RED RIVER FLOODING IN FARGO: ORGANIZATIONAL LEARNING THROUGH REPEATED EVENTS

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The Supervisory Committee certifies that this ***disquisition*** complies with North Dakota State University's regulations and meets the accepted standards for the degree of

DOCTOR OF PHILOSOPHY

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ABSTRACT

This research is a case study of the spring flooding from the Red River in Fargo, North Dakota. The 1997 record flood level broke a long standing record. However, in the last 7 years there have been three additional major floods, with 2009 breaking the 1997 level. The purpose of the study is to understand what was learned from repeated major flood events. This qualitative research gathered pertinent data from leaders involved in the flood management. In-depth interviews gathered rich data on these topics. The results from this case study found evolution in coordination, communication, response organizations, and mitigation. Specifically, the data revealed the expansion of the leadership team, expansion of communication, reduction in hazard vulnerability, increased focus on logistical planning for sandbags, and reduction in volunteer variability. All of these actions learned from these flood events are transferable and therefore add to the current emergency management body of knowledge on flood planning.

ACKNOWLEDGEMENTS

This research and academic adventure would not be possible without the support of the faculty and staff in the Emergency Management Department at North Dakota State University. I appreciate the support and redirection, as needed, to arrive where I am today. Thank you for challenging me to achieve the high academic standards of the Emergency Management Program.

DEDICATION

I dedicate this to my wife, children, parents, and friends. Lana, for adapting to the challenges of raising children while Dad is engaged in schoolwork, your strength and support are truly remarkable. Kids, never stop learning. Parents, thanks for instilling in me the perseverance required for this challenge. To Leon, the FFD, and all my friends in the City thanks for the support throughout this study, your knowledge is irreplaceable.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Figure Page

LIST OF ABBREVIATIONS

COAD ……Community Organizations Active in a Disaster

EOC……Emergency Operations Center

EOP……Emergency Operations Plan

FEMA ……Federal Emergency Management Agency

IC……Incident Commander

ICS……..Incident Command System

NDSU…….North Dakota State University

NGO……...Non-Governmental Organization

NWS…….. National Weather Service

USGS ……United States Geological Survey

CHAPTER ONE: INTRODUCTION

The researcher's interest in flooding in Fargo is a direct result of experience as a professional firefighter for Fargo from 2002-2010. During recruit training, an Assistant Chief described experience as a "Rolodex" where "each experience from an emergency call creates a card in the Rolodex." While the idea of a Rolodex is outdated, the analogy is one that is easy to envision. Today it might be more associated with an application on a smartphone. Over time people gain more and more cards in their Rolodex. Eventually, their Rolodex is filled with many experience cards. This creates a mental tool that facilitates quick and decisive action when arriving at an emergency by reflecting on a card or experience of a similar nature. When serving on the Fargo Fire Department the researcher was involved in several flood fights including the record flood of 2009. The experience in Fargo's flood responses sparked an interest in what has been learned from these repeated floods. Thinking back on the Assistant Chief's comment, the question arose, what is in Fargo's Rolodex from these floods? More specifically, what has been learned to help Fargo with the next flood?

The purpose of this study is to examine and analyze what the City of Fargo learned from multiple, spring Red River floods in 1997, 2009, 2010, and 2011. The theoretical framework for this study is analyzing what was learned from the perspective of coordination, communication, response organization, and organizational learning. Coordination and communication are topics identified by FEMA as important in floodplain management (FEMA, 2010) and are consistent with previous emergency management research analyzing flood affects over time (Kienzler, Pech, Kreibich, Muller & Thieken, 2015; McHugh 1995; Stokkom & Witter, 2008). However, there has not been an

encompassing study that captured the knowledge gained from major repeated seasonal river floods.

This dissertation addresses two research questions: First, what did the flood management team for the City of Fargo learn from the major seasonal river flooding in 1997, 2009, 2010, and 2011 that can be shared with other agencies and jurisdictions that are affected by seasonal flooding? Second, what organizational factors promoted learning?

To introduce this study, some background topics will be reviewed including:

- What contributes to flooding in Fargo?
- How are floods forecasted?
- What are the major floods in the last twenty years?
- What is the emergency management hazard cycle?
- What is organizational learning?

Flooding from the Red River in the City of Fargo

Fargo categorizes the river level with four different labels. The labels are: "action" at 17 feet, "minor" at 18 feet, "moderate" at 25 feet, and "major" at 30 feet and above (City of Fargo, 2015). In the last twenty years there have been several major floods along the Red River. These spring floods have received national news coverage. The flooding has destroyed large sections of cities along the Red River, such as Wahpeton and Grand Forks, North Dakota (see: Pielke, 1999). While the City of Fargo has escaped catastrophic damage in all floods covered in this study, the damage done along the Red River has been devastating to other areas.

Contributions to Spring Flooding

There are several factors that contribute to spring flooding. The spring flooding in the City of Fargo originates from the Red River. The Red River is a dividing line between the states of Minnesota and North Dakota. In turn, as a border city, Fargo's eastern boundary is the Red River.

A primary factor contributing to flooding is precipitation (Rannie, 2014). Precipitation in the fall, winter, and spring all affect flooding. In the autumn, heavy moisture can saturate the soil and fill water retention areas before a hard freeze. For example, if there is a wet fall, the river, sub-soil moisture, swamps, and ditches may be full of water and freeze before the water has drained or been absorbed into the soil. In the winter, the quantity and moisture content of the snow is a contributor. For example, if the there is a lot of high moisture content snow the area is more prone to flooding. Additionally, the amount of moisture that occurs in the spring is directly related to flooding. When the ground is still frozen, rain rapidly drains into the river not allowing an opportunity to be absorbed into the soil. Beyond precipitation, the river's unique characteristics contribute to its flooding: river rise timing, ice jams, glacial lake plains, and a decreasing gradient downstream (Rahman, Lin, Jia, Steele & DeSutter, 2014; Rannie, 2014; Schwert, 2009).

Another factor that contributes to flooding is the timing of the spring melt or run-off. The Red River flows northward where the thaw typically occurs later in the spring. As the water flows northward, it can encounter cooler temperatures. If the spring melt is rapid throughout the Red River Valley or mainly in the southern valley, the influx of run-off can top the river's banks very quickly.

The third factor for flooding is ice jams. There are different causes for ice jams but, in the case of the Red River, the ice jams are created from thermal decay (Carr & Vuyovich, 2014). The frozen river melts from a rise in temperature and sunlight as spring progresses. As the melt occurs in the southern end of the river valley, large pieces of ice drift northward. In some cases, large chunks of ice created from thermal decay can merge into non-melted ice further north creating a blockage or reduction in water flow in the river (Carr & Vuyovich, 2014). This blockage or reduction creates a rise in the river level, which can lead to flooding (Rahman, Lin, Jia, Steele & DeSutter, 2014; Schwert, 2009).

The fourth factor for flooding in the Red River is the remnants of the glacial Lake Agassiz. About 12,500 years ago, the Lake Agassiz included the Red River Valley and the area several miles surrounding it (Rannie, 2014; Schwert, 2009). The Red River is the natural drainage of water on a path from northwest South Dakota to Canada, including Lake Winnipeg with the final outlet at the Hudson Bay. This former lake plain is extremely flat, one of the flattest areas in the world. Hence, there are few natural topographical features to contain the river (Rahman, Lin, Jia, Steele & DeSutter, 2014; Rannie, 2014; Schwert, 2009).

The fifth factor for flooding is the decreasing gradient downstream of the river (Rannie, 2014). The river's elevation begins at 943 feet above sea level at the start of the river to 714 feet above sea level at Lake Winnipeg. This elevation change decreases or flattens out near the Canadian border (see Figure 1). The reducing gradient is similar to speed attributed to riding a bike downhill. If an individual is on a steep gradient, the speed of the bike will increase. Hence, as the gradient decreases, so does the speed. This same situation affects water flow. The slowing water from the decreasing gradient reduces the

water flow creating congestion and raising river levels upstream (Rahman, Lin, Jia, Steele & DeSutter, 2014; Rannie, 2014; Schwert, 2009; USGS, 2014). All of these factors; precipitation, timing of the melt, ice jams, glacial lake plain, and elevation gradient reduction attributed to major seasonal river floods in the City of Fargo in 1997, 2009, 2010, and 2011.

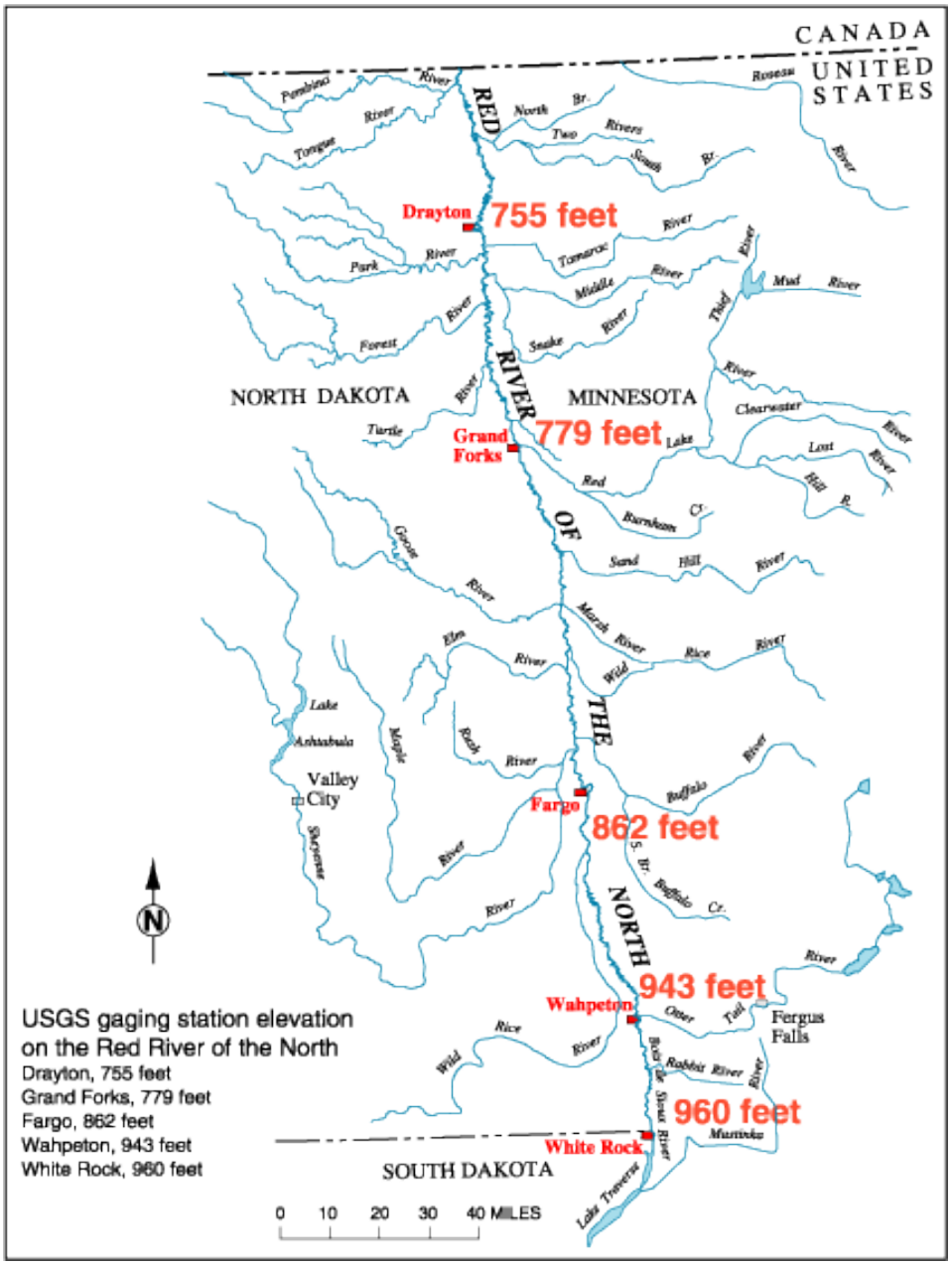

Figure 1. Elevation Change of the Red River (United States Geological Survey, 2014).

Flood Forecasting

The flood forecast is a critical aspect of seasonal flooding. A flood forecast is a prediction of how high the river level will rise. The National Weather Service (NWS) publishes the initial flood forecast in December or early January for the upcoming spring.

The forecasts are updated every two weeks thereafter. The NWS uses a series of measurements including fall precipitation, amount of snow, moisture content in the snow, as well as others to attempt to forecast the potential flooding in the spring. Flood prediction is a challenging task (Pielke, 1999). In 2009, with each updated flood forecast the chance of a record flood increased. The flood forecast is the catalyst for flood planning and initiates several actions. One such action is the assessment of flood protection.

Flood protection can be permanent or temporary such as clay levees, or sandbags. Permanent flood protection either consists of concrete flood walls or earthen levees that are constructed for long-term use. Temporary clay levees are formed by placing and packing large amount of clay in a linear mound creating flood protection. Clay levees are the preferred protection by the Fargo Floodplain Manager because they can be built using large earth moving equipment and minimal human resources. However, sandbags are used to construct emergency flood protection in areas that cannot be reached with large equipment such as the backyards of residential homes. The quantity of sandbags needed fluctuates with the flood forecast. For example, if the river is forecast to reach a level of 35 feet, the sandbag requirements may be 1 million sandbags. However, if the forecast is altered, which typically occurs, the amount of sandbags required can dramatically change. A specific example from 2009, cited by the Mayor, is the early flood forecast of a 50% chance of reaching 38 feet, a 10% chance of reaching 40 feet and a maximum of 44 feet. The city was preparing for a crest of 40 feet. The forecasts kept increasing, as did the need for more sandbags. One day before the crest of 40.82 feet a second flood crest was predicted at 44 feet. This increase would have required one million more sandbags beyond the 7.3 million already created.

Table 1 (below) lists the year, minimum permanent flood protection, emergency protection, miles of sandbags, early flood forecast, and actual crest. The permanent flood protection is the flood level in which the city is protected without any additional measures. The permanent protection level values across the years identified indicate the increased permanent protection over time. The emergency protection (either temporary clay levees or sandbags) identifies the quantity of protection needed in response to the projected flood. The miles of sandbags identify the distance in which sandbag floodwalls were constructed. The early forecast and actual crest identify predicted and actual flood crest. These flood characteristics provide foundational information regarding the recent major floods in the City of Fargo.

Table 1

Flood Protection Levels and Early Flood Forecasts

Year	Permanent protection level(ft)	Emergency protection (miles)	Sandbag protection (miles)	Early forecast 50% and 10% chance (ft)	Actual Crest (ft)
1997	28	33.8	14	--	39.57
2009	30	69	19	38 and 40	40.82
2010	Est. 32	11.6	5.5	38.6 and 43.7	39.57
2011	Est. 34	28.87	5.46	37.4 and 42	38.75
2013	38	5.13	1.24	33.2 and 36.6	33.32

(Eden, Walker, 2013)

The two most notable floods in the City of Fargo's history were in 1997 and 2009. Comparing these floods, in 1997 the city's geographical size as well as population were smaller as the development south of Interstate 94 was minimal. The primary flood threat was from extensive moisture in the winter (record snowfall) this included the run-off from the east, which included the Minnesota tributaries feeding the Red River. In 2009, the flood was primarily a North Dakota event with the water coming from the south and west. The city had expanded to the south and now was vulnerable to overland flooding. The City Administrator noted, during the 2009 flood fly-overs, some areas of the Red River were 12 miles wide for 20 miles in length and all the water had to go through a 600 foot opening in the Fargo Main Avenue Bridge. The City Planner recalled telling his wife "you need to get the kids and get out of town because I don't know what is going to happen here."

Recent Major Floods

The first major flood that this study will review is the 1997 spring flood. During the winter of 1996-97, the region had over 100 inches of snow. There was a sense in the community that there would be a significant flood. The prediction proved true, the river rose to a record 39.7 feet on April 18, 1997, breaking the previous record of 39.1feet from April 7, 1897 (Schwert, 2009). The City of Fargo eventually needed 3.5 million sandbags for flood protection (Kemp, 2010). On April 21, 1997, the river began to drop after an intense two-week response. The magnitude of this flood was considered by FEMA designations to be a once in a hundred year flood. Many residents did not expect to ever see a similar flood in their lifetime.

In the spring of 2009, the city once again experienced record flooding. During the fall of 2008, excessive rain left the ditches full of water and before the water could drain to the river it froze (InForum, 2010). Moreover, there was heavy snow in the winter followed by a rapid thaw in the spring. The rapid thaw fed the water into the river in a very short period of time. This produced a record flood at 40.8 feet occurring on March 28, 2009 (Schwert, 2009).

Flood forecasts in the spring of 2010 predicted that the river would approach record levels once again. The Fargo Floodplain Manager stated that due to the flood forecast, emergency flood protection was necessary to the same level as in 2009. However, the river crested considerably below the previous year. The official crest in 2010 was 37 feet on March 21, 2010 (Schwert, 2009).

The 2011 flood was again preceded by a wet fall and heavy snowfall (Akyuz, 2011). Additionally, 2011 produced a wet spring. These conditions can lead to a major

flood. The City of Fargo had a record flood only two years prior in 2009 with similar conditions. However, Mayor Dennis Walaker, who was viewed as the leader of the successful flood fight of 1997, stated, "I'd be shocked if the river rose above 41feet" (Burgess, 2013). That statement turned out to be accurate, but the duration of the flood was much longer. The river began rising on March 24, 2011. The river reached flood stage on March 29, 2011 and, due to a wet summer, stayed in flood stage until August 27, 2011 (North Dakota Department of Emergency Services, 2011). The Red River crest for 2011 was 38.81 feet in Fargo, the third highest on record (North Dakota Department of Emergency Services, 2011).

A method for measuring these historic floods is quantifying the amount of water flowing in the river. The amount of water flowing in the Red River is a comparative longitudinal measurement of the magnitude of floods. Figure 2 identifies the peak flow rates from 1901-2011. As the figure illustrates, the floods of 1997, 2009, 2010, and 2011 are four of the five highest flow rates in over one hundred years.

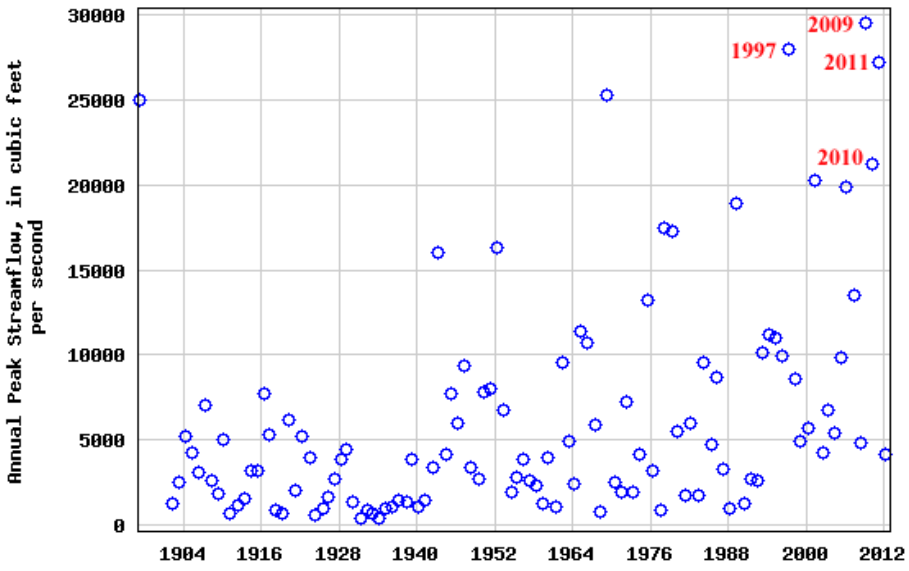

Figure 2. Peak Flow rates for the Red River 1901-2012 (Masters, 2015).

Emergency Management

The professional field of emergency management addresses natural hazards including floods, earthquakes, and hurricanes, as well as man-made hazards such as terrorist acts and accidental hazardous material releases. Characteristics of hazards impact their management. Three of the characteristics of hazards are speed of onset, magnitude, and scope (Bumgarner, 2008, p. 11). Onset speed can vary from slow to fast. For example, the Fargo floods are a slowly occurring hazard as opposed to the fast onset of an earthquake. Magnitude can be associated with intensity. Examples of magnitude include the height of the floodwaters or the Richter scale rating of an earthquake. Scope refers to the area affected. For example, the scope of the flooding from the Red River has been regional with cities and counties adjacent to the river suffering the effects. In an earthquake, the scope of the event radiates from a focal point where the earthquake began and expands concentrically minimizing as the distance from the focal point increases. An

emergency management paradigm for viewing hazard management is the four-phase hazard cycle. The next section reviews this cycle.

The Hazard Cycle

The hazard cycle can be illustrated as a continuous process of emergency management (See Figure 3). The four phases of emergency management are mitigation, preparedness, response, and recovery (FEMA, 2015; Waugh & Hy, 1990; Warfield, 2015). However, the four phases are not mutually exclusive.

