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A Survey of the Structural Determinants of Local Emergency Planning Committee Compliance and Proactivity;Towards an Applied Theory of Precaution in Emergency Management

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A SURVEY OF THE STRUCTURAL DETERMINANTS OF LOCAL EMERGENCY PLANNING COMMITTEE COMPLIANCE AND PROACTIVITY: TOWARDS AN APPLIED THEORY OF PRECAUTION IN EMERGENCY MANAGEMENT

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DEDICATION

This dissertation is dedicated to my loving family, without whom this milestone would not have been achieved. Thanks to Deborah and Les Richards, who gave encouragement and support as only parents can. Most of all, this is dedicated to Eric, Ethan, and Elliot Matheny, who give meaning to my work and my life.

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ABSTRACT

Millions of factories, chemical facilities, and highways store or convey extremely hazardous substances (EHS) in proximity to populated residential and commercial areas. The proliferation of hazardous chemicals in manufacturing has led to thousands of facilities that store and utilize them throughout the United States. There is inherent risk to neighborhoods and populated areas located near facilities that use and store hazardous chemicals. Local Emergency Planning Committees (LEPCs) were created in 1987 as stakeholder based, primarily volunteer organizations that address hazardous chemical accident mitigation. In addition, LEPCs were mandated with the intent of engaging communities in the debate about hazardous materials. Public safety has also increased in salience in the United States in particular since the terrorist attacks of September 11, 2001 and the 2005 Hurricane Katrina devastation in New Orleans. More recently, the earthquakes in Argentina, Chile, New Zealand, and most notably Japan have refocused efforts worldwide on examining policies and practices surrounding disaster management and response.

This dissertation is an examination of compliance and proactivity in LEPCs and how use of limited resources influences these factors. A convenient sample of LEPCs in Ohio was surveyed to gather data for this causally probative study. LEPCs that are more

compliant and proactive were expected to be in counties with larger, more urban populations that have more accident experience, and are expected to be in line with disaster management strategies that emphasize public involvement. The results of this study show a positive correlation between number of extremely hazardous substance facilities in a county and the compliance of that county's LEPC. Other findings include limited emphasis on provision of information to the public. Emergency planning resources have been stretched further and further, with additional responsibilities of homeland security in addition to chemical safety tasks, and little to no additional funding. The researcher proposes LEPCs look more towards collaboration as a means of ensuring community security within their limited capacity. Collaboration has been noted amongst emergency planning agencies between LEPCs and County Emergency Management Agencies (EMAs), often in the form of shared staff or resources. Collaboration can lead to greater success for all involved parties. Future research also needs to be completed to re-conceptualize the idea of LEPC "proactivity" to better capture the diversity of LEPC activities that may fall under this umbrella. In particular, emphasis on precautionary or mitigation activities may be a better use of emergency managers' limited resources. One of the most significant weaknesses of the current approach, in light of the original intent of LEPCs as stakeholder-inclusive entities, is access to information. As hazardous chemical information access has become more limited and restrictive, collaboration between involved parties and the public is also therefore limited. This may call for more proactive, creative solutions on the part of regulated industry to ensure emergency plans contain complete hazard information with proper security protocols maintained.

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CHAPTER I

INTRODUCTION

> "Across the country, more than 15,000 facilities report to the U.S. Environmental Protection Agency that they use large amounts of extremely hazardous chemicals. The law requires these facilities to disclose potential chemical accidents, from the most-likely emergencies to a worst-case scenario. Despite reporting large vulnerability zones and populations at risk, few chemical-using plants have announced measurable goals or timelines to reduce the size of the area at risk from a potential worst-case chemical fire or spill."
>
> --The Working Group on Community Right to Know (2004)

Background

In the United States, and throughout the developed world, millions of factories, chemical facilities, and transportation highways store or convey extremely hazardous substances (EHS). These substances can be found in proximity to heavily populated residential and commercial areas either at storage facilities or via transportation routes. Areas where we live, work, and our children go to school are within a stones throw of "threshold" quantities of EHS, yet we are generally unaware or unconcerned with just how close we are to these known chemical hazards (Kay County Local Emergency Planning Committee 2010). The threat of these hazards is real, and the potential for disaster is a serious matter. Public health and safety has become an issue of importance as the complexities and complications of the global community become better understood.

