structure was in place with different types of spotters defined.  In addition, the EMs stood out for their live video system designed to better communicate with and utilize their spotters.  Wichita's radio station also stood out among the cases for its two-way communications and team of mobile units.  Both the radio and TV stations also participated in interactive simulcasting with a TV meteorologist 'assigned' to assist the radio station.

On the other end of the spectrum, Portland had notably less normal-time interactions when compared to the other cases.  They also diverged from the other areas in regards to communication methods.  NWS chat was not a primary form of communication; in fact they considered it to be in a 'beta' phase.  On the other hand, social media and websites were more widely used than with other cases.  In contrast to Wichita, simulcasting between the radio and TV station was not discussed.  Also contrary to Wichita, the storm spotter network in Portland was not as established or widely utilized.  Portland was also the only case to mention conflict arising from private forecasting companies.  While none of the organizations interviewed claimed to use these companies, several mentioned the resulting conflicts that occasionally arose from their use by other local agencies and groups.

While more areas with varying degrees of hazard frequency would need to be examined in order to confirm this observation, it's reasonable to assume that warning systems evolve continually and organically, rather than in a step-wise fashion.

## 5.8    Limitations and Future Direction

While important information and findings were gleaned from this analysis, there were several limitations of this dissertation that should be noted. First and foremost, I was limited by what the respondents discussed in the interview. In many instances, I noted practices and characteristics that are only observed in a particular case. In reality they could occur in others, but were simply not mentioned during the interview. I attempted to adequately probe each interviewee to glean as much information as possible, but inevitably some nuances of each case could have been overlooked. Additionally, interviews were done over the phone rather than in person. Speaking face-to-face is preferable since the interviewer can more easily build repertoire, read body language, and understand changes in tone. The interviews tended to focus on collaboration and connection likely biasing interviewees toward more positive feelings and opinions, while perhaps masking some conflict. With this in mind, more negative aspects of the organizational culture within the warning system may not have been fully conceptualized. While nearly all of the organizations were represented, there were some I was unable to reach such as the radio station in Portland and the police station in Raleigh. In addition, I was not able to collect two interviews from all of the organizations as originally planned. Unfortunately, this limited analysis in certain areas; however I do feel that the culture and system in each case was adequately represented as a whole. Analysis of the interviews was limited in that transcriptions were coded by only myself. Preferably qualitative coding is best done by multiple people to offset the subjective nature of the method. To address this, I completed extensive memoing ahead of more rigid coding and reviewed each case multiple times before committing to codes.

Future research should repeat this study with a larger, more diverse sample, multiple coders, and face-to-face interviews. This follow-up study as well as more targeted examinations should focus on several key concepts. It's important to address the unconfirmed propositions with more thorough investigation. This includes formal and informal communication plans, opinions and understanding of roles, and variations in physical resources. I originally proposed a pre-existing dynamic between warning system organizations in all areas, arguing that this culture then evolves due to frequent hazards. Further work must be done to differentiate between pre-existing culture and more fluid characteristics. Specifically, another study could examine the broader context of the warning system and the various layers of culture. As discussed in the previous section it would be prudent to explore the influence of potential commonalities which would transcend frequency of hazard impacts such as the national structure of NWS and internal organizational dynamics. There are also a multitude of factors that could contribute to variations in warning system culture including location and local politics. Each warning system resides in a region, State, County, and so on. This broader locational context would most likely influence the organizational culture. For instance, each area has become accustomed to and developed around certain hazards, conditions, and State and local level policies and procedures. Similarly, local politics would also likely come into play. This could involve the integration of private forecasting companies, relations with media, or other similar issues. A future study could more thoroughly control for or explore these sorts of broader contexts and local nuances. Finally, it's important to explore the idea of a continuum of evolution in which culture changes continually rather than based on some set number of hazard impacts. The current dissertation combined with this

follow-up work should provide a substantial base for a quantitative study leading to more generalizable results.

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## Appendix A

## FULL INTERVIEW GUIDE

Hello and thank you for agreeing to participate in my study. As a reminder, my name's Danielle Nagele and I am a student at the University of Delaware Disaster Research Center. During our interview we'll discuss your responsibilities, activities, and interactions with others during a weather event. Since my background is in meteorology, I'm not looking for explanations of meteorological hazards or terms, but rather an account of your personal experiences within your office. You've already signed a consent form agreeing to participate in this interview, are you ready to begin?

### *Roles and Responsibilities*
1. First of all, could you talk to me a little bit about what your organization does during a severe weather event? In other words, what would you say your job or role is?