Figure 3. Phases of Emergency Management (FEMA, 2015).

Mitigation minimizes the effects from a hazard (FEMA, 2015; Waugh & Hy, 1990; Warfield, 2015). In the case of flooding, examples of mitigation are removing homes from flood prone areas, building a permanent floodwall, or creating a diversion for water to minimize river rise. These efforts lower the risk of future disturbance or damage from a river flood.

Preparedness includes developing plans for response before the event occurs (FEMA, 2015). In order to prepare, emergency management professionals ask and answer the following questions, what to do, where to go, and/or whom to call for help. These

preparatory actions improve the chances of successfully dealing with an emergency (FEMA, 2015; Waugh & Hy, 1990; Warfield, 2015). An illustration of the preparedness cycle is shown in Figure 4. This cycle is a continuous process of planning, organizing, training, exercising, and improving. Some examples of preparedness are ordering and storing supplies needed for floods.

Figure 4. Preparedness cycle (FEMA, 2015).

The time period when the hazard event is imminent until the immediate danger is over is called the response phase. Response efforts are focused on minimizing the effects from the hazard event (FEMA, 2015; Waugh & Hy, 1990; Warfield, 2015). The response phase includes first responders (police, fire and emergency medical services) along with a host of other organizations (other municipal departments, the Red Cross, Salvation Army, etc.) that provide assistance during hazard events.

Recovery takes place after the response when the hazard event's immediate danger is over. During recovery, the environment has not yet returned to normal. Recovery is the path back to normalcy (FEMA, 2015; Waugh & Hy, 1990; Warfield, 2015). Challenges associated with recovery are safety, the ability to cope with the disturbance, financial matters, and stress. In summary, the hazard cycle provides an important framework for

analyzing disasters and their management. The next section introduces organizational learning which is a critical outcome of effectively using the hazard cycle.

Organizational Learning

When an individual or organization has repeated experiences with similar events, the goal is to learn from those experiences. On an individual level, it can be related to the process of tying shoes. At first, tying shoes can be a slow and frustrating process with repeated failure. However, with repetition, the process becomes easier. The process eventually becomes fluid and a natural exercise that requires minimal cognitive effort. The same can be said for organizations. Although organizations are much more complex than a single task, the goal of improving is similar.

The learning associated with repeated processes can be applied to the City of Fargo's Flood Management Team. From the repeated floods, learning has occurred. When viewed under a theoretical lens, this type of learning is referred to as organizational learning. Organizational learning focuses on the learning process and methods associated with learning. In addition, there are attributes of an organization that can affect its ability to gain knowledge. In business, the ability to learn and adapt rapidly can be a competitive advantage over the competition (Crossan, Lane & White, 1999). Organizational learning cannot take place until the process of learning is understood (Birkland, 2006; Romme & Dillen, 1997).

Summary

This series of floods provides a powerful and unique research opportunity to identify the adaptations that can be shared with other municipalities that experience seasonal floods less frequently. The research questions guiding this study are

- What was learned by the City of Fargo flood management team from the major seasonal river flooding in 1997, 2009, 2010, and 2011 that can be shared with other agencies and jurisdictions that are affected by seasonal flooding less frequently?
- What organizational factors promoted learning?

The methodology for this research is an elaborated case study (Rubin & Rubin, 2005, p.6) of the City of Fargo's flood management team. This qualitative study gathers data through topical in-depth interviewing (Rubin & Rubin, 2005, p.12). This inductive research focuses around the emergency management's team knowledge gained over time and the organizational attributes associated with the learning. Structured interviews were the primary vehicle for data collection. This research compares each significant flood event from multiple roles and analyzes the data across all roles for each flood.

CHAPTER TWO: LITERATURE REVIEW

This chapter reviews literature on foundational topics related to this research. The topics covered in this review are organizational learning, response organizational typology, emergency management challenges related to flooding, Red River regional flooding, and Fargo flooding.

Organizational Learning

Organizational learning is the theoretical framework that will be used herein to examine the repeated flooding events in Fargo. The organizational learning in Fargo is evident by the many improvements made in mitigation, preparedness, and response. Each organization has its unique operating environment and culture. To provide additional insight on the knowledge gained from the floods it is important to understand how the knowledge was gained and the factors that influenced organizational learning. Organizational learning is a broad topic, however, for this review the topics covered are the learning process, learning methods, and leadership factors related to learning.

Organizational Learning Process

Various theorists have developed models of organizational learning that use different terminology. Generally, the organizational learning models include experience, reflection, learning, and implementation of the knowledge. One example is Crossan et al. (1999) describing organizational learning as intuiting, interpreting, integrating, and institutionalizing or the 4 "I's". Another study reviewing "lessons learned" described organizational learning as event set definition, data acquisition, interpretation, and packaging (Thomas, Sussman and Henderson, 2001). Huber presents a four step organizational learning process that includes knowledge acquisition, information

distribution, information interpretation, and organizational memory (Huber, 1991; Romme & Dillen, 1997). Huber's detailed model of the components of organizational learning is presented below (see Figure 5).

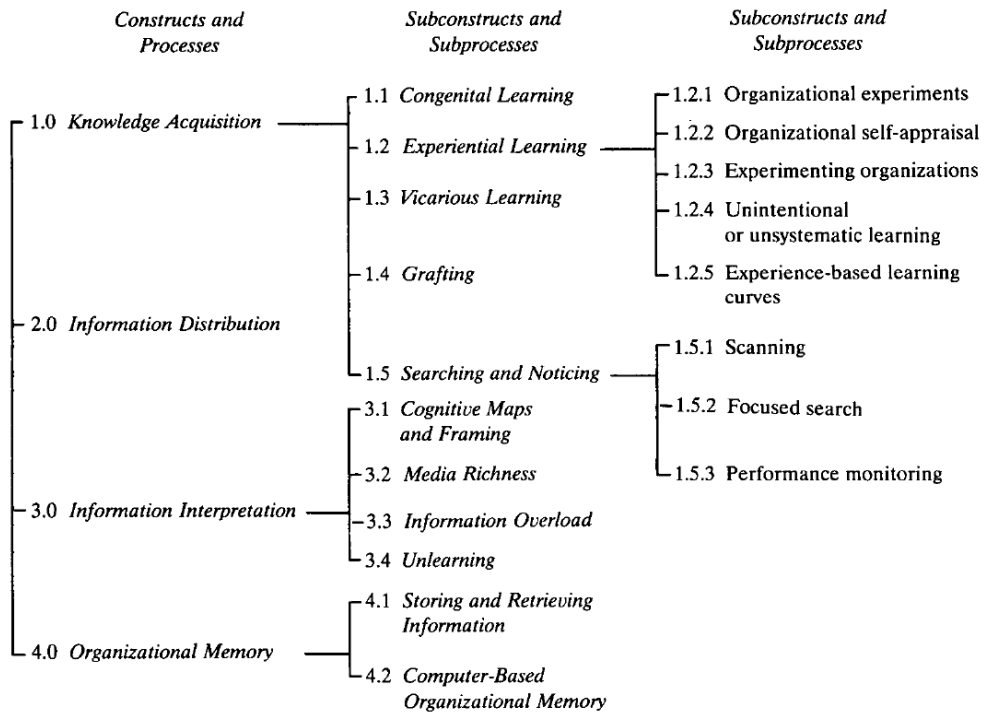

Figure 5. Constructs and Processes Associated with Organizational Learning (Huber, 1991)

Huber's model illustrates how the processes, constructs, and sub-constructs influence organizational learning. The model details the range of ways an organization can learn. The key aspect pertaining to this research study is categorized as "knowledge acquisition" (1.0) which can take place through various means including experiential learning (1.2) (Huber, 1991). Organizational self-appraisal, a sub-construct of experiential learning, is characterized as looking inward to facilitate the learning process.

Learning Methods

Learning methods are important to this study because they analyze how organizational learning occurred. This brief overview of learning methods provides a background that can help structure future learning. While there are many forms of organizational learning methods, this study focuses on two learning methods that are cultural or structural along with single-loop or double-loop

Cultural and Structural Learning Methods

Cultural and structural learning are not mutually exclusive (Fiol & Lyles, 1985; Moynihan, 2009). Cultural learning occurs by instilling the values and vision of the organization and allowing individuals or groups using this knowledge as guidance for learning (Fiol & Lyles, 1985). An example of cultural learning is improvisation. Improvisation is adapting standard procedures to achieve a goal while not deviating from the cultural vision or values (Bigley and Roberts, 2001). For example, in the 1997 flood, when the river water was about to flood a home, the fire department was asked to pump clean city water into the basement of the home. The intent was to minimize damage to the home by displacing the dirty river water with clean city water. Therefore, improvisation occurred when adapting a normal procedure, pumping water, while maintaining the values of the department, i.e. protecting property. Improvisation can be beneficial to organizational effectiveness (Bigley and Roberts, 2001; Crossan & Sorrenti, 2002; Moorman & Miner, 1998; Weick, 1993).

Structural learning occurs when following a predetermined format to guide the learning process (Fiol & Lyles, 1985). For example, many organizations have standard operating procedures (SOP). Learning the organization's SOPs educates individuals or

groups on how the organization functions. An example of structural learning is the Incident Command System (ICS), which was used in the 2009, 2010, and 2011 Fargo floods. ICS was created to improve communication and coordination (FEMA, 2004; Jensen & Waugh, 2014; National Research Council, 2006; Quarantelli, 1998). This system uses a replicable predetermined incident command structure that facilitates communication and provides responders concise direction (FEMA, 2004; Jensen & Waugh, 2014; Moynihan, 2009; National Research Council, 2006; Quarantelli, 1998).

Single-Loop and Double-Loop Learning Methods

Organizational learning includes single-loop and double-loop methods (Fiol & Lyles, 1985; Huber 1991; Moynihan, 2009; Romme & Dillen, 1997). Single-loop learning is evaluating an existing process and refining it to make it more effective (Fiol & Lyles, 1985; Huber 1991; Moynihan, 2009; Romme & Dillen, 1997). For example, in firefighting, ventilation is a key component for improving the environmental conditions inside a burning structure for firefighters. Prior to entering the burning structure, firefighters start a large fan in the doorway to push clean cool air into the structure. The firefighters then enter the structure and address the fire. This process needed to be adapted because the environmental conditions were still too challenging. Using a single-loop learning method, the process is evaluated to find what could be changed to improve conditions. Through this learning method, it is discovered that allowing the fan to operate and push clean air into the structure for one minute prior to firefighters entering yielded safer environmental conditions. This did not vastly modify the process of ventilation but rather looked at the variables in the process to determine what could change to achieve the desired outcome.

Double-loop learning is evaluating the process, in its entirety, and finding a new path to the solution (Fiol & Lyles, 1985; Huber 1991; Moynihan, 2009; Romme & Dillen, 1997). Rather than modifying the process, double-loop learning discards the existing process and starts anew to address a problem (Romme & Dillen, 1997). An example of double-loop learning can also be highlighted using the above example of firefighting ventilation. Double-loop learning is holistically evaluating the situation. For this ventilation example, the goal is to extinguish the fire with the least amount of risk for firefighters. The double-loop perspective requires rethinking the process. The double – loop learning method produced a solution of not entering the structure at all. Rather, extinguishing the fire from the outside of the building. This solution is a completely different process from the original, but still achieves the goal by moving beyond incremental revisions.

Leadership Variables Affecting Organizational Learning

There are variables of leadership that either promote or constrain learning in organizations. The first variable that promotes organizational learning is the ability for leadership to obtain accurate feedback information for decision-making. Such feedback provides leadership with interpersonal, group, intergroup, and bureaucratic factors that produce valid information to make and monitor decision-making (Argyris, 1976; Levitt & March, 1988). The second variable promoting learning is that leadership must be receptive to corrective feedback (Argyris, 1976; Levitt & March, 1988). Therefore, the leadership decision-making process can only be as good as the input data and leadership's ability to make effective decisions (see: Geyelin, 1966; Halperin, 1974; Moynihan, 1972; Schlesinger, 1973; Thomson, 1968; Wildavsky, 1964).

A third leadership variable that promotes organizational learning is previous experience or a history with the disaster (Crossan, Lane & White, 1999; Ghaderi, Som & Henderson, 2014; Huber 1991; Levitt & March, 1988; Moorman & Miner, 1998; Moynihan, 2008; Rich et al., 2012; Romme & Dillen, 1997). A fourth leadership factor is pre-existing relationships promote organizational learning, both interpersonal and inter-organizational (Abbasi, Hossain & Owen, 2013; Crossan, Lane & White, 1999; Fiol & Lyles, 1985; Huber, 1991; Levitt & March, 1988; Moorman & Miner, 1998; Moynihan, 2008; Rich et al., 2012; Romme & Dillen, 1997; Thomas, Sussman & Henderson, 2001; Zaheer, McEvily & Perrone, 1998).

There are also leadership variables that constrain learning. A challenge of organizational learning is the tension between what we already know and new ideas (Crossan, Lane & White, 1999; Romme & Dillen, 1997; Sweeny & McFarlin, 2002, p.402). Constraints of organizational learning include ambiguous feedback, political factors, and secrecy or disrupted information flow (Choularton, 2001; Romme & Dillen, 1997; Sagan, 1993). Additionally, constraints to organizational learning can be the mismatch of information and task, and cognitive limitations (Birkland, 2006; Fiol & Lyles, 1985; Huber 1991; Levitt & March, 1988; Moynihan, 2009; Romme & Dillen, 1997). Although not fully inclusive of all leadership variables, Table 2 was created to summarize the leadership variables that affect organizational learning in this research study.

Table 2

Leadership Variables that Affect Organizational Learning

Promote learning	Constrain learning
Accurate feedback to leadership	Ambiguous feedback
Leadership receptive to feedback	Politically charged environment
Organized policy	Unclear policy
Experience	Lack of experience
Pre-existing relationships between leaders	Lack of pre-existing relationships

Understanding these leadership variables is important to this research as they affect the ability of an organization to learn. For future researchers, understanding how leadership either promotes or constrains learning can assist with setting expectations for an organization to gain knowledge.

Response Organization Typology

The response to flooding in the City of Fargo involves many different organizations and city departments. Quarantelli and Dynes (1977) created the typology of response organizations to assist with doing "comparative and systematic research". The typology contains four different categories that response organizations may have, based on their tasks performed and whether the group existed pre-event (see Table 3).

Table 3

Response Organization Types

		Tasks	
		Regular	Non-Regular
Groups	Established	Type I	Type III
	Emerging	Type II	Type IV

(Quarantelli & Dynes, 1977)

The four categories of the typology are Type I, an established group performing regular tasks; Type II, an emerging group that is performing regular tasks; Type III, an established group performing non-regular tasks; and, Type IV, an emergent group performing non-regular tasks. The use of this typology categorizes response organizations and facilitates analysis.

Type I

The most consistent response organization is Type I. Quarantelli and Dynes (1977) describe Type I organizations as established and performing regular tasks. They use the examples of fire and police departments. However, these departments do perform some non-regular tasks in response to events such as a flood, but their primary function is not altered during the flood.

Type II

Type II groups are emergent groups that stay consistent with their pre-event primary function, these are labeled expanding organizations. Two examples noted by Quarantelli and Dynes are the American Red Cross and Salvation Army. Although, at first glance, the Red Cross and Salvation Army seem to be established organizations prior to a flood, each

agency only has a small, permanent core that is established. During a disaster, each agency rapidly expands with volunteers. Therefore, the rapid expansion of population in the organization classifies it as emerging. The pre-event primary function is unchanged during a flood. Some problems identified in Type II organizations are (Quanrantelli & Dynes, 1977):

- Change in function and structure;
- Lack of skills – however Red Cross tries to train official volunteers;
- Vague organizational boundaries;
- Rapid organizational size challenges accomplishment of tasks, communication, authority, decision making, delineation of organizational boundaries.

Type III

Type III response organizations are existing groups, but, alter their pre-event primary function, these are labeled extending organizations. An example noted by Quarantelli and Dynes is a construction company using their skills and equipment to assist in an emergency. Examples of Type III response organizations in a typical sandbagging effort are:

- City Departments (Planning, Solid Waste, etc.);
- Local contractors adding in sandbag loading/unloading;
- Church groups assisting with sandbagging;
- Social organizations assisting with sandbagging.

These organizations perform regular activities but these tasks are outside the pre-event primary functions of the organizations. In some cases, an organization's capabilities are available because their normal activities are deemed irrelevant or temporarily expendable

due to the flood. For example, the Public Works Department is responsible for street maintenance among other things. However, during a flood, these responsibilities are not a priority. Therefore, they change their primary function to flood response. Some problems associated with Type III response organizations are performing tasks outside their normal area of expertise and organizational control (Quanrantelli & Dynes, 1977).

Type IV

Type IV groups are emergent groups with an altered pre-event primary function, these are labeled emergent organizations. An example cited by Quarantelli and Dynes (1977) is impromptu search and rescue teams. In a disaster such as a tornado, people present after the event begin to search for those missing or trapped before public safety organizations have arrived. This ad hoc group is a Type IV response organization. In the case of the Fargo floods Type IV organizations would be neighborhoods grouping together for sandbagging teams without any pre-planning. Some characteristics Quarantelli and Dynes (1977) use to describe Type IV response organizations are:

- No organizational structure;
- No name;
- No pre-emergency existence;
- Form and dissolve rapidly.

The community is under great distress when there is a presence of Type IV response organizations (Quanrantelli & Dynes, 1977). The groups form because of lack of overall community coordination, control, and information (Quarantelli and Dynes, 1977).

Emergency Management - Flooding

The research literature includes several case studies on flooding that analyze issues related to coordination, communication, and mitigation. This section concludes with discussion of the City of Fargo flood reviews.

Coordination

In this section, four studies are examined. The first study from McHugh (1995) focuses on the ways in which adaptions from prior flooding affected the 1993 flood in Tucson, Arizona. McHugh found improved use of organizational structure in a multi-organizational response based on the adaptations. Failures were identified in 1983 and a community-wide emergency response system was implemented before the 1993 event. This response system included the use of the Incident Command System (ICS) and the Emergency Operations Center (EOC). This is salient to this effort as both of these coordination tools were utilized in the Fargo flood response.

Wachira and Sinclair (2005) researched public participation and how to improve the integration of the public into flood response. This study is relevant because it examined the extent to which individual, neighborhoods, and local groups are involved in preparedness and response activities, such as sandbagging. A key finding from this study noted that "individuals were the first responders to the flood threat and played a critical role in minimizing the damage caused by flood waters" (2005, p.154). Therefore, the public should be acknowledged as a front line of defense in flooding events. The findings in this study extend knowledge about coordination for flood response.

Another topic that is important to coordination is the magnitude of the flood. A study by Pielke (1999) with the National Center for Atmospheric Research, evaluated the

failed use of the 1997 Red River flood forecast; the challenges of accurately forecasting floods. The study identified local officials' reliance on the flood forecasts. After the 1997 flood it was learned that local officials misinterpreted the flood forecast which led to water overtopping emergency flood protection. The National Weather Service was blamed for inaccurately forecasting the flood; however, the failure was found to be the interpretation of the forecast by local officials. This data is valuable to this study because it highlights the importance of the flood forecast, and its proper interpretation, to local officials trying to adequately plan for the flood impacts.

The final study on coordination by Kemp (2010) looked at flooding in Fargo to "generate a holistic analysis of flooding and disaster in Fargo". Some of Kemp's key findings about the 1997 flood were:

- Prior to 1997 there was no flood plan;
- The 1997 flood was the first year Fargo took operational control of the flood response rather than Cass County;
- The flood preparations did not incorporate the use of citizens;
- Leadership recognized the need to organize volunteers.

These findings are valuable as they provide a comparison point for the current research. Kemp's work identified many areas for improvement in flood response, most specifically coordination (sandbag production, command and control) and communication (public and personal communications, along with expense tracking).

Communication

Kienzler, Pech, Kreibich, Muller and Thieken (2015) studied four flooding events in Germany and the subsequent changes that occurred. In this study, only one flood was caused by seasonal river flooding. The other three floods were caused by rapid rainfall. This study did evidenced similarities to with Fargo flood events; such as, the initial flood was associated with high flood damages and individuals had trouble coping with the flood. Also, this study documented that individuals began to prepare in multiple ways in anticipation of the next flood event. This was attributed to better communication.

Ryan (2013) studied how individuals gather information during a flood. The study examined the different sources from which people gather information in a slow-onset flood. Ryan (2013, p.229) concluded that "word of mouth remains a key source of information for people in any flood disaster, with local knowledge particularly relevant to information-seekers in a slow-moving flood." This study is relevant because it provides data on how people communicate in a seasonal river flood like those in Fargo.

Mitigation

Van Stokkom and Witter (2008) discussed the relationship between flood risk and land use in the Netherlands. This study is informative to the current study as it identifies the challenges of balancing flood mitigation, in the form of restricted land use and community economic development. Particularly salient is the conclusion that "flood risk management is a long-term concern which needs structural funding" (2008, p.337).