Public safety has also increased in salience in the United States in particular since the terrorist attacks of September 11, 2001 and the 2005 Hurricane Katrina devastation in New Orleans. More recently, the earthquakes in Argentina, Chile, New Zealand, and most notably Japan have refocused efforts worldwide on examining policies and practices surrounding disaster management and response. In addition, providing long-term, sustainable solutions rather than short-term fixes is an important consideration as society creates and manages problems with long-ranging consequences.

As a response to these disasters, the Federal government has implemented measures to attempt to ensure continued public safety including a mandate for the development of local disaster planning. Local Emergency Planning Committees (LEPCs) were created in 1987 to address disasters involving extremely hazardous chemicals (EHS) at a local level, using local knowledge. By some, the development of LEPCs are another government attempt to "shift and shaft" an unfunded mandate on already over-taxed localities (O'Leary, 1995). Much of the work done by LEPCs is completed on an unpaid, voluntary basis. Committees have either no or extremely limited funding. For others, this novel approach to disaster planning is seen as a positive way to involve stakeholders and inform the public of hazards in "their backyard". The informed public, in turn, are theoretically to respond by demanding change from their local legislators, resulting in a bottom-up sort of regulation. In order for this stakeholder-based system of disaster management to function as intended, informing and educating the public is a critical step. Without information and access, the public is unable to address accident/ exposure risk within their community.

Information is to be made accessible to the public by LEPCs in several ways. Information is primarily made public through the provision of Material Safety Data Sheets (MSDS), detailing quantities and specific hazards of EHS stored and used at nearby facilities. Secondly, publicly announced meetings are to be held to discuss hazards and disaster planning and management. These forums are intended to provide transparency and public inclusion in disaster planning.

To place the development of LEPCs within the historical context of the American environmental movement, the researcher will provide a brief historical overview. The environmental movement of the 1970's led to far-reaching and historic changes in American environmental policy. This spanned from the creation of the USEPA and the first Earth Day in 1970 to the development of water, air, and land pollution legislation over the next few decades that required industry to change how they do business and work to clean up past mistakes. Companies that did not meet newly set environmental quality standards were fined or otherwise penalized. This "command and control" style policy resulted in sweeping reductions in human health hazards (such as lead in gasoline) and environmental pollution (such as new heavy metal pollution entering rivers and streams). The political and economic policy of the 1980's that followed, under then-President Reagan, was less favorable towards environmental regulation and represented a political swing towards the reduction of the regulatory burden on corporations overall.

The environment was stuck between a figurative "rock and a hard place"; between those who felt that regulation wasn't doing enough and environmental clean-up efforts were too slow, and those who felt that too much time and money was being spent on what was considered as needless environmental regulation. The demands of big business

clashed with efforts to clean up the toxic environmental legacy of the industrial revolution and further development. LEPCs were created during this tumultuous time in U.S. environmental policy.

In 1987, Local Emergency Planning Committees (LEPCs) were created as a step towards addressing recognized chemical hazards in a democratic, collaborative fashion. LEPCs bring together local stakeholders and representative parties to develop decision-making and planning processes for managing and responding to catastrophic emergencies. LEPC members represent stakeholders and community members such as firefighters, hospital personnel and environmentalists (see Table 1 for complete list), who together decide how best to manage known community hazards. In addition, LEPCs work to advocate for reduction of hazards within their jurisdiction.

Table 1.

List of LEPC Representatives

LEPC Representative Membership	
State elected officials	Environmental groups
Local elected officials	Transportation officials
Police	Hospital officials
Firefighters	Regulated facility representatives
Civil defense	Community groups
Public health professionals	Local media

Legislative Background

In the 1970's, American attention was focused on addressing and managing chemical and natural disasters piecemeal, as they occurred. Governors, politicians, and

others were concerned with the lack of a national comprehensive policy or plan for managing disasters. In 1979, the creation of the Federal Emergency Management Agency (FEMA) was created, along with the 1979 publication of the text: *Comprehensive Emergency Management-A Governor's Guide***.** This was the first document to introduce the idea of "comprehensive emergency management." It focused on four primary functional areas, which continue to be important in all emergency management approaches today: *mitigation, preparedness, recovery, and response*. Comprehensive emergency management (CEM) was an important historic pillar of present day emergency management in that it categorized emergency management (EM) into functional areas and worked to identify the primary activities necessary to the tasks.