    Probe: Does your organization ever do any activities that you would consider outside this responsibility while in a weather event?

    Probe: You've mentioned a couple other organizations involved. Could you tell me a little more about their responsibilities and roles during a weather event?

    Probe: You've told me quite a bit about your organization in general, could you now elaborate on what your main job or responsibility is during a weather event?

    Probe: Do you feel like your role changes at all throughout the event?

    Probe: Do you do anything that you would consider outside or beyond this role?

### *Activities/Tasks*
2. We've been talking a lot about your responsibilities. Could we now get a little more specific about the activities that you are involved with. In other words, if I followed you through a workday in which a weather event is upcoming

and/or ongoing, what would I have seen you doing during the time leading up to the first warning?

Probe: What about after the initial warning was issued?

### *Intra-organizational Communications and Relationships*
3. It sounds like you would work quite a bit with other people in your office during a day like this. Could you go into a bit more detail about the sort of interactions you would have with others in your office?

Probe: Could you tell me a bit more about what sort of activities were happening when the interactions are usually most frequent?

Probe: Are these exchanges a back and forth type discussion or more of a one-way conversation?

Probe: Do you get or give any guidance, advice, or instruction?

Probe: From whom?

Probe: To whom?

Probe: How do you use the advice?

Probe: Are there any disagreements, misunderstandings, or differences of opinion between yourself and others in your office during weather event days?

Probe: What are they about?

Probe: What do you do to resolve them?

### *Inter-organizational Communications and Relationships*
4. You've told me a lot about interactions between yourself and others in your office. We've also discussed other organizations involved during a weather event. What are your interactions like with them?

Probe: Could you tell me a bit more about what sort of activities are going on when interactions are most frequent?

Probe: Are these exchanges a back and forth type discussion or more of a one-way conversation?

Probe: You've been telling me a lot about your interactions with other organizations. Is there any sort of plan in place that guides these communications?

Probe: Does your office get or give any guidance, advice, or instruction from/to other organizations?

Probe: From whom?

Probe: To whom?

Probe: How does your office use the advice?

Probe: Are there any disagreements, misunderstandings, or differences of opinion between your office and other organizations?

Probe: What are they about?

Probe: What is generally done to resolve them?

Probe: You mentioned [or didn't yet mention] that your office uses the NWS chatroom, could you describe in more detail how your organization uses it during a weather event?

Probe: Do you use it mostly for getting information or do you use it to talk back and forth with the NWS or other organizations as well?

Probe: Can you talk more about the sort of information you get from the chatroom?

Probe: Could you speak more about what sort of activities are occurring when the chatroom is most active?

Probe: Which organizations seem to utilize the chatroom most often?

### General Questions
5. We've been talking quite a bit about the other organizations you work with during weather events. Are these also the organizations you work with on a normal day-to-day basis?

Probe: Are there any other organizations that you work with that you haven't yet mentioned.

Probe: During a normal work-week with no significant weather events what would the interactions be like between your office and these organizations?

Probe: Could you tell me a little more about how frequent these exchanges are?

Probe: Were these exchanges a back and forth type discussion or more of a one-way conversation?

6. You've given me a lot of great information on how your office functions normally and in a severe weather event. I'm curious if there any national or state level policies that affect the way your office runs?

Probe: Is there any sort of agreement, understanding, or policy in place between your organization and others over timing and method of alerting the public of a hazard?

Thank you for your time and valuable input. This will help me greatly as I continue with my dissertation research. Hopefully this data will have relevant policy implications. It should lead to a better understanding of the warning system and those involved in it. If I could ask one more thing of you, I have a short follow-up email survey. It will only take you 5 – 10 minutes and you can complete it and email it back to me at your leisure. Would you be willing to do this?

**Appendix B**

**ABBREVIATED INTERVIEW GUIDE**

Hello and thank you for agreeing to participate in my study.  As a reminder, my name's Danielle Nagele and I am a student at the University of Delaware Disaster Research Center.  During our interview we'll discuss your responsibilities, activities, and interactions with others during a weather event.  Since my background is in meteorology, I'm not looking for explanations of meteorological hazards or terms, but rather an account of your personal experiences within your office.  You've already signed a consent form agreeing to participate in this interview, are you ready to begin?

*Roles and Responsibilities*
1. First of all, could you talk to me a little bit about what you do during a severe weather event?  In other words, what would you say your job or role is?

   Probe: Do you feel like your role changes at all throughout the event?

   Probe: Do you do anything that you would consider outside or beyond this role?