Choung (2014) identifies the importance of leveraging technology in response and mitigation in Korea. Specifically, the value of using technology such as LiDAR (Light Detection and Ranging) for gathering data on elevation mapping and flood preparedness

are discussed. LiDAR was used to show that the Nakdong River Basin has a specific area of flood vulnerability in South Korea. This is the same technology adopted by Fargo's Engineering Department to gather accurate elevation data of the land adjacent to the Red River Valley. This technology helps city officials make better informed mitigation decisions.

Examining mitigation from a more regional and local perspective, Rannie (2015) presents a case study of the effects of the 1997 flood Red River basin. Although Rannie's study primarily focuses on the Red River downstream in Canada, it provides insight into the magnitude of the flood while comparing the flood impact with respect to mitigation. In Winnipeg, major mitigation projects have been completed as opposed to the less developed mitigation efforts in North Dakota and Minnesota. Although not quantified Rannie's study, other efforts suggest an estimated reduction in damage from mitigation efforts in Canada (Wazney and Clark, 2015). Rannie (2015, p.9) does note that "every flood has led to measures which improve the ability of the region to cope with flooding." This study is important because it provides insight into the effect of mitigation projects that reduce or eliminate flood damage and show that organization learning is occurring from floods.

Using the same scope Rannie, Wazney and Clark (2015) conducted a similar case study of the 2009 Red River flood. This study addressed the magnitude and flood damage that occurred. Again, this study was focused on the downstream portion of the Red River in Canada, but it also reported on the effectiveness of the floodway, a large river diversion around Winnipeg. Wazney and Clark assign a value to flood reduction activities stating, "It is estimated that the operation of the Red River Floodway, Assiniboine Diversion and Shellmouth Dam prevented on the order of CAD $10 billion in flood damages" (2015, p.8).

This work is important to this study because it documents the relationship between mitigation and the reduction in potential flood damages. Wazney and Clark (2015) also discuss how ice jams on the river influence river levels upstream, which would include the Fargo area.

Another factor that can potentially increase river levels in Fargo is the rapid draining of agricultural land that drains into the Red River (In-Forum, May 19, 2014). A study by Rahman, Lin, Jia, Steele and DeSutter (2014) examined the ramifications of mitigating high moisture in agricultural land (drain tile) and the impact on Red River flooding. The study is particularly salient because the Red River Valley is primarily an agricultural area. The mitigation method for controlling high soil moisture is drain tile. Drain tile is a series of pipes a few feet under the soil that removes excess moisture providing consistent conditions for farming. The pipes are interconnected and drain into ditches adjacent to the fields. The ditches drain into streams and rivers, therefore, the water moves more rapidly through the pipes than the natural process of absorption. The theory is the increased speed in which water enters the rivers increases river levels attributing to flooding. A key finding of the study finds "our analysis showed that extensive subsurface drainage in the RRV [Red River Valley] would likely increase the magnitude of smaller peak flows while decreasing the magnitude of larger peak flows" (2014, p. 482). Therefore, it concludes that drain tile did not contribute negatively to the floods of 1997, 2009-2011.

In another study of the 2009 Red River flood, Kim, Chu, and Gajan (2011) examined the rapid mitigation techniques used to combat the record flood waters. These rapid mitigation techniques are relevant to this study because they permanently control

water flow during floods or even heavy rains, reducing the need for emergency flood protection. This type of mitigation is an important tool in reducing the city's vulnerability.

Niepert's 2008 study on the mitigation process of home buy-outs after the 1997 flood, focused specifically on the City of Fargo. Home buy-outs are a mitigation method that relocates people and their homes from potential flooding (Niepert, 2008). This study followed residents as they proceeded through the buy-out process from both a procedural and emotional perspective. This work is important to this study because the buy-out mitigation process is used extensively in Fargo and this research illuminates the processes and challenges associated with it.

In 2009, Fridgen examined the effect of flooding on home prices. This study connected the increased publicity of the 1997 Fargo flood to an increased depreciation for homes in the 100 year flood plain by comparing pre- and post- 1997 flood property values. This study is significant as it highlights an impact of flooding that goes beyond the community disruption and cost of flood response, to affect the property values of homeowners.

Kubas' research (2012) discusses the controversial mitigation plan of a flood water diversion channel around the Fargo metropolitan area. Kubas' found that residents perceived benefits of such a plan were influenced by their location related to the diversion; those receiving the majority of the benefits were most favorable to the diversion. This (2012) work is important to this study because the flood water diversion plan Kubas studied is the long-term mitigation project expected to alleviate the vulnerability of the Fargo area to Red River flooding.

Flood Reviews

The City of Fargo documented the operational actions from the floods of 1997, 2009, and 2010. These reports were created shortly after each of the floods. Although not constructed as a formal After Action Report, they documented what worked, as well as, what needed improvement.

The 1997 flood review, titled *Fighting the Flood, 1997: Plans, Actions, Mitigation: A Resource for Public Officials* was published by the City of Fargo in 1999. This document reviewed what worked well and areas in need of improvement. The report went through the organizational roles, communication, actions, clean-up, and future flood mitigation. It offered recommendations such as coordinating a central location for sandbagging, creating a decision making protocol, establishing a "war room", adding additional coordination efforts and the importance of mitigation. This information is important to this study because it served as an official review of the event, a source to confirm data from interviews, and it summarized needed improvements after the 1997 flood.

The 2009 flood review was completed by the Fargo Emergency Manager after compiling data from all participating city departments (Schlafmann, 2009). The data gathering procedure for the review included group and individual department meetings. In these meetings feedback was solicited regarding what went well as well as areas in need of improvement. This approach allowed individuals to speak about their actions in a non-threatening environment. This information is important to this study because it served as an official review of the event, a source to confirm interview data, and summarized the actions of the 2009 flood.

The Cass County Sheriff's Office also created a 2009 flood review that summarized actions taken during the event (Cass County Sheriff's Office, 2009). Although most of the Sheriff's Office activities occurred outside Fargo city limits, it adds value herein because it focused on coordination (internally and between agencies) and communication (internally, between agencies and the public).

The United States Geological Survey also created a 2009 flood report for the Red River and Missouri River Basin (Macek-Rowland and Gross, 2011). This report addressed the magnitude of the flooding, identifying the geographical area that drained into the Red and Missouri rivers. The report is important to this study because it provides data on flood levels and highlights the geographic area that drains upstream of Fargo into the Red River.

The 2010 flood operations review was also completed by the Fargo Emergency Manager and followed the same procedure for gathering data; however, in 2010, the document format changed (Schlafmann, 2010). This report contained the data from the 2010 flood as well as the central source for identified actions needing improvement from previous floods. The areas for improvement primarily focused on coordination and communication. The 2010 data revealed that coordination and communication significantly improved. This document is important to this study because it provides data related to organizational learning. It also serves as an official review of the event that can provide a comparison point for the interviews.

Summary

This literature review of organizational learning, response organizations, coordination, communication, mitigation and flood reviews provided the foundation from which this study was built. The organizational learning literature identifies the process,

methods, and leadership variables that affect learning. The response organization typology provides a framework for analyzing the different groups that are involved in the flood. The international, regional, and academic articles on coordination, communication, and mitigation in emergency management highlight the impact of these topics. And finally, the flood reviews provide detailed information on what happened, what worked, and what areas needed improvement.

CHAPTER THREE: METHODS

This study focuses on organizational learning from flooding events that occurred in Fargo in 1997, 2009, 2010, and 2011. The method selected for this study was the intensive interview approach. This approach is appropriate for this study because of the complexity of flooding preparedness and response. In-depth interviews allow the researcher to build a naturalistic and interpretive model of the topic under study (Rubin & Rubin, 2005, p.12). Under this model, interviewees are partners in the research enterprise rather than subjects to be tested (Rubin & Rubin, 2005, p.12). The rich data that are gathered with in-depth interviewing detail the complexity of other people's worlds (Rubin & Rubin, 2005, p.134). The goal of these interviews is to establish rapport and learn about the experience of the interviewee (Charmaz, 2006; Rubin & Rubin, 2005; Taylor & Bogden, 1998, p.95).

Purposive sampling was used to select interviewees for this study (Creswell, 2002, p. 194-196; Maxwell, 2005, p.89; Miles & Huberman, 1994, p.28; Patton, 1990, p.169). This sampling methodology bases the selection of sample members on how well they fit the purpose of the researcher. Purposive sampling is appropriate for this study because the flood management leaders in Fargo are known. Experience with floods in Fargo and knowledge of adaptations that have occurred in flood management were the two primary criteria for choosing interviewees (Rubin & Rubin, 2005, p.64). The interviewees are/were leaders and key decision makers and involved in the flood management for Fargo from 1997 to the present. The number of interviews was determined by how many experienced and knowledgeable leaders in flood management were available and agreed to participate in such interviews (Glaser & Strauss, 1967; Kvale, 1996; Taylor & Bogden, 1998, p.93). To ensure thoroughness, snowball sampling was employed at the conclusion

of the face-to-face interviews (Taylor & Bogden, 1998, p.93; Yarmohammadian et al., 2011). The interviewees were asked, "Is there anyone else who would be beneficial to interview?" The list of suggested interviewees was compared to the initial interview list, and new interviewees were asked to participate. In total twelve interviews were completed. Of the twelve interviews, nine of the leaders were initially asked to be interviewed by the researcher and three additional interviews resulted from the snowball sampling.

This study used the grounded theory strategy which is to seek data, describe observed events, answer fundamental questions about what is happening, and develop theoretical categories to understand it (Charmaz, 2006; Corbin & Strauss, 1990; Glaser & Strauss, 1967; Loy, 2011; Rubin & Rubin, 2005). Although this study did not strictly follow classical positivist grounded theory methodology (Cutcliffe, 2004; Glaser & Strauss, 1967; Loy, 2011) the constructionist philosophy of gathering data and inductively finding key concepts and emerging themes was used (Charmaz, 2006; Loy, 2011).

Interviewees

The initial interview list was constructed from the researcher's experience and discussion of the research topic with the Fargo Emergency Manager. The list was intended to capture all individuals who were in leadership positions involved in a flood event. The flood management team in Fargo includes the departments of Engineering, Public Works, Fire, Planning, and City Administration. The most valuable interviewees for this study were individuals who had a primary role in flood management and have experienced multiple flood events. The flood leadership team has experienced multiple flood responses and has historical knowledge of these flood events.

Interviewees include the following City of Fargo leaders:

- Deputy Mayor – Dr. Tim Mahoney;
- City Administrator - Pat Zavoral;
- Public Works Director – Ben Dow;
- Director of Engineering – Mark Bittner, PE;
- City Engineer –April Walker, PE;
- Enterprise Director - Bruce Grubb;
- Solid Waste Director – Terry Ludlum;
- City Planning Director – Jim Gilmour;
- Fire Department Assistant Chief – Gary Lorenz;
- Fargo Emergency Manager –Leon Schlafmann;
- City Floodplain Manager – Nathan Boerboom;
- Cass County Emergency Manager – Dave Rogness.

City and county leadership roles that were integral in flood management during the recent major floods of 1997, 2009, 2010, and 2011 are indicated in Table 4. These individuals in these roles were the purposive sample for this research.

Table 4

Flood Management Positions and Flood Experience

Leadership Role	1997	2009	2010	2011
Deputy Mayor		X	X	X
City Administrator	X	X	X	X
Public Works Director		X	X	X
Director of Engineering	X	X	X	X
City Engineer	X	X	X	X
Enterprise Director	X	X	X	X
Planning Director		X	X	X
Solid Waste Director	X	X	X	X
Assistant Chief – Fire		X	X	X
Fargo Emergency Manager		X	X	X
Floodplain Manager			X	X
Cass County Emergency Manager		X	X	X

Table 4 shows that interviewees had experience with multiple flood events. Of the twelve on the list, five of the leaders experienced the 1997 flood. This sample has the relevant experience to provide data on organizational functions and structure, preparedness and response changes, and organizational learning over time.

The study collected data in primarily one round of structured interviews. After the first two individuals were interviewed the interview guide and narrative responses were

reviewed to ensure the questions elicited appropriate data. The review of the initial interview data indicated that the open-ended questions were effective.

All interviews took place within the City of Fargo offices either in the interviewee's personal office or a meeting room within the City of Fargo offices. The timeframe for the interview process was May through June of 2015. As previously noted, all interviewees, with the exception of the Cass County Emergency Manager, are employed by the City of Fargo. The Cass County Emergency Manager was included in the interviews because he works very closely with the Fargo Emergency Manager on flood management.

Interview Format

All interviews were guided by a list of 26 open-ended questions; additionally, probes were incorporated to draw out additional data (Rubin & Rubin, 2005, p.137; Taylor & Bogden, 1998, p.106). The complete interview guide is presented in Appendix A. Interview questions were categorized by each major flood (1997, 2009, 2010, and 2011) to determine what, if any, learning occurred, and when. The interview guide started with background questions and then focused on flood management and training experiences. The background questions on employment position, role in flood management, and years of experience provided a resource for probing deeper into topics during the interviews.

After the background questions, the interview proceeded with the interviewee's description of their first major flood experience in Fargo. The initial question asked, "When it was determined that there was going to be a flood, what happened?" This topic continued until the conclusion of their flood activities for that flood event. The next chronological flood event repeated the initial question for that flood. Open-ended questions and probes for each flood event were used to draw out additional narrative. In

some cases the questions in the interview guide were not applicable and not asked based on the interviewee's previous responses and role in the flood response.

Key questions included:

1. Were you present and active in the 1997, 2009, 2010, and 2011 flood activities?
2. What was your position in the City of Fargo during these events?
3. Describe what happened when the flood was first predicted?
4. What were some challenges?
5. What were the working conditions/environment/emotions associated with this flood?

After all interviews were completed, the resulting data was coded by topic and flood event to identify emerging themes.

Data

All but one of the interviews were digitally recorded and transcribed. A technical problem resulted in the deletion of one interview. The deletion occurred immediately after the interview while attempting to check the sound quality of the recording. However, realizing the interview was not saved, extensive notes were written to ensure the data was captured. For all of the interviews the responses from the background questions were used for initial coding, such as the flood year(s) and the function they were involved with. For example, the interviewee was involved in the 2009, 2010, and 2011 floods, along with working with response coordination (see Table 5).

During each interview, key points described in the interview were noted and recorded in writing. After each interview, the written notes and transcriptions were merged into a more detailed summary document. This summary document was used to identify

key concepts (Charmaz, 2006; Corbin & Strauss, 1990; Glaser & Strauss, 1967; Loy, 2011; Rubin & Rubin, 2005). The written notes were scanned and digitally stored along with the interview audio.

As needed, follow up questions were used to address data gaps and inconsistencies found during the analysis; all follow up questions were done via phone or e-mail. The follow up questions and responses were documented in a written summary. After the completion of the interviews the entire data set was analyzed holistically to understand how organizational learning occurred in the City of Fargo from 1997-2015.

Coding

Qualitative coding is the process of organizing the data by topic and naming data units with labels that simultaneously categorize and summarize (Charmaz, 2006; Glaser, 2012; Glaser & Strauss, 1967; Loy, 2011; Rubin & Rubin, 2005, p.203). The goal of analysis is to reflect the complexity of events through interviewees and actual events to make the complexity understandable to others (Rubin & Rubin, 2005, p.202). This understanding was created through data analysis. The interview data sensitized the researcher to the key concepts and themes (Blumer, 1969; Charmaz, 2006; Corbin & Strauss, 1990; Rubin & Rubin, 2005).

Summary documents were used to facilitate data analysis. The analysis of the data used a categorizing strategy (Maxwell, 2005, p.98). The initial code list provided the starting point for data analysis. The initial code list was developed from personal experience with flooding, interview notes, and interview summaries. The initial code list is detailed in Table 5.

Table 5

Initial Coding List

	1997	2009	2010	2011
Organization				
Resources				
Coordination				
Roles				
Public Communication				
Mitigation				
Personal communication				
Learning				

The transcriptions were read line-by-line to generate additional concepts. These concepts evolved from the above table to an outline form with several heading and sub-headings. Adding notes and quotes from interviews then further enhanced the outline. For example, the transcription segment from the City Administrator who discussed personal communication with his staff was grouped with the Public Works Director who also discussed his communication with his staff. This type of coding is substantive or incident-by-incident coding (Charmaz, 2006, p.53; Corbin & Strauss, 1990; Glaser & Strauss, 1967; Loy, 2011; Maxwell, 2005, p.96).

Further refining the data, the concepts were chronologically categorized. For instance, all incidents were categorized by the year of each flood (1997, 2009, 2010, and 2011). The data was then holistically analyzed for overarching themes that occurred across

the timeline, this is called axial coding or theoretical coding (Charmaz, 2006, p.60; Glaser & Strauss, 1967; Loy, 2011; Strauss & Corbin, 1990). For example, what was learned about personal communication across all departments in 1997? What was learned about coordination across all city departments in 2009?

CHAPTER FOUR: WHAT WAS LEARNED FROM THE 1997 FLOOD

In the next two chapters findings are presented chronologically. This chapter includes data regarding the 1997 flood and the following chapter discusses flood events in 2009, 2010 and 2011. The chapters are organized in four major sections: coordination, communication, response organizations, and mitigation. The categorization was chosen based on patterns identified in the data from interviews and flood reviews. The coordination section includes leadership, the Incident Command System (ICS), the Emergency Operations Center (EOC), the emergency manager, and flood planning. The communication section includes public communication, operational communication, and interpersonal skills. The response organization section analyzes the data based on the typology of organizations involved in the floods. The mitigation section includes the topics of funding, priorities, and technology.

Coordination

The response to the 1997 flood began on February 14, 1997, immediately after the National Weather Service (NWS) forecasted a "reach or exceed" record flood (Stensrud, 1999). The forecast was to approach a level of 40 feet (North Dakota State University, 2015). The Fargo Emergency Manager made several points regarding the 1997 flood. He noted that prior to 1997, the private sector responded individually to flooding. As such, the city protected its infrastructure and private individuals or groups protected their own property. The flood forecast predicted record levels and it became apparent that the scope of the flooding would affect large numbers of private homeowners and businesses. The city was ill-prepared for a flood level over 28 feet; it was clear that a new community-wide

collaborative strategy would be required. Thus, the 1997 flood was a focusing event that established the need for a more organized and expanded flood response.

Coordination is at the forefront of the flood response. Without coordination flood response would be a variety of ad hoc actions. The learning that occurred as a result of the 1997 flood regarding coordination focused on the Incident Command System (ICS), the Emergency Operations Center (EOC), the emergency manager, and flood planning.

Leadership

Fargo's Enterprise Director described the emergent 1997 leadership team - the Mayor, Director of Public Works and City Engineer - as guided by "good common sense". This team still forms the foundation of flood management in Fargo. Since 1997, the leadership team has concluded that the flood response is more effective when responsibilities are delegated. Reflecting on this the Planning Director stated:

> That was one of the changes that happened after 1997, was that in 1997 it was primarily Engineering and Public Works Department that did the flood fight and after that it was more all of the departments were involved in the flood fights.

Multiple interviewees' stated each of the city departments is responsible for a specialized area. For example, the Engineering Department is responsible for understanding how the different river levels will affect the city infrastructure and also residential neighborhoods. The Planning Department is responsible for volunteer coordination. The Public Works Department is responsible for securing city infrastructure and sandbag delivery. The Solid Waste Department is responsible for sandbag production. The Fire Department is responsible for emergency response for sandbag emergencies. By departments being focused on specific tasks they became more proficient with their

responsibilities. In addition, the cooperation between different departments had a significant positive impact on the flood fight. Moreover, the Enterprise Director stated that after the 1997 flood the city leadership began to informally practice a "culture of preparedness" that kept flood management as a top priority for the future.

Incident Command System (ICS)

In 1997, city leadership did not use or understand the Incident Command System. In retrospect, the Mayor and Director of Public Works were in command roles with Engineering, Public Works, Police and Fire reporting to them. In the 1997 flood review it was recommended that a process be developed to allow for quick decision making (Stensrud, 1999). ICS facilitates such decision making by having clear lines of authority and identifying individual's roles.

Emergency Operations Center (EOC)

In 1997, the city opened an Emergency Operations Center (EOC) at City Hall. This was the first time the flood activities had been directed at the city level rather than the county. This EOC was created for planning and directing the flood fight along with a centralized location for the media (Stensrud, 1999). In 1997, Fargo's EOC was more closely associated with the focal point for media relations than a hub of operations.

Emergency Manager

The Cass County Emergency Manager provided insight on the role of emergency manager for Fargo in 1997. At the time the city was without a dedicated emergency manager. Cass County, which encompasses Fargo, had an individual assigned to the emergency management function. However, this mid-level manager was with the Sheriff's Department and could only allocate 25% of his time to emergency management. In 1997,

the magnitude of the flood in Cass County forced the part-time emergency manager to focus on his primary responsibility which was to take care of county government and rural county residents. As a result, the City of Fargo was without any local emergency management support.