In 1985, the Occupational Safety and Health Administration (OSHA) created the National Emphasis Program, which focused attention on practices and procedures for chemical safety and security in large manufacturing plants (Gray, 2002). Shortly after, EPA augmented the OSHA program with the Chemical Emergency Preparedness Program (CEPP), which was a purely voluntary program to provide information to concerned localities about air pollutants in their area (Gray, 2001). During this time, states and localities were organizing a series of right-to-know plans on their own, with around 30 states and/or metropolitan areas requiring information from industry by 1986 (Gray, 2002).

In 1986, the Emergency Planning and Community Right to Know Act (EPCRA), under Title III of the Superfund Amendments and Reauthorization Act (SARA III) mandated the creation of the first LEPCs (Emergency Planning and Community Right to Know Act, 1986). EPCRA was created to enhance and support CEPP by unifying the

legal patchwork of state and local programs and practices responsible for mitigating chemical spills and providing information to the public. LEPCs were created to encourage stakeholder and community participation in the emergency planning process (such as in the event of a chemical accident), and are comprised of a diverse range of representatives of stakeholder groups within each county jurisdiction. Figure 1 shows the theoretical emergency management model that SARA III was intended to articulate.

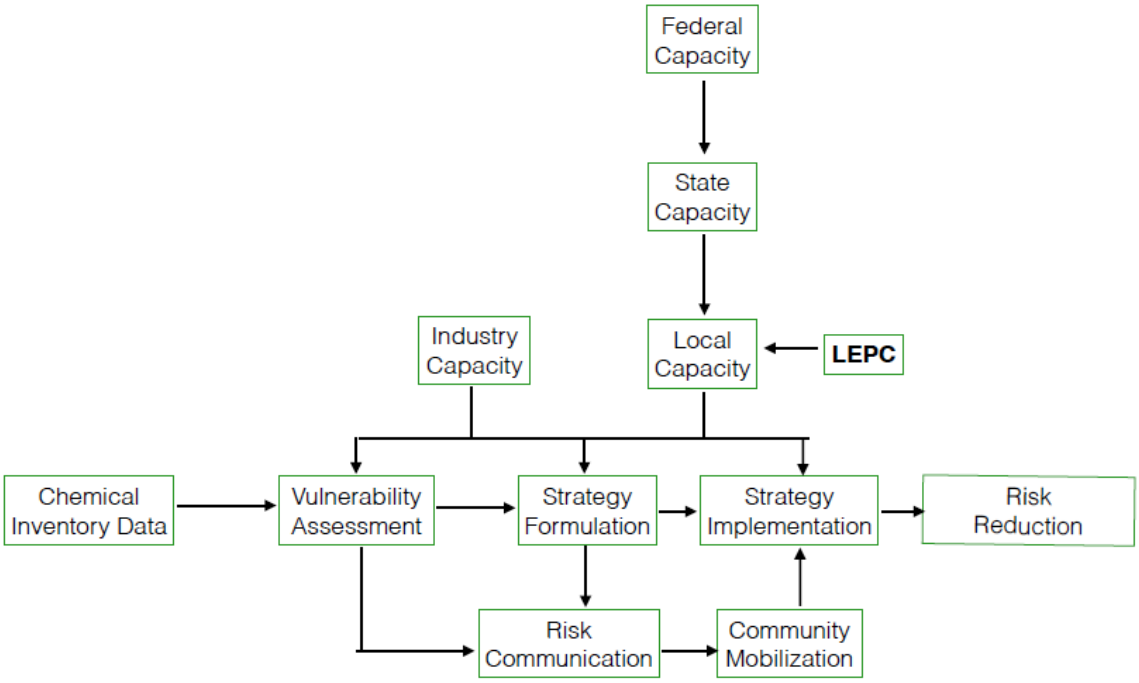

Figure 1. SARA III Model for Emergency Management (adapted from http://www.iiasa.ac.at/Research/RAV/conf/IDRiM07/Papers/Lindell.pdf).