*Activities/Tasks*
2. We've been talking a lot about your responsibilities.  Could we now get a little more specific about the activities that you are involved with.  In other words, if I followed you through a workday in which a weather event is upcoming and/or ongoing, what would I have seen you doing during the time leading up to the first warning?

   Probe: What about after the initial warning was issued?

*Intra-organizational Communications and Relationships*
3. It sounds like you would work quite a bit with other people in your office during a day like this.  Could you go into a bit more detail about the sort of interactions you would have with others in your office?

   Probe: Could you tell me a bit more about what sort of activities were happening when the interactions are usually most frequent?

Probe: Are these exchanges a back and forth type discussion or more of a one-way conversation?

Probe: Do you get or give any guidance, advice, or instruction?

Probe: From whom?

Probe: To whom?

Probe: How do you use the advice?

Probe: Are there any disagreements, misunderstandings, or differences of opinion between yourself and others in your office during weather event days?

Probe: What are they about?

Probe: What do you do to resolve them?

Thank you for your time and valuable input. This will help me greatly as I continue with my dissertation research. Hopefully this data will have relevant policy implications. It should lead to a better understanding of the warning system and those involved in it. If I could ask one more thing of you, I have a short follow-up email survey. It will only take you 5 – 10 minutes and you can complete it and email it back to me at your leisure. Would you be willing to do this?

## Appendix C

## EMAIL SURVEY

1. How many staff do you have at your organization? Please list them below.

    1 a. How many are volunteers and how many are paid staff?

2. Can you estimate how many of your staff has undergraduate or associate degrees?

    2 a. How many have graduate degrees?

3. Can you estimate how long each of your staff has been working in their field?

4. Could you estimate how many spotters are part of the storm spotter network in your area?

5. During a workday in which a significant weather event is going on, how often do storm spotters contact your organization?

6. What sort of technological resources do you use during a significant weather event?

7. What sort of computer programs does your organization have available to help you better understand the situation during a significant weather event?

8. What devices or methods do you have for alerting the public of a warning?

    9 a. Which of these do you use most often?

    9 b. What would prompt you to alert the public?

**Appendix D**

**IRB APPROVAL LETTERS**

RESEARCH OFFICE

210 Hullihen Hall
University of Delaware
Newark, Delaware 19716-1551
*Ph:* 302/831-2136
*Fax:* 302/831-2828

DATE:                          September 27, 2012

TO:                            Joseph Trainor
FROM:                          University of Delaware IRB

STUDY TITLE:                   [381950-1] Evolution of Culture Among Warning System Organizations

SUBMISSION TYPE:               Funding/Grant

ACTION:                        APPROVED
APPROVAL DATE:                 September 27, 2012
EXPIRATION DATE:               September 26, 2013
REVIEW TYPE:                   Expedited Review

REVIEW CATEGORY:               Expedited review category # 7

Thank you for your submission of Funding/Grant materials for this research study. The University of Delaware IRB has APPROVED your submission.

Please submit final copies of the protocol form, research measures and consent forms by amendment for IRB approval prior to initiating any human subjects research activities.

This approval is based on an appropriate risk/benefit ratio and a study design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This submission has received Expedited Review based on the applicable federal regulation.

Please remember that underlined informed consent is a process beginning with a description of the study and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the study via a dialogue between the researcher and research participant. Federal regulations require each participant receive a copy of the signed consent document.

Please note that any revision to previously approved materials must be approved by this office prior to initiation. Please use the appropriate revision forms for this procedure.

All SERIOUS and UNEXPECTED adverse events must be reported to this office. Please use the appropriate adverse event forms for this procedure. All sponsor reporting requirements should also be followed.

Please report all NON-COMPLIANCE issues or COMPLAINTS regarding this study to this office.

Please note that all research records must be retained for a minimum of three years.

Based on the risks, this project requires Continuing Review by this office on an annual basis. Please use the appropriate renewal forms for this procedure.

If you have any questions, please contact Jody-Lynn Berg at (302) 831-1119 or jlberg@udel.edu. Please include your study title and reference number in all correspondence with this office.

**RESEARCH OFFICE**

210 Hullihen Hall
University of Delaware
Newark, Delaware 19716-1551
*Ph:* 302/831-2136
*Fax:* 302/831-2828

DATE:                           November 29, 2012

TO:                             Danielle Nagele
FROM:                           University of Delaware IRB

STUDY TITLE:                    [381950-2] Evolution of Culture Among Warning System Organizations

SUBMISSION TYPE:                Amendment/Modification

ACTION:                         APPROVED
APPROVAL DATE:                  November 29, 2012
EXPIRATION DATE:                September 26, 2013
REVIEW TYPE:                    Expedited Review

REVIEW CATEGORY:                Expedited review category # 7

Thank you for your submission of Amendment/Modification materials for this research study. The University of Delaware IRB has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a study design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This submission has received Expedited Review based on the applicable federal regulation.