Even with the county identifying an emergency management function, the resource commitment of 25% was not adequate for even the rural area. The Cass County Emergency Manager recalled the overall attitude on emergency management at that time:

> If you lived in rural Cass County in an unincorporated area, you are on your own and you're not going to get much assistance from the county government. If you chose to live outside the metro area, a person should realize that Cass County doesn't have a lot of resources to help.

The Solid Waste Director stated without a dedicated emergency manager no one focused on creating a cooperative and coordinated effort for hazards throughout the city. The different departments remained in their "silos" and were reactive. The city departments measured success not as a community but by their individual actions. According to city officials, it felt like they had been slighted when resources were not available to them to help work through the flood issues

Flood Planning

The city leadership learned from the 1997 flood to start planning early. Although Red River floods are typically slow onset events, there is a tremendous amount of work to prepare Fargo for a flood event. It was noted by all interviewees who experienced the 1997 flood that maximizing the time to prepare for an event is critical. After 1997, the start date for flood planning was devised by working backward from the expected crest date. That is,

by projecting the duration of the tasks assigned to each department and moving backward in the calendar until arriving at an estimated start date. When flood planning was moved back earlier into the calendar year it was a major step forward for preparedness. The Public Works Director stated this also helps with expectations, "if you are assigned [a responsibility] then you know the expectations from the beginning and you will succeed." Flood planning improved as the city learned. The Enterprise Director recalled after the 2009 flood "organization is what made it work."

Communications

The 1997 flood highlighted the need for better communications. The 1997 flood review stated there was an attempt to communicate, but the priority in communication was still focused on leadership level coordination rather than the community as a whole (Stensrud, 1999). The next section on communications focuses on public communication, operational communication, and interpersonal skills.

Public Communication

City leadership recalled that public communication was an area that needed improvement during the 1997 flood. The 1997 flood was the first time organized staff meetings occurred, followed by a press conference. This was believed to be adequate frequency for communication at the time, but in retrospect it was not. The Mayor, who was a resident in 1997, noted that communication is critical to flood operations and learning occurred in regard to this.

> … the public needs communication. If you give it, they will respect it. If you really think about it or if you said voluntarily close your businesses, they did it.

> There was no law. There was no ordinance we passed. We said you are going to shut your businesses down. OK. And we didn't get challenged.

Another public communication lesson learned from 1997 involved residents understanding the elevation level of their residence. The City Engineer explained that residents were unsure at what point their homes would be inundated with flood water and the city had that data. Therefore, attempts were made to communicate that information via physical maps in public locations, but it was not readily available to all residents.

Operational Communication

A notable operational communication event that the City Administrator recalled is the failure of the cellular communication system. As he stated:

> At the height of the crest and when we were trying to get information out, our cell phone system failed… as well as our hard line system. And so the only thing we had was our two-way radio system for about 6 hours.

In addition to the operational communication challenges lessons were learned about interpersonal skills in personal communications.

Interpersonal Skills

The City Engineer shared some experiences regarding personal communications and relationship development between the members of neighborhoods and the engineering staff. He stated:

> …they were on a first name basis and they were invited in for all they could eat. They all had parties afterwards or even during the event. Our staff was always the first invitee. It was just unbelievable to watch the interaction of the public and how much they appreciated us and having staff available for them just to talk to. Not

only that, but to have them give advice when survey crews were out there staking. I remember in 1997 being invited to a party in the Ridgewood neighborhoods after I had recommended that we buy them out. I remember driving through there and asking myself "is this the right decision?" Anyways it was just a gorgeous subdivision and then being invited to their party. I stepped into the room, it was out at the Doublewood [a local hotel], a resident comes up to me and he says, "well thanks for coming." I have been told, "I can't tell you what I really think of your plan but I'm glad you're here." That was just an example of how the people reacted to us and something I will never forget.

Response Organizations

As described in the literature review, the response organizations are Type I, II, III, and IV (Quarantelli and Dynes, 1977). Fargo consists of several departments or organizations that served in different roles in the flood response. Table 6, details the response organization typology, the city department, and the corresponding skill specialization for the 1997 flood.

Table 6

1997 Organizational Typology for Department and Specialization

Organizational Typology	City Department	Specialization
Type I	Fire	Flood protection breach response
Type I	Police	Escorted sandbag delivery and traffic
Type III	Planning	Volunteer coordination
Type III	Solid Waste	Sandbag production
Type III	Public Works	Secure city government infrastructure and sandbag delivery
Type III	Engineering	Determine how changing river levels will impact city government infrastructure and residential areas
Type IV	Flood Leadership Team	Command and Control of Flood Operations
Type IV	Ad Hoc Neighborhood Sandbag Teams	Filling and Placing Sandbags

Type I – Fire and Police Departments

Type I groups are characterized as an existing group completing regular tasks (Quarantelli and Dynes, 1977). The Fire and Police Departments throughout the flood remained consistent in their primary function of public safety; therefore, they are regarded as Type I organizations. Both departments assisted in flood operations. The Fire Department assisted with flood emergencies and the Police Department assisted with traffic control measures associated with the flood. However, as stated above, the Fire and Police Departments did not drift from the primary responsibilities during the flood.

Type II

Type II groups are characterized as an emerging group completing regular tasks (Quarantelli and Dynes, 1977). There were no Type II organizations identified in this

study. It would be rare to see an emerging group performing regular tasks in a city-focused flood response.

Type III – Planning Department

A type III organization is characterized as an established group completing non-regular tasks. This type of organization is referred to as an extending organization (Quarantelli and Dynes, 1977). The Planning Department was responsible for volunteers. Fargo officials knew that volunteer coordination was going to be required at the onset of the 1997 flood. The Volunteer Center program was created and tasked with this effort (Stensrud, 1999). The Volunteer Center established phone lines for community members to call in for support. In 1997, volunteers served in a variety of different roles, but more staff support was needed for coordinating the volunteers (Stensrud, 1999).

One of the roles served by volunteers was the production of sandbags. According to multiple interviewees, the number of sandbags produced in 1997 was directly related to the quantity of volunteers. Volunteers simply made as many as they could. The materials for sandbag production were ordered as needed. Volunteer turnout was unpredictable; therefore, the number of sandbags produced was unpredictable.

Type III – Solid Waste Department

The Solid Waste Department was also a Type III response organization responsible during the flood response for the sandbag operations including production and logistics. The Fargo Emergency Manager stated the 1997 flood was the focusing event for an organized flood response. An important element of such a response is sandbag operations. Two notable elements of sandbag operations learned from the 1997 flood were the importance of the centralization of sandbag production and sandbag tracking.

Sandbag Production Centralization

In the 1997 flood, sandbag production did not have a centrally organized production system. The Fargo Emergency Manager explained how the city was divided by neighborhoods and sandbag operations were conducted by both private and public groups, but there was a lack of coordination between the groups. The quantity of sandbags and where they should be placed was not readily communicated. Moreover, as mentioned earlier, the amount of sandbags that were produced were not calculated but rather were dependent on the quantity of volunteers. This complicated the flood response.

The initial centralization of sandbags was accidental. The Solid Waste Director credited the weather for the centralization of the sandbag production. During the 1997 flood, a winter storm hit Fargo and the materials for sandbag production were brought inside to thaw. This impromptu change in logistics led to the creation of "Sandbag Central". The 1997 flood review recommended centralization of sandbag production from the onset of a flood (Stensrud, 1999).

The Enterprise Director described the sandbag production process and the quality of sandbags. In 1997, there was very little technology used for filling the sandbags. The process in the neighborhoods, and later at Sandbag Central, consisted of manual labor shoveling sand into upside down traffic cones, used as a funnel, to fill sandbags. The completed sandbags were loaded onto pallets or large metal containers. The creation of sandbags for emergency protection took long hours, and sometimes required volunteers to work around the clock.

To reduce some of the labor, a metal structure or sand filling bin, was introduced. The filling bin was much larger than the traffic cone, allowing sand to be filled with a front

end loader, thus allowing the filling of multiple bags at one time. The use of the loader and bin eliminated some manual labor but individuals still had to hold the bag under the bag filling chute while it was being filled. This progression did increase production but there were still quality issues.

The Enterprise Director defined sandbag quality as a consistently filled bag that is able to conform to the surroundings when used. Over-filled sandbags do not form an effective sandbag wall because they are too firm and do not conform, or mold, into the surrounding sandbags. In addition, over-filled bags are heavy and fatigue volunteers. Under-filled bags conform well, but require a larger quantity of sandbags to build a sandbag wall resulting in wasted resources. A properly filled sandbag is approximately 50% filled optimizing the size and conformability. Quality sandbags are consistently and properly filled.

Sandbag Tracking

Tracking the use of sandbags was identified as an important element of future flood fights. The Enterprise Director noted that in 1997 sandbag materials and their production were not centrally located and the distribution of sandbags was loosely tracked. Only at the peak of the flood, when sandbags were in short supply, did the distribution of the sandbag get tracked by locational need.

Type III - Public Works Department

The Public Works Department was a Type III response organization based on the department's flood response responsibilities. During the 1997 flood, department went right from snowplowing to flood fighting. This was further complicated by two additional snow storms during the flood. In a single night, the Public Works department switched from

flood fighting operations to plowing snow. With the extended responsibilities, the Public Works Director stated many operations were scrambling with very little organization and communication, but the work needed to get done. As the Public Works Director stated:

> …you can't fight a flood with paper. You have to act. You have to do. Do your best to document and take care of it so that you can have a good archive for the future, but recognize that sometimes you just have to do and follow up with paper.

Type III – Engineering Department

The Engineering Department was a Type III response organization based on the department's longstanding flood response role. The Engineering Director stated that prior to 1997, managing efforts for a flood response in Fargo fell primarily to the Engineering Department. In preparation for the 1997 flood, the Engineering Department divided the city into sections and for each section they determined how much emergency flood protection was needed. The City Administrator recalled needing enough lead time so the engineers could do surveys in the homeowner's backyards to identify low areas. When the areas were identified for emergency flood protection the Engineering Department decided whether to use temporary clay levees or sandbags to protect areas.

According to the Floodplain Manager, beyond the river overflowing its banks, the Engineering Department also had concerns with pump stations and underground infrastructure. He noted that many questions required answers, such as: Where is the city's infrastructure vulnerable to flooding? Who is responsible for it? Is there a possibility of getting flooded from below through the sanitary sewer interconnects? As such, multiple non-routine demands were placed on the Engineering Department.

Type IV

Type IV organizations are characterized as an emergent group completing non-regular tasks; they emerge to address an unplanned and unfilled need in an emergency (Quarantelli and Dynes, 1977). Two groups that were not established and performed non-regular tasks in the 1997 flood were the flood management team and neighborhood sandbag operations. The flood management team, which was comprised of the Mayor, Engineering Director, and Public Works Director was established to address the 1997 flood. After 1997, this became an established team and was used in future floods.

The neighborhood sandbag operations emerged as a result of cul-de-sac kits. The Engineering Director stated cul-de-sac kits were all the inputs for making sandbags in a neighborhood such as bags, sand, ties and so forth. The materials were delivered to neighborhoods, but did not provide manpower. This resulted in the emergence of neighborhood sandbag operations to fill and place sandbags.

Mitigation

The magnitude of the 1997 flood emphasized the need for mitigation in Fargo. According to multiple interviewees' the 1997 experience highlighted the fact that the best way to avoid future flood emergencies was to minimize risk. It was noted in the 1997 flood review, that more staff members need to be dedicated to the mitigation process (Stensrud, 1999). Mitigation projects require a focus on funding, priorities, and technology.

Funding

The Planning Director stated that funding for mitigation after the 1997 flood came primarily from the Federal government. According to the 1997 flood review: "seventy-five

percent (4.2 million) of buyouts were funded by FEMA, with HUD's matching community development block grants funding fifteen percent and the State of North Dakota covering the remainder" (Stensrud, 1999). In total, Fargo received over five million dollars primarily for buy-outs of roughly 100 homes (Stensrud, 1999). The Planning Director recalled that "a lot of people did not want to go through this again so they were anxious to have the city buy them out. Also they thought if they ever had to sell it on the open market that it would be tough." Additionally, some homeowners were concerned that the buy-out process was not consistent. A recommendation to create a consistent streamlined process for buy-outs was included in the 1997 flood review (Stensrud, 1999).

The Enterprise Director recalled that a failure during the 1997 flood was the lack of planning and documentation for response reimbursement. The timely and thorough documentation of response expenses was not prevalent in the flood fight. Moreover, the process for reimbursement for flood fighting expenses was not understood. Multiple interviewees noted that some reimbursements for response expenses were not collected.

Priorities

According to the City Engineer, up until 1997, Fargo thought they could protect everyone from flooding. That belief changed when the magnitude of the flooding from the Red River increased. Some areas in and around the city were extremely vulnerable to flooding and could not be protected. Multiple interviewees stated there also were homes in low elevations adjacent to the river that required high quantities of sandbags for emergency protection. These residences became first priority for buy-outs.

The City Planner stated acquiring those houses was the initial focus of flood mitigation. A success noted in the 1997 flood review was the rapid determination of areas

that would be in the buy-out program (Stensrud, 1999). The rapid determination resulted in a high purchase rate. Leadership wanted to communicate with the homeowners before they began rebuilding. The concern was that if homeowners started rebuilding they may be more reluctant to sell their home to the city.

The vulnerability of city infrastructure was another lesson learned in the 1997 flood. According to the City Engineer, flood mitigation in Fargo began in the 1960's with the Army Corps of Engineers' (Corps) building of the 4th Street levee. The Corps' 1962 project plans reference the 4th Street levee and also the sanitary sewer gates. The sanitary sewer gate outfalls are pipes that channel the run-off from all the city streets into the river. In the case of high river levels, the water can actually flow backwards flooding the city. The Director of Engineering discussed how mitigation projects completed prior to the 1997 flood assisted in the successful flood fight:

> I think that the difference between the flood we had in 1969 and 1997 was the fact that we had already gated something like 128 pipe outfalls and that led to the reason that we were successful, mostly successful in 1997.

Per the Director of Engineering these infrastructure mitigation projects continued and expanded after the 1997 flood.

The interconnectedness of the sanitary sewer system created challenges for the city. The Floodplain Manager discussed the challenges this presented during a flood:

> …when you consider every house has a sanitary sewer service. Well, if you have one basement that gets flooded, your whole sanitary sewer system now is inundated with water. How do you plug it off in the right locations and do you have all the right locations?

In addition to challenges identified with interconnectedness of the sewer system, changes were needed in the maintenance program of city equipment. Vulnerability can occur as a result of the failure of city equipment (i.e., pumps and valves). The Public Works Director recalled that prior to 1997, the Public Works Department ran a lot of equipment to failure. He explained that after 1997 that practice changed. The current maintenance program minimizes failure by only using equipment to its projected life. For example, if a manufacturer states a pump is expected to function properly for two years, the city replaces the pump after two years. In the past, the pump would have remained in service until it stopped functioning, which could have been in the middle of a flood.

Technology

Fargo has learned that embracing technology can assist with the mitigation and response of Red River Flooding. The Director of Engineering and the City Engineer noted examples of technology used for mitigation. In 1995, the city acquired its first digital aerial imagery. This technology was able overlay two images to extract elevation data. The Fargo leadership wanted to start collecting elevation data throughout the river channel however; this process was extremely slow and expensive. In 1997, despite of the fact that the data was not fully processed yet, the extreme urgency of the flood situation warranted its use to help understand the ramifications of the river level rising beyond 36 feet.

Also in 1997, contour maps created from the aerial imagery were posted throughout the city so residents could see their property elevation in relation to the river level. These contour maps were deemed very important by residents and long lines of people formed waiting to learn the elevation of their property. In addition, the Engineering Department assigned two staff members to answer technical questions from the public.

After 1997, the elevation data was taken to the next level. The Engineering Department created a spreadsheet that went lot by lot, factoring in the elevation for each lot in determining how many sandbags would be required to protect the home. This data was gathered and projected for entire neighborhoods. The Fargo Emergency Manager stated this spreadsheet was a useful tool for projecting sandbag requirements for different river levels.

CHAPTER FIVE: WHAT WAS LEARNED FROM SUBSEQUENT FLOODS

As a result of the magnitude of the 2009 flood many more opportunities for learning were identified. A city official said that going into 2009 he thought the city was pretty well-prepared. However, in retrospect, the city was not. The data revealed that the hectic nature of the 1997 flood fight was repeated in 2009. During the 2009 flood, the Fargo Emergency Manager stated that Fargo was not just protecting property; they were protecting the entire city. This chapter primarily focuses on the 2009 flood which includes sections on coordination, communication, response organizations, and mitigation. The coordination section includes leadership, the Incident Command System (ICS), the Emergency Operations Center (EOC), emergency managers, and the reimbursement process. The communication section includes public communication, operational communication, and interpersonal skills. The response organization section analyzes the data based on the typology of organizations involved in the floods. The mitigation section includes the topics of funding, priorities, other areas of vulnerability, and technology. The chapter closes with areas of improvement identified from the major floods of 2010 and 2011.

Coordination

In 2009, the former Public Works Director, who was described as saving the city in the 1997 flood, had retired from that position and was serving as the Mayor of Fargo. At the onset of the 2009 flood, a concern voiced by multiple interviewees was whether the Mayor would observe his role as the Mayor or assume command over operations. Elected officials in Fargo are typically focused on media communication and public relations as opposed to orchestrating the details of flood operations. The current Mayor stated, elected

officials are most effective being the "face" of the event not the Incident Commander. Fortunately, the Mayor recognized his elected role and left the city department heads to direct flood operations. However, there was one very clear observation: the Mayor was still a focal point for city residents during flood events. The Enterprise Director noted that if Denny [the Mayor] was calm, the city was calm. There was tremendous confidence in the Mayor and this allowed city departments to focus on flood fighting.

Leadership

Multiple interviewees' stated autonomy flowed down the command chain and helped with the coordination of flood operations by maximizing the opportunity for city employees to be effective. In crisis mode, the leadership had minimal time for oversight and encouraged staff decision making. An example of this autonomy was in the City Engineer's praise for an Engineering Department team member:

> …she called me up one day and said I got to make some changes out here. I said go ahead. I go out there the next day and find out she had pulled the deck off of a couple of houses and run a levee right on the very backside of the houses. It was a quarter mile long. People make amazing decisions when they are under pressure.

The Public Works Director stated "if I show up and it is still an issue then there is a problem. What were you waiting for? Do something. When in doubt, do something." He empowered his staff to make the decisions and think outside the box. He also stated "one of the things that came out of 2009 was empowering your staff and giving them the autonomy to fix it."

According to the City Administrator, in 2009, a City Commissioner was frequently seen providing volunteers encouragement and asking them what they needed. If the City

Commissioner identified a need, he reported the need back to the EOC and moved to another area. The City Administrator stated that this was an effective mechanism for garnering feedback.

Several interviewees described the use of city departments and staff. The Solid Waste, Public Works, and Engineering Departments were referred to as a "three-legged stool". These departments worked together to build, transport, locate, and complete the emergency sandbag protection. The coordination between these teams was paramount.

Many city employees supported the "three legged stool". According to several interviewees, this began with putting the right people in the right roles. Department leaders used individual's skills and personality to align with flood orientated work assignments. For example, if an employee had good interpersonal skills, that individual was put in a public contact position. Conversely, if an individual was stressed about being around large groups of people they were not assigned to tasks that put them in those situations.

In 2009, city leadership used resource planning to maximize the effectiveness of the entire city staff. Understanding the importance of and challenges associated with adequate staffing, ancillary resources (i.e Library and Public Health staff) were leveraged. In 2009, Fargo had 600 city employees. Each employee had specialized skills used for normal city operations. Not all of those skills translated to flood related activities. In addition, some of the employees were not available because their homes were directly affected by the flood.

Incident Command System - ICS

The Fargo Emergency Manager stated that the intent in the 2009 flood was to fully engage ICS procedures; however that was not achieved. He noted that working with the ICS positions, particularly the Incident Commander (IC) position was a "learning

experience". He recalled many chaotic events regarding who the IC was and a very fuzzy incident command structure. The situation peaked several days into the 2009 flood response when a police lieutenant pulled the Fargo Emergency Manager into a conference room at the EOC along with an Assistant Fire Chief, Fire Chief, and Police Chief. The lieutenant said, "We need to get a grasp on who is in charge". The only question the Fargo Emergency Manager could ask of this group was "Who is the Incident Commander?" There was consensus in the group that they did not know who should be the IC. They deferred to the Fargo Emergency Manager to be the IC. However, the Fargo Emergency Manager explained that the emergency manager is never the Incident Commander because emergency managers are tasked with coordination. They are responsible for bringing people together but are not in operational management (contrary to a common misconception). After the group realized this misconception, the Fargo Emergency Manager went to the City Administrator's office and said, "I think we need to make sure that we have a strong Incident Commander. Who is the Incident Commander? He said, 'I am'". That resolved the vacuum for the IC position.