EPCRA was the United States' federal response to concerns about chemical safety and security after several devastating incidents involving exposure to hazardous chemicals. The first was a 1984 Union Carbide chemical accident in Bhopal, India, which killed an estimated 3,800 people and permanently injured thousands more (Union

Carbide Corporation, 2001). A few months after the Bhopal accident, a similar, though much smaller scale, accident occurred involving methyl isocyanate again at a Union Carbide pesticide facility in Kanawah Valley, West Virginia.

When implementing EPCRA, states were given the freedom to interpret the word "local" in the means best fitting their state. As such, the implementation of EPCRA varies on a state by state basis, as some states interpreted the law into the creation of county-level LEPCs, others developed the groups based on densely-populated areas (such as metropolitan urban areas), or the recommendations of local industry. Ohio chose to base its LEPCs at the county-level.

Further legislation has been developed since this time addressing hazardous materials security issues. This includes the Homeland Security Act of 2002 and the 2007 development of the Chemical Facility Anti-Terrorism Standards. These rules address risk-based performance standards, including the development of Security Vulnerability Assessments, along with the creation and implementation of Site Security Plans for vulnerable facilities. While important, these newer rules focus on mitigation and security, and do not address the underlying vulnerability inherent in possessing and storing large quantities of extremely hazardous substances.

It is interesting to note that the U.S. legislative attempt at managing chemical disasters is novel when compared with the framework set out to manage natural disasters. Natural disasters, such as hurricanes, tornadoes, etc. are primarily handled from a national or "top-down" level by Federal Emergency Management Agency (FEMA). Local organizations, including LEPCs, are provided with the tools to locally plan for these situations, but local organizations are in general not the primary decision-makers

and planners for managing natural catastrophes when they occur. In general, natural disaster planning is not handled in as democratic or stakeholder-inclusive a process as is chemical disaster planning.

LEPCs are unique in that they are intended to incorporate citizen-participants in the planning process. EPCRA, the legislation responsible for LEPCs, was described by Goldman (1991) as "what may be the most important advance in U.S. information policy since the Freedom of Information Act (FOIA)." This represents a shift in policy from "command and control" style environmental regulation with its agency-heavy, top-down approach at setting and enforcing regulations to a more participatory, public-mediated, democratic approach to managing regulation locally. As illustrated in Figure 1, EPCRA was built on the idea that local stakeholders would "step up" and take responsibility for managing risk by lobbying their legislatures, once the hazard information was made available to them.

This has also been described as a transformation from direct regulation of environmental problems to "informational regulation" (Kleindorfer & Orts, 1998). Case (2001) also suggests that this more participatory regulation is an excellent addition to traditional "command and control" regulation by improving efficiency and flexibility in a cost-effective manner. There is some evidence to back up these claims. Santos et al. (1996) found improvement in production processes and increased communication and cost-effectiveness amongst regulated industry as a response to SARA III implementation.

The Toxics Release Inventory Program (TRI), also created under EPCRA, collects information in a database on nearly 700 toxic chemicals released or disposed of in communities throughout the United States (http://www.epa.gov/tri/). This information

is available to the public on USEPA's website, and can be searched by zipcode. Despite some of the accuracy issues known to TRI data (Bowen et al., 1995), it is still some of the best available aggregate information we have to date. That being said, quantities of TRI emissions decreased by more than 45% between the year 1988 (after the implementation of EPCRA) and the year 1995. Public pressure, or informational regulation, is argued to be effective, whether it takes the form of stock valuations of publicly traded companies after release of TRI data (Konar and Cohen, 1997) or public company surveys (Santos, Covellos, and McCallum, 1996). The "fear of embarrassment" became the biggest reality for many companies subject to the new EPCRA rule (Wolf, 1996; Templeton and Kirk, 2008). Wolf (1996) argues that access to TRI data by environmental groups, government agencies, mass media, and industry itself forced the regulated industries towards voluntary reform.