Please remember that <u>informed consent</u> is a process beginning with a description of the study and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the study via a dialogue between the researcher and research participant. Federal regulations require each participant receive a copy of the signed consent document.

Please note that any revision to previously approved materials must be approved by this office prior to initiation. Please use the appropriate revision forms for this procedure.

All SERIOUS and UNEXPECTED adverse events must be reported to this office. Please use the appropriate adverse event forms for this procedure. All sponsor reporting requirements should also be followed.

Please report all NON-COMPLIANCE issues or COMPLAINTS regarding this study to this office.

Please note that all research records must be retained for a minimum of three years.

Based on the risks, this project requires Continuing Review by this office on an annual basis. Please use the appropriate renewal forms for this procedure.

If you have any questions, please contact Jody-Lynn Berg at (302) 831-1119 or jlberg@udel.edu. Please

241

include your study title and reference number in all correspondence with this office.

**R**ESEARCH **O**FFICE

210 Hullihen Hall
University of Delaware
Newark, Delaware 19716-1551
*Ph:* 302/831-2136
*Fax:* 302/831-2828

DATE:                          September 4, 2013


TO:                            Danielle Nagele
FROM:                          University of Delaware IRB

STUDY TITLE:                   [381950-4] Evolution of Culture Among Warning System Organizations
IRB REFERENCE #:
SUBMISSION TYPE:               Continuing Review/Progress Report

ACTION:                        APPROVED
APPROVAL DATE:                 September 4, 2013
EXPIRATION DATE:               September 26, 2014
REVIEW TYPE:                   Expedited Review

REVIEW CATEGORY:               Expedited review category # *7*


Thank you for your submission of Continuing Review/Progress Report materials for this research study. The University of Delaware IRB has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a study design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This submission has received Expedited Review based on the applicable federal regulation.

Please remember that informed consent is a process beginning with a description of the study and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the study via a dialogue between the researcher and research participant. Federal regulations require each participant receive a copy of the signed consent document.

Please note that any revision to previously approved materials must be approved by this office prior to initiation. Please use the appropriate revision forms for this procedure.

All SERIOUS and UNEXPECTED adverse events must be reported to this office. Please use the appropriate adverse event forms for this procedure. All sponsor reporting requirements should also be followed.

Please report all NON-COMPLIANCE issues or COMPLAINTS regarding this study to this office.

Please note that all research records must be retained for a minimum of three years.

Based on the risks, this project requires Continuing Review by this office on an annual basis. Please use the appropriate renewal forms for this procedure.

If you have any questions, please contact Nicole Farnese-McFarlane at (302) 831-1119 or nicolefm@udel.edu. Please include your study title and reference number in all correspondence with this office.

DATE:                          September 25, 2014


TO:                            Danielle Nagele
FROM:                          University of Delaware IRB

STUDY TITLE:                   [381950-5] Evolution of Culture Among Warning System Organizations

SUBMISSION TYPE:               Continuing Review/Progress Report

ACTION:                        Approved for Data Analysis Only
APPROVAL DATE:                 September 25, 2014
EXPIRATION DATE:               September 26, 2015
REVIEW TYPE:                   Expedited Review

REVIEW CATEGORY:               Expedited review category # *(7)*


Thank you for your submission of Continuing Review/Progress Report materials for this research study. The University of Delaware IRB has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a study design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This submission has received Expedited Review based on the applicable federal regulation.

Please remember that informed consent is a process beginning with a description of the study and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the study via a dialogue between the researcher and research participant. Federal regulations require each participant receive a copy of the signed consent document.

Please note that any revision to previously approved materials must be approved by this office prior to initiation. Please use the appropriate revision forms for this procedure.

All SERIOUS and UNEXPECTED adverse events must be reported to this office. Please use the appropriate adverse event forms for this procedure. All sponsor reporting requirements should also be followed.

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Please note that all research records must be retained for a minimum of three years.

Based on the risks, this project requires Continuing Review by this office on an annual basis. Please use the appropriate renewal forms for this procedure.

If you have any questions, please contact Nicole Farnese-McFarlane at (302) 831-1119 or nicolefm@udel.edu. Please include your study title and reference number in all correspondence with this office.