The City Planner described the leadership style of the IC/City Administrator as generally collaborative. However, if the situation needed a firm absolute decision, he would be authoritarian. This was evident when he discussed the 2009 decision not to evacuate the city:

> The State tried to run the show but they are just a support function. The state wanted to come in and say Fargo has to go. You have to evacuate. The mayor said no. All emergencies are local. All disasters are local. The state has no say to come

> in and say you have to evacuate. They can request it, they can encourage it, but it is up to the local incident commander to say 'yes or no'. And we didn't.

The City Administrator noted that this decision was proven correct; the city was not evacuated, which left many more individuals to watch and report dike conditions.

The use of ICS in the 2009 flood was inconsistent. In the 2009 flood review, the Public Works Department staff stated that there were too many people making decisions, and that ICS was needed (Schlafmann, 2009). Additionally, the Engineering Department staff stated that people out of the chain of command were giving orders which created problems such as rework, loss of valuable time, and loss of resources.

It was learned from the 2009 flood that full implementation of ICS was needed. The Engineering Department was not familiar with operating with ICS. In contrast, the Fire Department had routinely operated under ICS. To facilitate the use of ICS, each city section was assigned an engineer, along with a fire captain, and three firefighters. This team effectively allowed each department to focus on their strengths. The Fargo Emergency Manager commented:

> In 2010 when we set up the organization [ICS], I actually had the City Engineer come out to the EOC and tell me that he doesn't understand ICS. He doesn't necessarily like it, but the damn thing works. I knew that we did well because I got him out of his office to come out here which is pretty dang good.

Moreover, when asked about the five key items learned about flood management the Cass County Emergency Manager stated, "Incident command is at the top [of the priority list] because we wouldn't be able to manage our system without it."

Emergency Operations Center - EOC

A recommendation from the 1997 flood review was the creation of a "war room" to provide face-to-face communication enhancing operations (Stensrud, 1999). This recommendation resulted in the current day Emergency Operations Center; albeit, in 1997 they identified the need, they did not know how an EOC functioned.

The primary use of the EOC began in 2009. The Fargo Emergency Manager addressed the history of the EOC in Fargo. In the mid-2000's the EOC was allocated space within the newly constructed Public Safety Building. However, in early 2009 this space was being used temporarily for Library staff offices while the city was building a new library. A Library leader said to the Fargo Emergency Manager "Good news, we will be out in two weeks." Later that afternoon, after the city had received new flood projections, the Fargo Emergency Manager returned to library staff and said "Good news, you're out today." A Fire Department crew backed up a moving truck and loaded all of the library materials into it. The furniture was ordered and within 24 hours white boards, projectors, phones, and furniture were being installed in the EOC. The space went from an empty room to being a functional, equipped, and fully staffed EOC within three days. The Fargo Emergency Manager recalls, "It was a very short ramp up time for new equipment, new space, and new technology. It was a very steep learning curve." This was the first time citywide operations were brought to that level. He added, "It was chaotic and somewhat disorganized, but it worked."

In 2009, the EOC was a support entity with the exception of the Public Works and Engineering Departments. Engineering was not housed in the EOC because all the physical engineering records they needed to access were in City Hall. The Public Works

Department did not use the purchasing function of the EOC. It independently purchased sand, sandbags, lights, forklifts, and many more items. The Public Works Director stated that during the 2009 flood, the Public Works Department's human resources became overextended from all of the purchasing activities in addition to the department's other responsibilities. Learning from 2009, it was recognized that all purchasing should be completed through the EOC.

An example of the inefficiencies evidenced in 2009, were the duplication of orders for materials by different departments. The Public Works Director detailed the current process:

> …they say, oh we have a flood coming, I look at the map, who engineering is assigning to each reach [location in city] and I hand them the wish list. Tell me what you need. Get it back to me by this date and when you want the stuff set there. After that date, then they have to go through the EOC.

He further discussed how engineers went through and measureed how much plywood they needed, they measured from point to point. They identified how many sheets and where they wanted it delivered. They learned to delegate the plywood delivery to the lumberyard. The night before making a sandbag wall the Public Works Department night shift went out and delivered the poly (used in sandbag wall creation) so it was ready for morning. All the items were delivered and ready before the sandbag wall was built.

After 2009, similar to ICS, the need for full involvement in the EOC was established. The Public Works Director stated, "I can't stress enough that we fought the EOC the first year [2009]. I didn't want to send somebody out there; it was a waste of time. I'll admit to this day I was 100 percent wrong." The Fargo Emergency Manager said

in the EOC, the volunteer coordinators and engineering team members talked across a table to resolve how many volunteers were needed for different sandbags locations; as he recollected, "it just flowed".

Emergency Managers

A unique aspect of emergency management practice in Fargo and Cass County is resource sharing. The Cass County Emergency Manager attributes much of the flood fighting success to the cooperation between the city and county. According to the Cass County Emergency Manager this relationship is not a common one. He stated it helps that they are in close proximity to one another. They work in the same section of the Fargo Public Safety Building. Their offices are within feet of each other. The Cass County Emergency Manager stated that the success lies in:

> … the trust that we have built. Leon [Fargo Emergency Manager] and I start our day by sharing a cup of coffee. And whether there is anything professionally going on that day or not, it doesn't matter. We maintain that relationship. We train together, we exercise together, we plan together, the only thing we don't do together is sleep together.

He further elaborated on the successful partnership between the city and the county saying:

> When it comes right down to it, it is not you and them, it is us. So the city Engineering Department and County Engineering Department work together. We do joint press conferences. We do joint meetings in the mornings. We have learned the value of doing that not only just for the efficiency of the operation, but for the benefit of our community.

The collaboration between the city and the county was reinforced by the Fargo Assistant Fire Chief who noted "…that in 2011, they [volunteers] did all of the sandbagging for the county and the city in the one spot."

As stated above, the Fargo Emergency Manager and the Cass County Emergency Manager worked together in many aspects of flood planning and response. The Cass County Emergency Manager considered all residents in the community as having a role in flood response. Beyond human resources, during the 2009 flood response there were many other resources consumed. These resources included equipment rentals, tools, fuel, and physical materials; resulting in a significant expense. According to several interviewees, accounting for expenses was another lesson learned in 2009.

Reimbursement Process

According to the City Administrator, for the 2009 flood response, Fargo incurred about $12 million in expenses but only recovered $10 million. In subsequent floods, this reimbursement gap was minimized through documentation. The Federal Emergency Management Agency (FEMA) reimbursement requirements have been integrated into the flood response process. The Enterprise Director stated that shortly after the 2009 flood, they did not understand the detail required by FEMA for reimbursement. "When we got involved with FEMA from a reimbursement standpoint, we began to realize that the amount of paperwork was almost insurmountable. Quotes, purchasing, tracking, and use were all details that were not well-documented." According to the Director of Solid Waste the lack of proper paperwork resulted in Fargo bearing a significant expense from the 2009 flood and possibly prior floods. Two years after the 2009 flood, city officials and FEMA representatives were still working on obtaining the required details for expense

reimbursement. The City Auditor and Finance Department drove procedural changes to the purchasing procedures to align with FEMA reimbursement requirements.

The Floodplain Manager described increased organization after the 2009 flood. An element of the organization was the Finance Department, who was interested in ensuring the City of Fargo was reimbursed effectively. Their priorities were adhering to the procedural changes for purchasing supplies needed for the 2010 flood response. An example the Floodplain Manager shared from the 2010 flood was the change in regard to the contractor's expense reimbursement paperwork. Contractors hired for flood response were told "Here are these forms that you have to fill out and you are going to put your hours down." Everything was recorded. The saying was "Document, document, and document."

Documentation is important for reimbursement from FEMA. From the 2009 flood the city roads were significantly damaged. The Floodplain Manager stated that fortunately, the Engineering Department had just completed the 2008 Pavement Survey, a process in which all city road conditions are documented. The survey includes a record of road conditions which are typically used for planning future maintenance. The data proved to be valuable for damage reimbursement from FEMA. This valuable data was partially attributed to the Engineering Department's use of GPS cameras. These cameras toke digital pictures while also recording the GPS coordinates of the picture's location. The Engineering Department staff was able to present FEMA with pre- and post-flood photos, from the same location. As the Floodplain Manager stated, "the coordinates are objective." Regarding the GPS cameras, the Enterprise Director stated, "any kind of equipment that you get, FEMA taught us that you really had to be more diligent with your bookkeeping."

The refined reimbursement process implemented changes to the flood response processes. For example, in 2010, the EOC's Finance Department representatives made sure everything was properly documented. Per FEMA requirements, the purchasing procedure required three quotes for the acquisition of equipment or material. A software program was also implemented to streamline this procedure.

The software program was WebEOC, a computer-based incident management system, which contains a module for tracking reimbursement procedures. According to the Fargo Emergency Manager, the reimbursement module was implemented prior to the 2010 flood. However, the value of the software goes beyond the reimbursement procedures. WebEOC is a communication tool which allows other stakeholders visibility to operations. During an event in which the EOC is activated, the city posts everything into the system. As noted by the Cass County Emergency Manager "They [State of North Dakota officials] can see what we are doing at the State Emergency Operations Center. Otherwise, they are on the phone every five minutes or they listen to KFGO [local radio station] and just go crazy." Fargo and Cass County use WebEOC heavily for logistics tracking and ordering resources. The Fargo Emergency Manager explained "All levels of State government have that [WebEOC] in front of them. The National Guard uses it, the Health Department uses it." Fargo used WebEOC for the floods in 2010 and 2011. Purchasing requests would come into the EOC through WebEOC. For example, when an Engineer needed something in the field, the Engineering Department representative would input request to WebEOC, triggering task assignment to the appropriate individuals. The Fargo Emergency Manager recounted such a request, "The request would pop up on the screen and say I need 5,000

sandbags and 400 volunteers. Before I had to do anything, the desks [staff] already had it taken care of. They were already on the phones. They already had the buses relocated."

Communications

At the onset of the 2009 flood, the City Administrator stated that communication was a priority. Past communication challenges had been improved, however, the scope and magnitude of the record setting 2009 flood exposed additional areas for improvement. These areas were public communication, operational communication, and interpersonal skills.

Public Communication

The magnitude of the 2009 flood brought the national media to Fargo. The City Administrator stated, "The media was falling all over each other to get stories and so we had a difficult time managing just how to get the message out, even with our daily newscast." He recalled the recognition that the national media was not trying to get the message out, but looking instead for a catastrophe. When that did not happen, they moved on. Learning from 2009, during the 2010 flood, Fargo established a 24-hour hotline and dedicated website for public communication. The website became a focal point for public communication.

Public communication surrounding social media was also addressed. The Mayor described the social media program. Social media as a medium for communication was problematic because it was a mechanism by which false information and rumors were spread. To ensure accurate communication with the public, several city employees were assigned to monitor Facebook, Twitter, and other social networks. The team searched for incorrect statements regarding the flood and when such information was discovered the

staff published accurate information via that same network. The intent of the social media program was to quickly correct false information, minimize flood-related tension, and avoid unnecessary worrying of the Fargo residents.

Public communication was also present through daily city meetings. As stated by several interviewees, a small group of city leaders met every morning in private to discuss flood progress and needs. After this meeting, an open forum status meeting began that included all involved agencies. Following this open forum meeting, there would be a press conference with the Mayor and top city officials. To increase public communication, the city broadcast the entire open forum meeting live on local television stations, resulting in direct unfiltered access to what was happening on a daily basis. According to the Mayor, the broadcasted meetings were very well received by the community and provided a gateway to accurate and current information. Moreover, the broadcasts reduced the amount of media requests to city leaders for interviews.

The Mayor continued, prior to beginning the televised daily meetings, city officials agreed there would not argue or fight in this public setting. The intent of the meetings was to be informative, they were not a forum to debate flood fighting strategy. He also stated it was important to provide real expectations, transparency, and a unified platform to the public.

Public communication also included data on property elevations. During the 2009 flood, the Engineering Department created elevation maps for all areas of the city and displayed them at the city libraries. Learning from 2009, in subsequent years, to improve communications, property elevations became an application on the city website. In addition, access to this information was also available through a telephone hotline staffed

by librarians. According to the City Engineer, librarians were chosen for this task because they are comfortable with public interaction and were familiar with the materials. This hotline reduced 90% of the calls that were routed to city personnel in previous floods.

The Public Works Director offered that in 2009, there were a lot of failures kept from the public. Knowing the radio system communication was monitored by the media, city personnel intentionally stayed off the radio system and used cell phones. He emphasized that the teams did not want any distractions from their job protecting the city, "We were always tiptoeing right on the edge, where the city felt we were relatively secure, as secure as you can be at that level (41 feet), but there is going to be stuff that goes wrong and fails."

Public communication also involved the CodeRED system. This system allows a jurisdiction to call or text message to individuals' home and cell phones in a specific geographical area. The system is typically used for weather emergencies. During the flood many residents signed up for the free service. The Mayor passed along a story told to him in 2009:

> I don't know who the hell did it but at 3 in the morning someone did a CodeRED and I had to get up. And the funny thing is, that on CodeRED you get up and if you don't get up, your neighbor will know because your light won't be on. He said I almost felt like putting my light on and pretending I went to the bags. The brilliance in a CodeRED in the middle of the night is that you know if you don't get up your neighbors will know. And it is almost guilt by association. In 15 minutes, we had 300 people at the dike. In a half hour, they had rebuilt the wall. In 45 minutes, the women had chili and hot food in the garage ready for the people.

Elaborating further, the Mayor stated it is almost critical that you have the neighbors volunteering in their own neighborhood because there is a direct connection. They do not want to lose their house.

Operational Communications

One of the areas identified for needing improvement after the 2009 flood was operational communication. Multiple interviewees' noted that key personnel communicated through the use of personal cell phones in 2009. Engineers were assigned to specific locations in the city and when they went home to get some sleep they took their personal cell phones with them. This halted communications with the area of the city in which they were assigned.

Learning from 2009, in subsequent floods, there were two significant modifications to bolster operational communications during the flood. First, the local telephone companies increased the capacity of the cellular and landline phone infrastructure. Second, the communications procedure was changed for key personnel. To remove communication gaps, a radio was assigned to a location to avoid reliance on individual cell phones.

Interpersonal skills

According to multiple interviewees, interpersonal skills are also a key aspect of communications. The Enterprise Director reflected on communication with his staff as encompassing four points; inspire rather than motivate, listen, be present in trying times, and appreciate efforts employees have already contributed. Adding to this philosophy, the Director of Public Works stated, "You've got to be leading them how you would want to be led, and not just shoving stuff down their throat." He also relayed that his leadership style incorporates not assigning tasks that he would not personally complete. Specifically

he stated, "You go down the sewers, stuff like that and look at stuff. That is how they have to be led through this."

The Fargo Emergency Manager and Cass County Emergency Manager stated that their soft skills had a tremendous effect on operations, because they had no legal authority, only the power of persuasion. The Cass County Emergency Manager elaborated:

> If you don't have those soft skills that enable people to understand the value of joining in whatever kind of goal you have, it is going to be really tough to do that. And that comes all the way from the elected officials all the way down.

An example of the power of interpersonal skills is the relationship between the Director of Public Works and an owner of a large construction company in the area. During the 2009 flood, the City of Fargo had a developing problem of overland flooding in a far south area of town. The Director called the owner of the construction company and said he needed some clay to build temporary levees. The Director stated, "I have to put up a temporary dike here." The construction company owner said "my excavator is sitting out in the borrow site [where clay is taken from], just go get in it and start loading your trucks." The next night the city had additional problems with overland flooding and the Director called the construction company owner again saying "I can't come run the excavator tonight," he [the company owner] said "okay" and got out of bed and ran it for us. By utilizing interpersonal skills the Director of Public Works and the owner of the construction company were able to work together and thus assist the flood response efforts.

The Engineering Director shared another situation that was navigated with strong interpersonal skills. During the 2009 flood fight, a situation occurred in which there were

not enough resources to protect a neighborhood with emergency flood protection. An Engineer was sent to the neighborhood to communicate this message and discuss options:

> …we had been focusing on other neighborhoods and putting sandbags out in other lower neighborhoods and when we got to River Villa and the water was starting to get to them, we had no sandbags to offer them. The sandbags were all committed and tied up in other neighborhoods. We couldn't even get trucks to haul in earth. All the trucks that were moving earth were committed to other locations. I had to go out there and say to that community, if you want us to help you; you have to let us dig up your back yard. We need to do a dig and dump and take the material right from your own yard to build up a levee to hold back the water. And we did that, but when I walked in there they said well what about this, and what about this? What about our plants? What about our sprinkler systems? I remember a resident, he has since passed, he stood up and he said to this garage full of people, 'she is not here because she wants to be here telling you she doesn't have resources for you. These are our houses and they are trying to help us save our houses. Forget about your plants. We will worry about it later.'

The final example of interpersonal skills recalled by the City Engineer occurred between her and a resident affected by a mitigation project. In the past, this resident had stood up and very vocally stated his belief that Fargo was never going to see another flood like 1997. However, after the 2009 flood, the City Engineer recalls a funny conversation with this same individual. He said:

> I [the resident] want to talk to you but I forgot my teeth and if it doesn't bother you, it doesn't bother me. He apologized. He said I am so sorry. I really, really thought

> we would never have a flood bigger than 1997. I was wrong. We have been opposing this project when you guys were trying to protect us. I am sorry for my role in holding off that project.

The City Engineer was amazed by the resident who; recognized his error, admitted it, and apologized for it.

Response Organizations

The response organizations were analyzed for the 2009 flood and were also categorized by typology. All four types of response organizations were not discussed in the interviewees, the interviewees did not discuss Type IV response organizations. This does not imply that no Type IV response organizations were present during the 2009 flood, merely that, none were drawn out in the interview process. Table 7, details the response organization typology, the city department, and the corresponding skill specialization for the 2009 flood.

Table 7

2009 Organizational Typology for City Departments and Specialization

Organizational Typology	City Department	Specialization
Type I	Fire	Flood protection breach response
Type I	Police	Escorted sandbag delivery and traffic
Type II	COAD (not a city department)	NGO coordination
Type III	Planning	Volunteer coordination
Type III	Solid Waste	Sandbag production
Type III	Public Works	Secured city government infrastructure and sandbag delivery
Type III	Engineering	Determine how changing river levels will impact city government infrastructure and residential areas

Type I – Fire and Police Departments

Multiple interviewees stated that the Fire and Police Departments, type I organizations, primary function was not changed during the flood, but did add some additional non-regular duties. The Fire Department's role was expanded by assigning a small team of firefighters to each neighborhood. There firefighters were responsible for ensuring the volunteers remained on task, sandbag protection was constructed properly, and efforts were coordinated with the engineers. The Police Department role was expanded by providing escorts (lights and sirens) for sandbag delivery trucks. The Police Department escorts reduced the time it took for sandbag delivery trucks to make a delivery and return for the next load.

Type II - COAD

The Cass County Emergency Manager discussed how the NGOs and county had created a COAD (Community Organizations Active in Disaster) that unified community organizations in Cass and Clay counties. The COAD was an incredible asset because they brought together, at any one time, about 20 to 25 different NGOs. Each organization has some kind of disaster service focus in their mission and the COAD brings them together in an organized manner. Now COAD leaders are brought routinely into the EOC.

The Red Cross and Salvation Army were tasked with supporting the volunteers and workers. From the EOC, the Red Cross and Salvation Army supplied workers and volunteers with food and drinks. Both organizations wanted a presence throughout the city but did not want their coverage to overlap. Therefore, organizations switched coverage areas daily between the north and south side of Fargo. The City Planner recalled, "The one thing we learned with high school kids is that they can eat up a storm!"

Type III – Planning Department

Multiple interviewees stated that volunteers were a key component in the Fargo flood fights. The volunteers have produced and placed the sandbags in every major flood event. The 1997 flood review stated the numbers of volunteers needed to be increased in future events (Stensrud, 1999). The data from this study identifies that Fargo officials have experienced organizational learning regarding volunteers. The learning included minimizing the variability of volunteer workforce and increasing volunteer safety. The variability of volunteerism spans from a chaotic "all hands on deck" environment to the controlled pre-planned quantity of volunteers delivered to a specific location.

Variability

The Planning Director described the variability of the volunteer workforce as including such issues as; the quantity of volunteers, where they arrived, and how long they worked. The challenge was that the sandbag production needs were fixed, but the volunteer workforce required to produce and place the sandbags was variable. The 1997 flood review suggested that to optimize volunteerism, an organization should be dedicated to volunteers (Stensrud, 1999). In 2009, FirstLink, a non-profit organization, was called upon to work with the city to assist with promoting volunteerism and volunteer coordination. The Planning Director was the Fargo official teamed with FirstLink. He recalled that the first day did not go so well because of the limited supply of sandbag components and volunteers. The system did not balance. Volunteers were needed for both sandbag production and placement. The focus on volunteerism was beginning, but it was not 100% effective yet. The variables of how many volunteers and how long they worked was not resolved.