The toxic chemicals regulated under EPCRA are called extremely hazardous substances (EHS). EHS are defined and categorized by the United States Environmental Protection Agency (USEPA), and specifically identified and regulated in Chapter 40 of the Code of Federal Regulations (40 CFR part 355). These chemicals are considered to be extremely hazardous when housed, transported or moved above threshold planning quantities (TPQ) (USEPA, 2009). TPQ is the quantity of a substance that triggers reporting requirements to the USEPA. In other words, when a substance is stored or used in a specified amount considered hazardous, for example at or above 500 pounds, it must be reported to local government authorities to facilitate emergency planning. The amount varies by substance type (the actual chemical) and form (solid, liquid gas). The only

industry regulated under EPCRA is that with TPQ of EHS. There are thousands of small firms housing EHS in combinations and quantities less than TPQ that go unregulated.

The potential threat to communities' basic health and safety posed by proximity to large quantities of EHS is being managed by EPCRA . Many facilities, however, that either store or manufacture large quantities of extremely hazardous chemicals are situated within close proximity to residential neighborhoods, schools and businesses. Most, if not all, communities have highways and railroads that run through them where hazardous materials are transported nearby on a regular basis. Even if the terrorist threat to these communities is never realized, the risk to both human health and the natural environment from "normal" or inevitable accidents and chemical spills is statistically unavoidable over the long term (Perrow, 1984).

The term "normal accident" was coined by Perrow to describe specific situations under a narrow series of high-risk conditions that include tight coupling, interactive complexity, and sometimes operator error (1984). "Interactive complexity" refers specifically to instances where there are multiple layers of complexity within a system with consequences and results that we cannot accurately predict given our current understanding and modeling limitations (Marais, Dulac, & Leveson, 2004). These are frequently the circumstances under which EHS are held. Under these conditions, Perrow defines components of tightly coupled systems as those that have rapid and profound impact on each other, in which case intervention may only function to further complicate problems rather than solve them. This tight coupling is complicated further by *inherent interactive complexity* within the defined system. *Interactive complexity* is defined as conditions in a system in which the presence of several individual, unrelated or "discrete"

failures would result in further unforeseen complications. In plain English, this means that the complexity is the result of the interaction of two or more unrelated processes in a system. This type of complexity can be seen as *inherent* within the system, as it is intrinsic or essential within the process.

All these characteristics (tight coupling, interactive complexity, and operator error) in an unpredictable, technologically complicated system can lead to the development of normal accidents. "The old parable about the kingdom lost because of a thrown horseshoe has its parallel in many normal accidents: the initiating event is often, taken by itself, seemingly quite trivial. Because of the system's complexity and tight coupling, however, events cascade out of control to create a catastrophic outcome" (Piccard, 2005). The most common and obvious example of such a situation may be a nuclear energy facility. Very small errors can quickly spiral "out of control" in such environments, resulting in unforeseen consequences, even when the best attempts at controlling for such errors are taken into account. It is for this reason that in addition to attempting to control for errors and create safety checks in complex situations, it is also prudent to strive towards actions that reduce inherent hazards themselves.

Hazard Reduction Activity

Hazard reduction activities are sometimes described by the term, "*Inherent safety"*. The idea of inherent safety has been advocated in the United Kingdom (UK) since a 1974 factory disaster in Flixborough, Britain (Kletz, 1996). A caprolactam (a precursor to nylon) manufacturing plant in the small village of Flixborough, Britain exploded June 1, 1974, killing 28 and injuring 36 more. Nearby villages as far as eight miles away were structurally damaged from the blast, and it took more than ten days to

control the resultant fires. Out of this experience, the concept of inherent safety became publicly salient in the UK as a means of trying to prevent, rather than mitigate, future catastrophes. Inherent safety may include a variety of different activities, including intensification, substitution, attenuation, limitation of effects, and simplifying (Mannan, Rogers et al. 2003).