As the 2009 flood evolved, city leadership asked local businesses to close to increase the volunteer workforce. This increased workforce was still not enough support to achieve the sandbag goals. Multiple interviewees stated a major breakthrough occurred when the local schools became involved. School district leadership offered their students as volunteers during the school day. This relationship with the schools transformed the volunteer workforce. The student volunteers minimized the volunteering variables of workforce quantity and duration. In addition, the students thought it was wonderful to be out of school working on sandbagging. The city benefitted from a captive supply of willing volunteers.

Multiple interviewees also described the need for more sandbags than Sandbag Central could produce. As the 2009 flood progressed, it was evident the quantity of sandbags for flood protection were not going to be achieved by Sandbag Central alone. The Fargodome, a local arena, was opened as a secondary sandbag production location. The Fargodome operation merged sand, bags, and bag ties into finished sandbags as fast as possible. Local university officials canceled classes and asked their students to volunteer for sandbag support. Thousands of volunteers supported the twenty four hours a day, seven days a week, sandbag operation. As a result, the Fargodome operation was able to produce sandbags at an extraordinary rate. Ultimately, the two operations (Sandbag Central and the Fargodome) produced the sandbags needed in the 2009 flood.

The Planning Director stated that after the 2009 flood, volunteerism was underwhelming, it was more challenging to get public volunteers. Flood fatigue set in with the residents of Fargo. He believes fatigue mixed with complacency to create a belief in residents that somehow it will get taken care of even if they did not volunteer. Fortunately, the Planning Director noted, since the school district was now integrated into flood planning discussions, they were prepared to assist with student volunteers. The kids once again loved volunteering and thought of it as a party. Multiple interviewees stated that volunteer coordinators were able to schedule enough students to allow a frequent rotation to the break station, which kept the volunteers fresh. By having access to students volunteer coordinators could plan, request, and obtain a virtually unlimited amount of volunteers. The day prior, volunteers would be requested for the following day. On that day, the group of student volunteers would be bussed from schools to areas of need.

In subsequent years the school volunteers made achieving sandbag production goals possible. As stated by multiple interviewees, if it would have only been public volunteers the sandbag goals would not have been met. Moreover, to minimize the impact of flood preparation the Floodplain Manager recalled in 2011, that sandbag production began in the middle of February, the earliest it was ever initiated. By starting earlier it allowed for more flexibility in the production schedule and minimized the magnitude of the volunteer effort.

Registration

The safety of the volunteers was also improved. According to the Solid Waste Director, along with students, there were many community members volunteering at Sandbag Central and the Fargodome. When the Fargodome was opened for sandbag operations its proximity to the North Dakota State University (adjacent to the north border of campus) facilitated a tremendous influx of volunteer college students. Many volunteers left their jackets and personal items in the stadium seats while they worked down on the floor producing sandbags. Unfortunately, as stated by the Solid Waste Director, some individuals at the Fargodome did not have pure intentions. There were some instances of personal items being stolen. Moreover, there was not an account of who was volunteering at the Fargodome or Sandbag Central. Thus, the possibility existed that individuals who legally cannot be around minors may have been volunteers. This was deemed to be an unacceptable situation.

In 2010, as a result of double-loop organizational learning it was determined that everyone needed to be registered before volunteering. The Solid Waste Director stated the registration provided valuable data for security and assisted with resource planning. As

with volunteering, Fargo has experienced organizational learning in sandbag production and placement operations.

Type III – Solid Waste Department

The Enterprise Director stated that between 1998 and 2008 there were several floods, that while not to the magnitude of the 1997 flood, gave the city an opportunity to implement and refine sandbag production processes learned from previous floods. According to the Fargo Emergency Manager, the continual learning was cited as a factor in the successful response for the record flood of 2009. However, the record breaking flood of 2009 exposed many other areas for improvement. The major elements were sandbag delivery, sandbag tracking, integrated priority system, sandbag production, and sandbag storage. According to the City Engineer after the 2009 flood, "We didn't have it down yet but we were getting better."

Sandbag Delivery

Trucks were used for sandbag delivery to the neighborhoods. When the sandbags were delivered volunteers built a sandbag flood wall. In 2009, volunteers were directed via radio and coordinators to drive to neighborhoods where the sandbags were ready and flood wall building was in progress. The need for flood walls spanned several locations. An initial challenge was getting the proper amount of volunteers to the correct locations. Too many volunteers arrived in one area and to few in others. In addition, the volunteers' vehicles parked up and down the streets created congestion making it difficult for sandbag delivery trucks to navigate in the neighborhoods.

Similar stories of imbalanced resources were shared regarding the quantity of sandbags needed for flood wall construction. The City Engineer described in 2009 there

were not accurate estimates regarding the number of sandbags needed for flood protection in each neighborhood. When an engineer requested a large amount sandbags to be delivered to a neighborhood, activity increased and with minimal organization and no parking restrictions the traffic came to a halt. Seventy semi-loads of sandbags driving into a neighborhood created congestion. This gridlock was the catalyst for organizational learning regarding sandbag delivery and volunteer site coordination.

The Planning Director noted that prking restrictions and standardized delivery routes helped alleviate congestion. The street congestion from volunteers' vehicles was also resolved. Volunteer coordinators learned it was more effective to have a centralized location for volunteer parking and use buses to transport them to areas of need. Also in 2009, the city leveraged the large parking lots at NDSU, Assembly of God, and Hope South churches as central locations for volunteer parking.

Sandbag Tracking

The distribution and tracking of the sandbags had only marginally improved between 1997 and 2009. As stated previously, in 2009 the estimates of how many sandbags were needed for different areas was not always accurate. Some neighborhoods requested sandbags simply by saying "keep them coming". As a result, too many sandbags were delivered to some areas while not enough were delivered to other areas.

The Solid Waste Director illustrated the result of poor sandbag tracking with a story from 2009. That year, people could drive up to sandbag central and receive a load of sandbags in their personal vehicle. One resident drove his pickup to Sandbag Central and received a load of sandbags for his home. Later in the day he returned, and gathered more sandbags. However, the resident's home was in the middle of town and not in danger of

flooding. The media reports and general concern had motivated him to create a ring dike around his home. Due to poor sandbag tracking, the resident used valuable resources that could have been used elsewhere. In 2010, the use of an integrated priority system for sandbags was implemented.

Integrated Priority System

The data shows that Fargo officials have experienced significant organizational learning in the use of sandbags for emergency flood protection. For example, double-loop learning resulted in a centralized location for effective sandbag production. Also learned from the 2009 flood, coordination of volunteerism, sandbag delivery, and sandbag placement were critical for building sandbag emergency flood protection. This experience has led to the process that will be referred to in this study as the Integrated Priority System. This system controls production, delivery, and placement of the sandbags. The Fargo Emergency Manager described the priority system as "more like a machine in 2010, than the chaos in 2009." This process, serves as a review of critical flood response tasks done regularly by the flood team leadership. It is as follows:

1. The flood forecast is reviewed.
2. The Engineering Department prioritizes areas for protection based on elevation.
3. The Engineering Department estimates the quantity of sandbags required for those areas.
4. Sandbag Central (Solid Waste Department) ensures the availability of the quantity of the required sandbags.
5. The Public Works Department transports and stages the required physical resources (sandbags and equipment) for use the following day.

6. Volunteer coordinators (Planning Department) direct needed human resources for sandbag placement.
7. Volunteers arrive at a central location to be bussed to a work area, where they stay until protection is complete. Volunteers are then transported to the next work area.
8. The Fire Department provides supervision and quality assurance during sandbag placement.
9. The Engineering Department confirms protection levels and dictates completion.
10. Salvation Army and Red Cross provide food service for volunteers at the work area.
11. The entire process is documented and tracked to facilitate the reimbursement process from Federal and State agencies.
12. The System is repeated until the protection level throughout the city is acceptable for the flood forecast.

Multiple interviewees stated the importance of the Integrated Priority System cannot be overstated. The system is the culmination of a tremendous amount of learning.

Sandbag Production Equipment

Multiple interviewees described the discovery and acquisition of the "spider". In 2009, without a request from the city, a husband and wife from Winnipeg, Manitoba demonstrated a new piece of technology that drastically improved sandbag production called the "spider". It consisted of a sand hopper, a feed drive, an auger, upper distribution point, and chutes. The sand travels from the hopper onto the feed drive which loads the sand into an auger which raises the sand to the upper distribution point and then down one of twelve chutes. The upper distribution point revolves and distributes an allotment of sand into each chute. Each chute receives enough sand from the central distribution point to fill

a sandbag. The machine's nickname derives from the chutes all coming down from a central point which is similar looking to a spider. After viewing the demonstration, the city immediately signed purchase agreements for the machine used in the demonstration and two additional spider machines. The spiders enhanced sandbag production by consistently producing quality sandbags and increasing output.

Spider Sand

The new technology was not without challenges. The Solid Waste Director described the challenge of using the correct type of sand in the spiders. In 2009, the spiders' chutes began to clog. He noted that even in 1997, with the use of the sand bins, there was an issue of bins clogging slowing down operations; however, the clogging situation was magnified given the high production rates of the spiders and it drastically slowed down production. He described the situation in the following way, "It just turned into a complete train wreck and that is why ultimately we moved away from some of the spiders and up to the dome (Fargodome)."

In addition, a safety issue occurred as a result of the clogging. A National Guard soldier, in an attempt to clear the clogged chutes, had his arm pinned in a spider machine. His arm was pinned at the revolving upper distribution point and blocked it from revolving. This caused the belt from the electric motor driving the rotation to begin to slip. The motor had to be shut down quickly so the soldier could remove his arm. This situation could have resulted in a severe injury.

Other interviewees also pointed out that the type of sand greatly affects the functionality of the spider. The Public Works Director explained the history of purchasing

and using sand. Before the city began to use the spider, they ordered the cheapest sand available. This sand was unwashed, or "pit run" sand, and was acceptable for sandbag production when it was shoveled into sandbags. The "pit run" sand has a component of clay in the mix. When used in the spider machines this clay component sticks to the auger and chutes, thus clogging them. When the machines became clogged and production slowed to a crawl in 2009, it was learned that sand without the clay component, or "washed sand", does not clog the spider. In subsequent floods washed sand was ordered for the spiders and clogging was no longer an issue.

Spider Feed Drive

The Solid Waste Director described another enhancement to the sandbag production process which was the spider feed drive. The spider feed drive is the mechanism that moves the sand into the spider. Initially the spider feed drive was a machine designed and used for maintaining sand traps at golf courses. However, the volume of the sand flowing to the spider was over the capacity of this machine and it rapidly wore out the sand trap machines. The next evolution of the feed drive was to use the sand dispensing mechanism on a snowplow truck. This mechanism was capable of handling the sand volume and was also had flexibility to control the sand flow rate to the spider by increasing the speed of the diesel motor on the truck. Although this feed drive method allowed for flexibility, it also created health concerns about the indoor air quality at Sandbag Central. With the diesel motor running indoors, it required significant efforts to control air quality.

The current refinement for the sand feed drive mechanism is a variable speed electric feed drive. This system allows the flexibility of increased and decreased sand flow

rates to the spider without air quality issues. The electric drive is powered by a large generator placed outside the building removing the threat of carbon monoxide poisoning.

Sandbag Storage

Multiple interviewees described how the weather effected sandbag placement in 2009. The weather turned cold as the flood crest approached, with lows neared zero degrees. The sandbags awaiting use froze solid in the outdoor storage. This created a problem because sandbags need to conform to the ground or the other sandbags around it to be effective. Without this conformity, the sandbags do not meld together to create a wall to hold back the water. This forced volunteers to hit or crush the frozen sandbags to break up the sand. This drastically slowed the sandbag deployment rate and consumed valuable human resources. From this experience city officials realized the need to protect sandbags from freezing temperatures. Sandbag logistics were modified to ensure the sandbags were not frozen when delivered.

The Enterprise Director stated the solution the city arrive at was storing ready to use sandbags in heated storage. As such, in preparation for the 2010 flood, storage areas were located and leased by the City of Fargo. However, in one case, there was another opportunity for process refinement. The Enterprise Director recalled the evaluating storage locations for sandbags. In a specific conversation with a building owner he asked, "Can we store sandbags in here? [regarding the physical stability and structure of the building]. The building owner replied "Yes. This will be fine." Fargo employees began loading the warehouse space with palletized sandbags the following Monday morning. He was at a city commission meeting and received a call from one of the employees loading the warehouse advising him that the floor had collapsed. While no one was injured, it created

a safety issue and a large repair bill. Moreover, a multiple year litigation process ensued to determine who was financially responsible. The process for determining sandbag storage now includes an engineer to certify the structure prior to equipment and sandbags being brought onsite.

Type III - National Guard

The Fargo Emergency Manager recounted that the city turned to the State of North Dakota for assistance in 2009. The National Guard was mobilized by the Governor to provide manpower. In particular, the National Guard assisted with dike patrol and traffic control. The National Guard performed very well and was much appreciated for these tasks. A comment stated in the 2009 flood review stated the twenty-four hour a day seven-day a week patrol of the dikes was a great service provided by the National Guard (Schlafmann, 2009). In addition, the National Guard provided manpower for traffic control, allowing availability of Police Department resources for other tasks.

A challenge occurred when the city began assigning quick response tasks to the National Guard. A Fire Department official discussed that a quick response from the National Guard in 2009 was getting the equipment rolling in twenty minutes. Comparatively, the Fire Department gets truck rolling within one minute. This difference in response time frustrated fire department staff. The challenge for the National Guard operations was that orders are only given to them by Command in Bismarck, North Dakota. This created response delays, which did not align with the rapid response expectations of the city. As a result these cultures clashed.

Another challenge, stated by the Fargo Emergency Manager, was working with the North Dakota Department of Emergency Services for the acquisition of HESCO barriers.

HESCO barriers, typically used for military operations, are large self-standing bags that are filled with sand for bullet protection for troops. However, in Fargo, the barriers were used for emergency flood protection. HESCO's were seen as a fast and effective method for flood protection. The challenge arose when the Fargo Emergency Manager requested as many HESCO barriers as possible from the State. The acquisition process was new for both Fargo and the State.

From available inventory information the Fargo Emergency Manager explained that he knew the State had 4,000 linear feet of HESCO barriers. The Mayor, City Administrator, and Engineering had requested all 4,000 feet. The Fargo Emergency Manager put in the request to the State, and received a reply that the City of Fargo could only get half of the requested barriers. There was reluctance to release all the barriers in case someone else needed some. The Fargo Emergency Manager replied:

> I understand. I just want you to understand that I am putting in the request for 4,000. You can deny it. It is documented that you are going to deny it. So if we get wet, you can justify why you are sitting on it. And I still need 4,000 feet.

After hearing the Fargo Emergency Manager's reply the State accepted the requisition in less than 30 seconds. According to the Fargo Emergency Manager, the State Director for the Department of Emergency Services replied "You guys just keep asking and asking and asking [for materials and equipment]. You guys are going to have to pony up." About 20 minutes later, the Mayor called the Fargo Emergency Manager and requested a million dollars more of HESCO barriers. The Fargo Emergency Manager knew the State did not have the requested barriers, but he still put in the request. He recalled the situation as follows:

> I gave 35 thousand feet, or whatever, it was a huge number of 4-foot HESCOs and that really got them drooling down there. I mean just slobbering because they didn't know what to do. Because they figured, how are we going to provide this to the City of Fargo and they said you guys have to pony up. We cannot afford to buy this, number of feet of HESCO. I said, how much is it and when can you get it to me? Then they called back and said okay, we found it. It is in Louisiana. It was like $775,000 dollars and they want money before it will be shipped. I said I'll get right back to you.

The Fargo Emergency Manager then called the Mayor and City Administrator and requested the funds. The Fargo Director of Finance worked out the details and the HESCO barriers were on the road within an hour. Within 24 hours the city had the barriers on the ground from Louisiana. The Fargo Emergency Manager continued "Those are some of the things that EOC resolved during the 2009 flood event, but overall it was said we had no concept of what we were doing."

After 2009, the challenges the city had working with the state were resolved through inter-event learning. After reviewing the entire process post-event, it was found that coordinating with the National Guard much earlier in the flood planning process would allow them to establish the proper procedures and orders prior to the actual flood event. This in turn allowed the National Guard to be much more flexible and responsive in future flood events.

Type III - Public Works Department

After 2009, the Public Works Director learned that they needed to refine their operations. He described several examples of processes that were assessed and improved.

One refinement was outsourcing some of the flood response tasks. In 2009, the Public Works Department over-allocated staff resources. To improve, they focused on their areas of expertise and delegated the remaining tasks to contractors. The Public Works Director used the phrase "it only cost us a little bit more for us to do it ourselves." Other examples were the water pump program, unloading of sandbags, material and resource tracking, yard damage, and shift length.

Portable Water Pump Program

In 2009, the Public Works Department created a portable water pump program. This program provided pumps to the public for pumping seepage water out from behind flood walls. The Public Works Department promoted the message that citizens that needed a pump should call the city and a pump would be brought to them. The Public Works Department distributed about 250 portable pumps. A problem emerged when the Public Works Department realized the public's expectation was that city workers would also fuel and maintain the pumps. Hence, additional manpower was required for maintenance and fueling for the overstretched Public Works staff. The pump program was beneficial to homeowners, but was a failure for the Public Works Department because the program added many staff hours.

In 2010, the Public Works Department refined the program to minimize staff involvement. The Public Works Director announced the city had pumps available, but homeowners had to pick them up. He described the pump checkout process as, "Here is your gas can. Good luck to you. If you have any questions or if it stops running and it's not gas-related, call us." The refinement to the program was effective because it delegated the majority of the labor, refueling the pumps, to the homeowner. This refinement also

provided clear expectations to home owners that they were responsible for the general operation of the pump.

Unloading Sandbags

The unloading of finished sandbags into neighborhoods was another challenge for the Public Works Department in 2009. The Public Works Director summed it up succinctly in saying, "It was a failure." He explained that it stemmed from a logistics problem of getting the proper equipment into the proper location to efficiently unload sandbag trailers. The logistics failures resulted in delays in other flood related operations. There just were not enough resources.

In 2010, the process was refined by establishing pre-event agreements with contractors for the task of unloading the sandbags. The Public Works Director described the program as contractors or "attack forces" that were assigned to specific areas of the city. They were responsible for the equipment and operators to quickly unload sandbag trucks. In addition, the contractor equipment was available for other tasks in the assigned location.

Materials and Resource Tracking

The Public Works Department also learned the need for tracking of incoming supplies and equipment, The Public Works Director described the situation in 2009 and the solutions implemented in 2010. In 2009, materials and equipment were being delivered and shipped from multiple locations. The EOC and the Public Works Department were both ordering supplies which created challenges with duplicate supply orders, multiple delivery locations, and being able to locate delivered supplies. The city was so overwhelmed it gathered equipment and hired as many contractors as possible.

The Solid Waste Director also stated that, in 2009, he called around town and asked every implement dealer if they had skid steers, loaders, trailers, anything that could brought to Sandbag Central.

Also in 2009, The Public Works Director described the lack of accountability regarding fuel usage. Heavy construction equipment was operating all over town building flood protection. City fuel trucks drove around filling fuel tanks for anyone who requested it. This process had minimal tracking and accountability.

In 2010, the EOC was the sole entity ordering supplies and established a central delivery area in a heated warehouse. The central warehouse allowed for all incoming and outgoing supplies to be documented. Supplies were tracked and efficiently distributed. Fuel usage and delivery was accounted for by established pre-event agreements with contractors. The private contractors all had identification badges which allowed the fuel trucks to account for all fuel deliveries. The identification badges also ensured the work locations were secured and controlled.

Yard Damage

Multiple interviewees described the challenge of damaging homeowners yards while creating flood protection. In 2009, skid steers were used to efficiently move sandbags from the street to homeowner's backyards, where the sandbag walls were typically built. The skid steers route was in-between homes; unfortunately, this destroyed lawns in the process. The tracks, ruts, and mud left by the skid steers created a significant cleanup and recovery cost. In the 2009 flood review, the idea of placing plywood on the skid steer routes between homes emerged (Schlafmann, 2009). In addition, also to minimize yard damage post-2009, the Public Works Department now only rents tracked

skid steers. These two changes were successfully mitigated yard damage in subsequent floods.

Shift Length

The Public Works Director described another lesson learned from 2009, which was managing the Public Works Department's shift length. In 2009, 18 hour shifts were routine. Operating heavy equipment for that duration of time was grueling, unsafe, and unproductive. A decision was made that 12 hour shifts were safer and more effective. This policy is still in place today for all emergency situations.

Mitigation

As multiple interviewees stated, Fargo's Red River flood mitigation efforts reduced the resources required for flood response (FEMA, 2015). This is an example of Fargo's organizational learning in mitigation. According to the City Engineer, the successful flood fight of 2009 was attributed to the mitigation projects completed as a result of learning from the 1997 flood. Specifically, referencing mitigation projects completed prior to the 2009 flood. She said "Without those, facing the 2009 flood, boy we would have been in a very different situation if we had not had those improvements in place." Mitigation elements learned from the 2009 flood event are funding, priorities, vulnerability, and technology.

Funding

According to multiple interviewees, removing flood prone homes is paramount. Buy-outs are mitigation projects that purchase and remove of flood prone homes. The City Planner stated that after the 1997 flood, the Federal Department of Housing and Urban Development was quick to provide five million dollars for buy-outs. Also he stated that

since 1997, the city has spent $183 million for mitigation, primarily through buy-outs. However, after the 2009 flood, a more significant flood than 1997, Federal funding was not available because of a weak national economy and the United States was at war. Multiple interviewees stated that it was recognized that a predictable source of funding for flood mitigation was needed.

The City Administrator explained the process of creating a predictable source of mitigation funding. In the shadow of the 2009 flood, a special public vote was scheduled to implement a ½ cent sales tax in both the City of Fargo and Cass County. The vote was successful and has been consistently collecting 23-27 million dollars annually. Since 2009 alone, the City of Fargo Engineering Department has spent over $100 million dollars on mitigation. The work completed since 2009 is comparable to 56 miles of flood protection. The mitigation projects have removed about 45% of the risk of flooding in the affected neighborhoods. The next $240 million spent on mitigation will remove approximately 98% of the risk of flooding in Fargo.

According to the City Floodplain Manager, for mitigation projects to be successful it is important for the Engineering Department to work well with the City Commission. He gave the example of presenting the five-year funding projections for flood mitigation to the City Commission. The Engineering Department developed a five-year plan for flood mitigation projects. Some of the projects were not fully defined, but the plan provided budgets and locations for the projects. The City Commission accepted the five-year plan which allowed the Engineering Department to focus on planning and implementation rather than funding.

The City Administrator described an ironic twist regarding mitigation funding. The twist is that some locally generated sales tax funds have been used to reimburse FEMA for buy-outs. When FEMA provides the funding for a buyout there is a stipulation that the land can never be used for any purpose. This created a conflict. In the City of Fargo, many buy-outs were intended to be transformed into permanent flood protection. So, to comply with the FEMA policy, Fargo was forced to reimburse FEMA for some buy-outs. This created the opportunity to build permanent flood protection on the land in the form of a levee or flood wall.

The Cass County Emergency Manager stated that buy-outs are the primary mitigation method outside of the city. He noted that, the Cass County does not have infrastructure, such as sewers and lift stations, to protect; but the county has been removing the flood prone neighborhoods along the river corridor. In Cass County, unlike Fargo, FEMA funding is acceptable because there are no mitigation projects to be built upon the purchased land.

Priorities

The Fargo Emergency Manager stated "2009 was the kick in the pants to really get started with mitigation." The Fargo Floodplain Manager stated that between 2009 and 2011 Fargo and Cass County jointly developed a Mitigation Plan. He continued the mitigation plan which establishes long-term priorities and direction for projects for all jurisdictions in Cass County. This plan was formally approved by the Fargo City Commission in 2012. According to the Floodplain Manager, mitigation projects post-2009 have been prioritized by their impact and construction duration. The easier projects have been completed and more difficult projects wait. This process has been heavily dependent

on buy-outs. Since 2009, 173 buy-outs have been completed. The mitigation program has strived to increase the level of protection throughout the city. According to the City Administrator, 300 homes purchased for flood mitigation purposes since 1997 have taken the City of Fargo from a normal flood protection level of 31 feet to their goal of 38 feet. However, 38 feet goal based on the 100 and 500 year flood levels designated by the Army Corps of Engineers. However, these levels have been increased.

The City Administer discussed the challenge of flood mitigation for the increased heights of 100 and 500 year floods. The flood levels were raised by 1.5 feet. Thus, the size of the floodplain increased dramatically. This resulted in the number of buyouts needed for flood mitigation increasing from approximately 400 to 2300. Fargo created a new comprehensive plan that incorporated mitigation projects to address the expanded floodplain. It included flood mitigation projects to achieve protection to the 39.5 feet flood level. However, this level of flood protection may rise again. According to the City Administrator the requirements for flood protection continue to increase:

> …mitigation is heading to 39.5 feet. With the diversion [a major flood mitigation project that creates a channel for flood water to go around the City of Fargo] that would put us at real protection to 44' the 500 year level…..well, it will be at 39.5 feet, it will be real protection to about 42 or 43 but it won't be certifiable. We need the diversion to certify this effort. Because FEMA has already said that within 5 years they are going to go from 39.5 to 41.1 and you need 3 feet freeboard [amount of protection beyond the elevation of the flood water] so that is 44.1. We can't get the 44 feet completely within the city because we don't have high enough ground to tie into. We would have to do a ring dike all the way around Fargo and West Fargo

> and that would cost about $2 billion. But we can get to the 44 feet with earth levees at 39.5 feet and the diversion. The diversion reduces the 100-year flood level to 35 feet. The water will flow through town; the rest of it will go around. If we have a 500-year event which is 41feet we would be protected. So we are planning to get certifiable at 44, that will be 39.5 feet and the diversion then we are good for the 500-year event too.

Although the numbers can be confusing, the point is the target for mitigation is increasing along with the requirements of continued mitigation efforts. For more information on the City of Fargo Comprehensive Plan please see Appendix E.

Multiple interviewees noted the prioritized mitigation projects have been successful. Conducting mitigation projects by elevation has resulted in a reduction of resources needed for response. The Floodplain Manager described the effects of the mitigation projects. Since 2009, Fargo has established 16 miles of permanent levee. This amount of permanent levee results in a reduction of four million sandbags for a similar flood to 2009. The benefits of the mitigation projects are sandbag numbers really coming down. The permanent protection levels are high enough that in some neighborhoods a response is not needed. The city only needs to monitor conditions in those areas. Fargo is seeing mitigation directly reduce the effort needed for response. Reiterating that point, the City Planner emphasized that the more homes you remove from the lower elevations the less you need to rely on sandbags.

The Public Works Director, comparing current flood protection to the 1997 flood level commented, “That was a significant flood for the day but that flood today would be kind of a walk in the park.” The Assistant Fire Chief stated, “Every year … we put more

and more permanent protection in place … it has lessened the number of sandbags we needed and that has been enormous." The Public Works Director described the completed permanent flood protection, "People don't even know a flood is going on when there is a 38 foot flood anymore…areas where we had 750 to 800 thousand sandbags, close to a million sandbags, now we need none."

Multiple interviewees stated the mitigation projects, including buy-outs, require a great deal of communication. In many cases, it involves removing entire neighborhoods. The Floodplain Manager described the importance of homeowner's involvement in mitigation projects. There is a lot of communication with the neighborhood residents. Engineering Department staff meet frequently with the residents to develop mitigation projects. Typically, an initial neighborhood meeting is held to present the project to residents. This meeting consists of discussing the project, project alternatives, and receiving feedback from the neighborhood. Afterwards, the Engineering Department staff incorporates the feedback and modifies project designs. After the modifications, they return to the neighborhoods and recommend the final project. Moreover, those who are directly impacted receive additional time with the Engineering Department to discuss project details and conduct project walkthroughs. These walkthroughs sometimes result in further refinement of the project. Once those refinements are complete, the intent is to have a mitigation project that the neighborhood residents can support. The refined mitigation project is then brought to the City Commission for approval. The Director of Engineering indicated that the Engineering Department staff know many landowners by name due to the number of meetings they have had together. He also stated, referring to the long process of flood mitigation projects, "I joked the other day that we do know all

these people. We can name the ones that live on the river. Hopefully we get this solved before I know their grandkids."

Other Areas of Vulnerability

Vulnerability can also come from response itself. The City Administrator stated the evacuation in 2009 and future evacuations have consequences. In 2009, the city evacuated 2,900 people from nursing homes. It took a great deal of time to find places for these evacuees in other nursing facilities across the state. A tragic consequence of this evacuation was an estimated 100 residents died due to the stress of relocation. The consequence of evacuation was included in the Army Corps of Engineering's justification for a Federal funding allocation for permanent flood protection. According to the City Administrator, the Army Corps of Engineers estimated that the community could lose 600 people in a 500-year flood event without permanent flood protection.

Fargo's vulnerabilities also include quick onset flooding or flash flooding. Multiple interviewees stated that a flash flood event was even more threatening than a large flood. The City Administrator described a storm in 2000 when the city received eight inches of rain in twelve hours. He stated, "There was flooding in 10,000 homes." He also described the efforts to mitigate flash flooding such as water retention ponds. Fargo policy states when there is a new development, any major development over an acre, there must be on-site water retention to minimize the impact of rapid rainfall or flash flooding. In 2000, there were eight or ten retention ponds and now there are about 70.

Technology

The Director of Engineering stated in 2008 there was another evolution of mitigation technology. Light detecting and ranging (LiDAR) increased the accuracy of

contour data. This technology uses pulsing lasers to measure precise distances. LiDAR has incredible accuracy. In 2008, it was found this data was accurate to plus or minus three inches. This highly accurate contour data was used for mapping during the flood response in 2009. Additionally, the Cass County Emergency Manager stated that the United States Air Force flew over the region during the 2009 flood and provided approximately 7,000 aerial photographs. These images provide definitive evidence of flood water extension at different river levels.

The Cass County Emergency Manager noted a sophisticated Geographical Information System (GIS) has been developed to allow county residents to learn the elevations of their home or property. From this elevation data, a web based mapping application was created to allow users to see the extent of flooding at their residence at different flood levels. For example, if a flood is expected to reach a river level of 38 feet they can type in "38" and it will show them specifically where the water will be on their property.

The Cass County Emergency Manager stated another piece of technology that can be used is drones. During more recent floods the county and city leadership have established relationships with the United States Border Patrol. This relationship opens the opportunity to use United States Border Patrol drones to fly over and photograph flood conditions. Such information will be helpful in understanding the extent of flood conditions.

Another type of mitigation technology is river simulation software. The Floodplain Manager discussed the use of Hydrologic Engineering Centers River Analysis System (HEC-RAS) software to analyze and predict river levels. The river water level is not

consistent throughout the city. The river flows north, dropping in elevation as it flows towards the Hudson Bay. However, bridges or various bends in the river will cause the river level to rise slightly. The software is able to analyze these subtle changes in river level. Based on this information HEC-RAS predicts how the water will interact with the surroundings. Simulations can be completed using potential emergency flood protection lines and analyzing the effects in other areas of the river. The repeated flood events have produced many actual data points that help to further refine the results and predictive ability. These cutting edge technologies can be used in the future in mitigation, preparedness, or response to a flood.

Major Red River Floods of 2010 and 2011

Multiple interviewees stated that the floods of 2010 and 2011, although reaching historical flood levels, did not create the response turmoil of the floods of 1997 and 2009. Learning from 2009, at the start of the 2010 flood, the Fargo Emergency Manager quickly clarified who was IC. He went directly to the City Administrator and asked "Who is the IC?" The City Administrator stated "I am". The lessons learned from the prior year were implemented. Hence, the interview data for the floods of 2010 and 2011 was not as plentiful.

The Mayor stated that although the 2010 flood was a major flood (nearly 40' feet) the city was so well-organized it became a non-event. The Floodplain Manager stated, in 2011, the NWS predicted another major flood that initiated flood planning as early as January. He recalled the focus on preparation along with recovering as much money as possible. In addition, the city was proactive on getting clay out on the ground earlier. He noted:

> We got more clay out on areas than we did previous years because we were able to have projects developed a little bit more. Vacant lot, let's go throw clay on it now. Don't even wait. Let's just do it. So then those projects turned into more permanent projects in 2011 after the flood.

The Floodplain Manager stated the planning, organizing, and sandbag production started early because of the potential for high flood levels. By 2011, the contractors had also learned from the multiple floods. For example, the Planning Director recalled:

> We were having one of the pre-meetings, maybe 2011, contractors were there and they were talking about building the dike out here [southern Fargo] and someone asked what the haul routes were going to be And he said, 'same as last time' and everyone knew.

In 2010 and 2011 Fargo had major floods. Approximately one million sandbags were used for the 2011 flood. However, according to the Floodplain Manager, mitigation projects, such as acquiring flood prone homes, alleviated the need for an estimated five million additional sandbags. From what was learned in 1997 and 2009, the floods of 2010 and 2011 became routine. The Fargo Emergency Manager stated, in 2010, the EOC ran so smooth that individuals in the EOC got bored.

The Fargo Emergency Manager described a situation in the EOC. As a result of the smooth operation of the EOC in 2010, at the onset of the 2011 flood the Fire Department assigned individuals to the EOC with less decision making ability. The higher ranking individuals were assigned to, what was thought of, as more complicated or challenging roles in the flood fight. However, as the flood progressed the Engineering and Police Departments took issue with the fact that the Fire Department did not have the personnel in

the EOC with enough authority to fulfill the EOC function. This was an intra-event learning moment from the 2011 flood. Proper Fire Department personnel were reassigned to the EOC for the remainder of the 2011 flood.

With the exception of retaining senior leadership in the EOC, none of the interviewees stated any major challenge or learning opportunity in 2010 or 2011. The issues identified for improvement were at a task level. Some examples of suggested improvements were: Can we just get an email to Firstlink? The EOC needs more dry-erase boards and 24/7 IT on-site support. And, the volunteer drop-off and pick-up sites need better signage. The feedback after the 2010 and 2011 floods was valuable, but all interviewees stated that by then, the overall process of flood management was routine.

CHAPTER SIX: SUMMARY AND CONCLUSIONS

The City of Fargo flood leadership team learned from the floods in 1997, 2009, 2010 and 2011. In particular, the data show that learning was especially significant in 1997 and 2009 and the knowledge was implemented in 2010 and 2011. In addition, due to the repeated floods, the city leaders implemented mitigation projects that directly reduced resources needed for flood response. Overall, the data for the floods of 1997 and 2009 was dense and rich. The data for the floods of 2010 and 2011 was less plentiful but revealed the organizational learning significantly improved the effectiveness of the flood operations.

A quote from the Cass County Emergency Manager provides a holistic view of the organizational learning which has occurred in the Red River Valley "It is almost like we have gone from the first grade all the way to graduate school. It has just been that dramatic." The Red River has a history of flooding along its path from South Dakota through Canada. However, the 1997 flood serves as a focusing event for flood response in Fargo. The city was fortunate to avoid the community destruction that occurred in Grand Forks, ND, just 75 miles north.

Many floods have occurred in the last 20 years in this region. The north flowing Red River has extended beyond its banks in the years of heavy precipitation, rapid melt, or both. The unique challenges associated with the river highlight the continued need for permanent flood protection.

The 1997 flood review stated that the flood fight was successful in part because of strong public communication, the ability of the city staff to make tough decisions (such as contingency dikes) and the decision-making processes of the city departments (Stensrud, 1999). The learning was not static. From 1997, 2009, 2010, and 2011 learning occurred

regarding many aspects of flooding. Fargo learned through single-loop and double-loop learning. As noted by the Fargo Emergency Manager, learning during a flood is preferred because it is quick and has immediate affects. However the data found that only single-loop learning was achieved during a flood. Double-loop learning was facilitated by flood reviews that provided an opportunity for a thorough process review.

This chapter begins with a discussion of the learning that occurred in the categories of coordination, communication, response organizations, and mitigation. The chapter concludes with discussion of the significance of the study and additional research recommendations.

Coordination

The data from the literature review was consistent with the repeated flood events in Fargo. All of the variables identified in the literature including: the use of ICS, EOC, the flood forecast, along with improved public coordination was identified in the data and contributed to the organizational learning. After 2009, and subsequent floods, the Fargo Emergency Manager facilitated learning by having flood reviews with each city department. These department discussions and subsequent flood reviews were intended to create a complete list of areas for improvement. Some questions driven by these reviews were: How do we track equipment? How do we incorporate maintenance? What is the maximum safe shift length? How do we communicate with the city employees and the general public? The Fargo Emergency Manager documented the feedback and incorporated it into the flood review. This document served as a guide to coordinate organizational learning and provide specific areas of improvement.

In 2009, the improvement of sandbag deliveries highlighted learning coordination as stated by the City Administrator:

> …we finally had to shut down University and 10th Street because we were running sandbags from the Dome to the southern end of town and those were the only locations [areas where sandbag protection was being built at that time]. The police and the Guard figured out how to do that and within about an hour [reduce the time it took to deliver a load of sandbags and return]…and then we had transports that had to be brought into the neighborhoods by squad car because there were so many cars from people coming to volunteer that we had just limited availability of streets to get into. Every time there was an issue, we figured out how to do it. And then the next time when we had to do something like that, 'Well, we did it this way and it worked so we are going to do that again.'

The evolution of flood planning benefited from the coordination established by using the Incident Management System (ICS) and Emergency Operations Center (EOC). These established Emergency Management systems did not require double-loop learning but simply required adoption by all city departments. Another example of coordination was aligning their resource acquisition and tracking processes with the established FEMA requirements for reimbursement. These established systems did not require extensive resource investment for redesigning processes, just simply adoption and incorporation.

The Public Works Director recalled when Fargo's flood leadership team was asked to assist the 2011 flood fight in Bismarck, North Dakota, because Bismarck's leadership did not have experience with coordination. This was Bismarck's focusing event for

flooding in their region. He reflected on traveling to Bismarck to assist with flood response:

> We took two spider machines up there and I sold them 3 million sandbags, a heck of a lot of HESCOs, trap bags. We opened up our war chest and said whatever you want is for sale. They were like we were in 2009, running around with their heads cut off. They didn't know where to start so we came in and we brought some techniques that we had learned.

That experience provided immediate feedback to the Fargo leadership of the organizational learning that had occurred in Fargo.

The organizational learning in coordination can be illustrated with the refinement of operational methods. The Floodplain Manager identified several refinements learned for flood protection including quality, resource management, and safety. One example was that using clay is better flood protection than sandbags because it is more effective, requires less labor, and is safer to construct. He stated:

> The number one goal for emergency flood protection is really to try and use clay as many places as we possibly can … clay is a lot more reliable than sand. The clay levee doesn't have the seepage of sandbags and is much less labor intensive to put in place. In addition there is a safety issue. This is to minimize the use of high school students' right alongside rivers that are flowing very high and at a fast rate.

Multiple interviewees noted learning in coordination included: the value of expanding the leadership team, delegating, and starting early. The learning occurred in single-loop or double-loop processes. Single-loop is the refinement of an existing process

while double-loop is redesigning a process to find a better path to the solution. Some major learning examples include:

Single-loop

- After 1997, 2009, and 2010, Fargo learned that shifting the flood planning process to earlier in the calendar year allowed more time for preparation, to include additional time for clay levee construction.
- After 2009, Fargo officials learned how to leverage State resources for the flood response (i.e., National Guard).
- After 2009, Fargo officials incorporated city-wide adoption of the Incident Command System (ICS). During the 2009, flood some departments were still not convinced ICS was needed.
- After 2009, the City of Fargo adopted the Emergency Operations Center (EOC) organizational format. During the 2009, flood some departments were still not convinced the EOC system was needed.
- After 1997 and 2009, Fargo officials learned to delegate responsibilities (i.e. Solid Waste Department is responsible for sandbag production and the Planning Department is responsible for volunteer coordination) to fulfill the many tasks needed in a flood response.

Double-loop

- After 2009, Fargo officials learned the importance of developing and using Community Organizations Active in a Disaster (COAD) for response support during the flood event.

- After 2009, Fargo officials allocated all available city resources for flood response and maximized effectiveness by assigning tasks to city employees based on personality characteristics.
- After 2009, Fargo officials improved internal acquisition and tracking processes for resources and materials, aligning them with the FEMA reimbursement process.
- After 2009, Fargo officials revised and improved the processes for unloading sandbags in neighborhoods, which included minimizing property damage to homeowner's yards.

Significant learning occurred from the experience of multiple floods in Fargo. As coordination improved, resources effectiveness also improved (i.e. National Guard and COAD). Moreover, the implementation and adoption of organizational systems such as Incident Command System (ICS) and Emergency Operations Center (EOC) also added in coordination. The single-loop learning was generally used for adoption and implementation of established organizational systems while the double-loop learning involved situations that were unique to the Fargo events.

Communications

The data revealed that communications appear to follow a progression from effective communication within the leadership, to the public, and ultimately with effective communication with all staff. Some factors that affected Fargo's communication were the magnitude, scope, and complexity of the flood events. With increased magnitude, scope, and complexity of the flood event the challenges of communication also progressed.

The first phase of the procession of communication is "leadership." In this phase communication is well established within leadership for flood conditions and operations. In Fargo, the leadership team in 1997 and 2009 was overwhelmed. In 1997, the leadership team was a small. In 2009, the leadership team expanded to enhance coordination and refined the process for communications with the public.

The second phase of the communication progression is effective public communication. After 1997, it was understood by the Mayor that more communication was required with the public. In 2009, a lack of communication contributed to the formation of Type IV response organizations (i.e., emergent groups). Also in 2009, improvements were made in public communication by increasing the frequency of news conferences, televising live daily flood meetings, and the creation of interactive web maps. Overall, Fargo's public communication progressed and now provides information via multiple communication mediums. In 2009, Fargo may have found the boundary of effective operational communication as it was stated in the 2009 flood review that there were too many meetings (Schlafmann, 2009). The Engineering Department emphasized that two meetings per day, communicating updates and changes, were sufficient and any additional meeting were counterproductive.

The third phase of the progression is effective operational communication with staff in the field. In 2009, city staff in the field reported finding out general flood information, such as on flood conditions or crest updates from the public (Schlafmann, 2009). A staff member in the field assigned to a specialized area, were not privy to general flood information. The public looked to city staff for information. In many cases, the public had

more updated information than the city staff. This challenge in communication on a staff level can also be seen as a positive outcome as the public is well informed.

Overall Fargo officials experienced organizational learning in communication through repeated flood events. Some examples:

Double-loop

- After 1997 and 2009, Fargo improved the public communications processes to provide more accurate information to the public.
- After 2009, Fargo improved the operational communications processes to provide continual contact with persons at specific locations during the flood.

Figure 6 presents a visualization of the progression in communication.

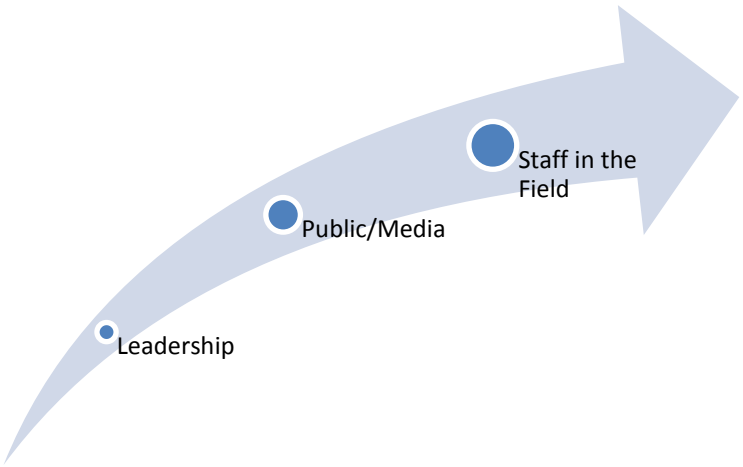

Figure 6. Communication Progression

Response Organizations

The response organization typology enhances the ability to analyze the knowledge gained from the repeated floods. However, an amendment to the regular and non-regular descriptors established by Quarantelli and Dynes (1977) is suggested.

Rather than using the regular or non-regular descriptors, it is suggested that the organization either maintain its pre-event primary function or does not. For example, the Fargo Fire Department responded to breaches in emergency flood protection during each of the recent major floods in Fargo. This requires unique or non-regular tasks associated with the flood. Based on this definition, the Fire Department would be a Type III response organization. However, Fire and Police are identified by Quarantelli and Dynes (1977) as a Type I response organization. Substituting "pre-event primary function" for "regular" and "altering pre-event primary function" for "non-regular tasks" the typology is a better representation of Quarantelli and Dynes (1977) intent of allowing "comparative and systematic research."

Each of the different response organization types are identified in different activities along with the learning method. The knowledge gained was retained through policy and procedural revisions or structural learning.

Type I – Fire and Police Departments

The Type I response organizations in the flood response were the Fire and Police Departments. The primary function of these organizations did not alter due to the flood. The Fire Department still responded to fire and medical emergencies and the Police Department still maintained law and order. However, the floods were significant

disruptions in the community and each organization assisted in operations. Some examples are:

- During the 2009 flood, the Fire Department was deployed to assist in sandbag wall placement and quality.
- During the 2009 flood, the Fire Department was deployed to assist engineers with incident command.
- During the 2009 flood, the Police Department used lights and sirens to escort convoys of sandbags from the production area to the areas being protected.

The Type I organizations did have increased responsibilities during the repeated floods.

Type II – COAD

There was not an abundance of data gathered on Type II organizations. The primary organizations were the Salvation Army and Red Cross. However, the leadership team learned after 2009 the assistance that the COAD can deliver in the flood response. The COAD established its significant value in flood events.

Type III

The groups associated with Type III response organizations are the Engineering, Public Works, Solid Waste and Planning Departments as well as the Flood Leadership team and the National Guard. With the exception of the flood leadership team, which began as a Type IV organization in 1997, the organizations have been consistent.

The Engineering Department was regularly tasked with infrastructure projects of all kinds. However, during the flood the team extended to non-regular tasks such as working

with the Army Corps of Engineers and locating and managing emergency flood protection including clay and sandbag protection.

The Public Works Department also extended beyond its normal tasks. In its daily operations, the Public Works Department was responsible for many activities such as street maintenance, forestry, water mains, and maintenance of the city's fleet of equipment. The department extended its capabilities by coordinating with outside contractors for neighborhood sandbag unloading, sandbag delivery, and additional flood related tasks.

Type III – Solid Waste Department

Sandbagging efforts have been greatly improved due to experience from multiple flood events. At the onset of the 1997 flood fight, the sandbag production was done by neighborhood. When the sandbag process became centralized, the procedural improvements increased quickly. Adding spiders in 2009, and continued refinements in operations resulted in rapid, predictable, and repeatable sandbag production. Some examples of learning are:

Single-loop

- During 1997, the initial system integration of the Engineering, Solid Waste, and Public Works Departments for sandbag production and placement.
- During 2009, incorporating the spider machine for sandbag production.
- During 2009, recognizing, reacting, and creating a solution for frozen sandbags.
- After 2009, the production of sandbags was refined with the spider machine. One area of repeated learning was the feed drive. Initially, the feed drive was a machine designed for maintenance of golf sand traps. The feed drive

was then fed by dump trucks and finally an electric feed drive. Another refinement to the spider technology was learning how the different types of sand affected the machine performance. The change of "unwashed sand" to "washed sand" eliminating the chute clogging.

Double-loop

- After 2009, refinement of the Integrated Priority System. This system now determines how many sandbags need to be created, where they need to be placed, and how to coordinate volunteers to complete the sandbag walls.
- After 2009, Fargo officials improved the process of delivery of sandbags to neighborhoods which ensured that appropriate locations were receiving sandbags at the appropriate time.

Type III – Planning Department

Volunteer coordination has improved from the experience of multiple floods. In 1997, volunteer variables included the number of volunteers and the duration of their service. Through organization learning Fargo has minimized those variables. The volunteering efforts are now predictable and sustainable. Examples of double-loop learning include:

- After 2009, volunteer variability was reduced by incorporating students into the process, thus creating a robust supply of volunteers.
- After 2009, Fargo officials recognized the need for volunteer registration and implemented a process of gathering volunteer data.

The Type III response organizations, the Planning and Solid Waste Departments, shared the same steady improvement. In 1997, the organizations merely reacted to the response

conditions. They did not initially recognize the variables that affected their operations. In the second stage, the response organizations identified the variables that impacted the operation (i.e. number of volunteers, duration of work shift, and location of volunteers) and systematically reduced variability. The final stage of progression was realized by the ability to control the variables that affected operations (i.e. scheduling with the schools a predictable number of volunteers and defined shift length). Reliable and predictable methods allow for consistent performance. Figure 8 presents a visualization of the progression of Type III Response Organizations.

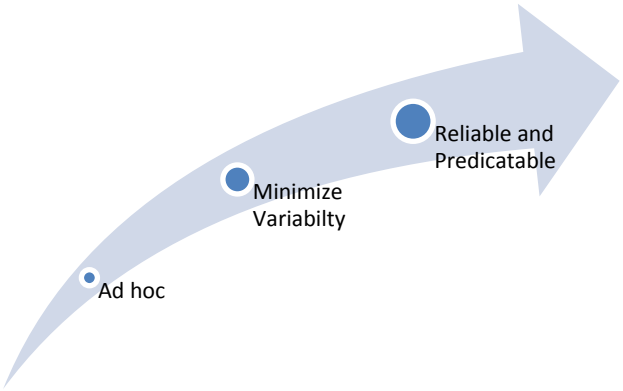

Figure 7. Progression of Type III Response Organizations - Extending

The current flood leadership team is a group of administrative leaders including the city administrator, city department heads, and elected officials. Again, this response organization was permanently established after the 1997 flood and performs tasks outside their normal day-to-day duties. The National Guard is also an established response organization that extends beyond its normal military operations during a flood

Type IV

The presence of Type IV response organizations, an emergent group performing non-regular tasks, has been identified with high magnitude events (Quarantelli & Dynes,

1977). In 1997, the flood leadership team and the neighborhood sandbag groups emerged to satisfy a need. Through organizational learning, the flood response needs were identified minimizing Type IV organization in subsequent floods. This was achieved through enhancement in coordination and communication. Table 8 was created to provide a snapshot of response organizations and groups, the tasks associated with them, and the flood year in which they engaged.

Table 8

Response Organizations by Type and Year

Organizational Typology	1997	2009	2010	2011
Type I – Established Regular/Established	Fire Police	Fire Police	Fire Police	Fire Police
Type II – Expanding Regular/Emergent		COAD *Volunteer Organizations*	COAD *Volunteer Organizations*	COAD *Volunteer Organizations*
Type III – Extending Non-regular/Established	Planning - *Vol. Cord.* Volunteer Organizations Solid Waste - *Sandbag Operations* Engineering Public Works National Guard	Solid Waste - *Sandbag Operations* Planning - *Vol. Cord.* Engineering Public Works Flood Leadership National Guard	Solid Waste - *Sandbag Operations* Planning - *Vol. Cord* Engineering Public Works Flood Leadership National Guard	Solid Waste - *Sandbag Operations* Planning - *Vol. Cord.* Engineering Public Works Flood Leadership National Guard
Type IV – Emergent Non-regular/Emergent	Flood Leadership Neighborhood Sandbag groups			

Mitigation

The literature on flood mitigation identified opportunities for programs such as restricted land use, LiDAR, buy-outs, and permanent flood protection. These opportunities were present in this study's data. Multiple interviewees stated that mitigation efforts are critical. The Engineering Department has remained vigilant in its focus on flood mitigation. The need for long-term funding was identified (Stokkom & Witte, 2008). The

City of Fargo and Cass County now accrue funding for mitigation through a city and county sales tax. By leveraging technology, the Engineering Department identified priority areas for mitigation projects. This study's data highlighted that completed mitigation projects have reduced flood vulnerability. Some examples of double-loop learning are:

- After 1997, Fargo officials learned the importance of technology (i.e. LiDAR) in mitigation and response efforts.
- After 2009, Fargo officials learned the value in different mitigation priorities and the need for local control of mitigation funding.

Organizational Learning

The process of organizational learning that occurred within the Fargo leadership team aligned with the literature which includes: an experience, reflection, learning, and implementation of the knowledge. The experience was the flood events. The reflection included the process of flood reviews. The learning occurred through revisions to processes and procedures. Last, the revised processes and procedures were implemented for the next flood event.

The data gathered identified that both cultural and structural organizational learning occurred. The vast majority of the learning was structural. Structural learning occurs when following a predetermined format to guide the learning process (Fiol & Lyles, 1985). This was demonstrated by the Fargo leadership team learning from the flood reviews to improve the standard operating procedures. Fargo leadership retains this knowledge through documentation.

Although the majority of organizational learning was through structural methods such as the flood reviews, cultural learning was stated. The "culture of preparedness" was

identified by multiple interviewees. Cultural learning is instilling the values and vision of the organization to assist decision making (Fiol & Lyles, 1985). A cultural learning example, improvisation, was identified in the data. Improvisation is adapting standard procedures to achieve a goal while not deviating from the cultural vision or values (Bigley and Roberts, 2001). Improvisation was evident when interacting with the highly structured organizational culture of the National Guard. This 2009 challenge was improved prior to the flood of 2010 by leadership clarifying organizational roles for the flood fight.

Single-loop and double-loop learning events occurred as a result of the repeated floods. The vast majority of the learning occurred between floods events. However, in some cases (i.e. reacting to frozen sandbags and receiving a spider machine) learning occurred during the flood. Multiple interviewees stated that the Fargo leadership was diligent on capturing and retaining the experiential knowledge gained from the flooding events.

The Fargo Emergency Manager stated "we have come a long way in a short amount of time. We have been fortunate to be very successful. Even as chaotic as I make 2009 sound, we were very successful in protection." Multiple interviewees stated that trust of leadership, developed from pre-existing relationships, enhanced their ability to focus on their tasks.

Fargo's organizational leadership included variables that promoted learning. The data shows that leadership received accurate feedback in flood meetings, was receptive to feedback, and adjusted plans as needed. The flood reviews and updated internal documentation were evidence that city policy adapted, increasing the depth of knowledge. Hence, leadership variables present that promoted learning were:

- Accurate feedback to leadership;
- Leadership receptive to feedback;
- Organized policy;
- Experience;
- Pre-existing relationships between leaders.

The data gathered did not evidence organizational leadership variables that constrained learning. There was no data that included ambiguous feedback or unclear policy feedback. Also, no interview data identified a politically charged environment. The leadership variables that constrain learning but that were not present in this study are:

- Ambiguous feedback;
- Politically charged environment;
- Unclear policy;
- Lack of experience;
- Lack of pre-existing relationships.

The organizational learning that occurred from multiple flood events in Fargo aligned with the literature on the organizational learning process, structural and cultural learning, single-loop and double-loop learning, and leadership variables that promote or constrain learning. Fargo was fortunate to have leadership that focused on continuous improvement in flood fighting. The knowledge gained from the repeated floods has been incorporated into the operating procedures of the city.

Significance of Study

This study gathered data on Fargo's official's adaptations to flooding as a result of several major floods over the past twenty years. The Cass County Emergency Manager described successful flood responses as an "incredibly complex system of interrelated parts." For this time period the leadership in the City of Fargo has been relatively stable. This situation presented a unique opportunity to gather data from those who were directly evolved in flood management and find out what was learned. The data demonstrated organizational learning.

The research from this study adds to the body of knowledge in Emergency Management. The direct impact of mitigation projects to reduce response resources are well-documented within the data. Also, how organizational learning progresses from multiple events is transferable. This information refines the knowledge of preparedness, response, and mitigation and provides guidance to other jurisdictions that experience seasonal river flooding.

Limitations

The repeated spring floods in the City of Fargo provided a unique opportunity for research. This study evaluated data regarding flood management from as far back as 1997. Respondent memory of previous events is a methodological challenge that must be acknowledged. A limitation of in-depth interviews is the individual's ability to remember behavior and observations from up to eighteen years ago. For example, the Solid Waste Director stated "the floods all kind of run together." Specifically, in one case, the year the Fargodome was used for sandbag creation was mistaken by an interviewee. Cross-referencing of interviewee transcriptions, post-incident review documents, and follow-up

questions were used to address any inconsistencies.

Suggestions for Future Research

This study has identified many additional areas for future research. For example, how much do training and exercise advance through the improvement stages for communications or Type II response organizations? How does the learning curve factor into repeated events?

There appears to be knowledge patterns with coordination and communication that would be relevant in many hazard events. Each category presents an opportunity for an effectiveness rating. For example, a one to five rating could be applied to each of the different categories. If communication was well established within leadership, media, and staff it would result in a high score as opposed to an organization in which communication is not effective. The same rating scale could be used for Type II response organizations. The result could be a quantitative measure of how well an organization or community is prepared for a hazard event.

Research on the factors that contributed to volunteerism in the Fargo flood fights may also provide a rich ground for study. The topic of flood fatigue was raised on two occasions in this study warrants additional investigation. The specific leadership characteristics of the city leaders who were able to achieve a productive connection between all departments and minimize friction between inter-department and public relations could be further evaluated. Also, future research topics could compare the Fargo flood events to others around the country or world. Further, does the dynamics of organizational learning differ based on the speed of hazard event onset?

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APPENDIX A: INTERVIEW QUESTIONS

Consent – Read to interviewee (while recording)

My name is Steve Thompson, a doctoral student in NDSU's Emergency Management program, and conducting research for my dissertation. I would like interview you to gather data on the evolution of City of Fargo's flood practices. If you participate in this interview I will ask series of questions about your role, activities, and procedures and practices learned during the multiple floods. The interview will take approximately 50 minutes. I would like to remind you that participation in this research is voluntary. You can choose to stop participation at any time. The information collected will be reviewed for correlation with current response research. It will only be used for the purposes of research and available if you would like a copy. If you have any concerns about the interview process or the research in general, please feel free to contact my advisor, Dr. Dan Klenow @ Daniel.Klenow@ndsu.edu

Is it acceptable to interview you?

- If yes, the interview continues to introduction

Introduction

We are researching how the multiple floods – 1997, 2009, 2010, and 2011 – affected the mitigation, preparedness, and response from the City of Fargo. We are organizing the research by changes after each significant flood from the respect of mitigation, preparedness and response. For example of preparedness, in 1997 it was learned that we needed additional support from private contractors for clay procurement. Hence, as preparation for the next flood, agreements were set-up with private contractors for their

support. An example of mitigation, during the 2009 flood several areas of vulnerability were identified that would be prime candidates for buy-outs or permanent dikes. In turn, how did these reductions of vulnerability affect the flood response? These are some potential examples of the information we are researching along what the catalyst for the change, how the change was made, and how the change was communicated and learned by the group. Does this make sense? If so, we can begin with some background questions.

Initial questions

1. How long have you been involved with the City of Fargo?
2. How long have you been directly involved in activities to flood management?
3. Were you present and active in the 1997, 2009, 2010, 2011 flood activities?
4. Starting with the first flood experienced with - When it was determined there was going to be a flood, what happened?
    - Probe into timing and activities
5. What was your position?
6. Which phase of flood management would you consider your role associated with preparedness, mitigation, and/or response
7. What were/are you primary responsibilities for these phases?

Intermediate questions

8. What changes (within phase of involvement) were you part of during or between the multiple events?
9. What was the catalyst for the revisions?
10. How was the changes identified?
11. How was the procedures/plan changed?

12. How were these changes communicated and learned by the team?
13. How did the mitigation efforts between the floods affect the preparedness and response?
14. What went well in preparedness and response?
15. What were some challenges?
16. Are there primary planning or reference documents that guide the mitigation, preparedness and response?
17. Is this the same document used throughout the duration of your tenure? If not, were there other documents or were these documents refined?
18. What was the working conditions/environment during the flood? (pull-in emotional conditions to assist with recall of events)
19. How was communication and change handled within your team?
    - Probing – use of ICS?
20. How was communication and direction handled by your supervisor? – (ICS structure)
    - Probing – were you involved in the decision making process? - Consultative- authoritative?

<u>Finishing questions</u>

21. What training did you receive to prepare you for this response?
    1. Probing – what were the topics, examples?
22. Did you have any exercises/drills/tabletops that were beneficial to your role in the response?
23. Who led the training and who drove the need for training?

24. Do you have any additional comments or memories of the flood mitigation, preparedness or response that you would like to share or remember?
25. Is there anyone else in your team that it would be beneficial to interview? (Snowball)
26. May I correspond with you again if needed?

APPENDIX B: IRB APPROVAL LETTER

NDSU NORTH DAKOTA STATE UNIVERSITY

January 13, 2015

Daniel J. Klenow
Emergency Management

Re: IRB Certification of Exempt Human Subjects Research:
Protocol #HS15136 , "Lessons Learned for Red River Flooding in Cass County"

Co-investigator(s) and research team: Steven Thompson

Certification Date: 1/13/15 Expiration Date: 1/15/18
Study site(s): varied
Sponsor: n/a

The above referenced human subjects research project has been certified as exempt (category # 3) in accordance with federal regulations (Code of Federal Regulations, Title 45, Part 46, Protection of Human Subjects). This determination is based on the original protocol submission (received 1/12/15).

Please also note the following:
☐ If you wish to continue the research after the expiration, submit a request for recertification several weeks prior to the expiration.
☐ The study must be conducted as described in the approved protocol. Changes to this protocol must be approved prior to initiating, unless the changes are necessary to eliminate an immediate hazard to subjects.
☐ Notify the IRB promptly of any adverse events, complaints, or unanticipated problems involving risks to subjects or others related to this project.
☐ Report any significant new findings that may affect the risks and benefits to the participants and the IRB.

Research records may be subject to a random or directed audit at any time to verify compliance with IRB standard operating procedures.

Thank you for your cooperation with NDSU IRB procedures. Best wishes for a successful study.
Sincerely,
Kristy Shirley Digitally signed by Kristy Shirley DN: cn=Kristy Shirley, o=NDSU, ou=SPA, email=kristy.shirley@ndsu.edu, c=US Date: 2015.01.13 11:10:16 -06'00'

Kristy Shirley, CIP, Research Compliance Administrator

For more information regarding IRB Office submissions and guidelines, please consult www.ndsu.edu/irb. This Institution has an approved FederalWide Assurance with the Department of Health and Human Services: FWA00002439.

INSTITUTIONAL REVIEW BOARD
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