Intensification is the simple reduction of the quantity of hazardous chemicals stored/ housed at the chemical plant. Substitution involves the use of a less harmful substance in place of a hazardous one. Attenuation means working with chemical(s) under less severe conditions, such as a reduced temperature or pressure. Limitation of effects results from a move towards safer facility design or process conditions, rather than potentially faulty process safety controls. Finally, facilities that are simpler are far less likely to experience failures than plants that are complex in design, structure and process.

LEPCs may help reduce hazards by aiding facilities in the performance of inherent safety opportunity audits, which point out opportunities for chemical facilities to use inherently safer means; by providing educational materials to facilities on the benefits of reducing hazards, and/or by awarding hazard reduction steps through public relations recognition or other approaches.

Context Within Which LEPCs Operate

Since 2001, LEPCs have been given a greater role in carrying out terrorist prevention activities by helping to facilitate the application of homeland security legislation on a local level. LEPCs were originally created with a range of responsibilities surrounding the response to and management of chemical disasters. Their mandated tasks include providing information to the public through community right-to-know requests,

collecting data for annual chemical inventories for facilities within each jurisdiction through reporting on Materials Safety Data Sheets (MSDS), conducting disaster drills, and working under the supervision of the State Emergency Planning Commission (SERC) and the State Environmental Protection Agency (EPA), and in conjunction with county Emergency Management Agencies (EMA) to create local emergency plans (USEPA, 2011).

In many cases, LEPCs work in tandem with area organizations and neighboring LEPCs in order to develop emergency plans and practice drills that more accurately reflect the nature of true EHS emergencies. As the EHS don't respect jurisdictional boundaries, adequate emergency planning must take this into account and allow for cross-cooperation and coordination between adjacent areas. There is evidence of LEPCs acting cooperatively with each other and with other nearby agencies towards emergency planning and management (Franklin County EMA, 2010; Gablehouse, 2007; Templeton & Kirk, 2008).

Statement of Research Question:

There are 2 main questions that will be addressed by this research:

- How compliant and proactive are LEPCs, measured using Starik et al.'s (2000) Compliance-Proactivity index?
- What contextual factors are correlated with the compliance and proactivity scores of LEPCs?

This project was designed to explore the compliance and proactivity of LEPCs, and to examine these factors in relation to selected criteria that vary amongst groups. If one were to imagine LEPC compliance on a one-dimensional plane, it would extend from groups that are essentially not compliant, not functioning or defunct (fulfilling less than

five of the requirements developed by Starik et al., 2000). LEPCs classified in this group are not in compliance with state regulations or federal law.

Starik et al.'s (2000) second category consists of groups that are "mostly compliant", i.e., they adequately meet some or most of their legislative and regulatory goals (those meeting 5-6 requirements listed). These LEPCs meet the majority of the statutory requirements listed in EPCRA and the state regulatory requirements. This category will follow requirements set out in the Ohio Revised Code and the Ohio Administrative Code (ORC and OAC Ch. 3750.) This includes the creation of a local emergency plan, in conjunction with the county EMA, which must be approved by a majority of county LEPC members, and revised and updated annually by October 17. The plan must also be coordinated with those of adjoining planning districts. Emergency plans must be approved by SERC or are subject to revision requirements. If emergency planning requirements aren't met by LEPCs, 50% of the planning portion of SERC's grant funding to the LEPC will be cut. If there are no changes, an LEPC can submit a "no change" letter to the state in lieu of an updated plan.

These "mostly compliant" LEPCs also regularly perform emergency exercises, which consist of tabletop drills, functional drills, and full-scale drills. Exercises are performed by each county on a four-year rotation, with the current rotation being from 2010-2013. Each four-year cycle is expected to contain one of each of the above types of exercises with at minimum one exercise occurring annually. Two actual incidents may be substituted for exercises within a four-year cycle if they fit criteria listed within the OAC. An LEPC's annual hazardous materials exercise can be combined with a County Emergency Management Agency (EMA) exercise, but must still comply with all of the

SERC's exercise rules and requirements. Each exercise must involve either a "fixed extremely hazardous substances facility" or a "transporter of regulated chemical cargo," and can include any chemicals designated as "extremely hazardous" under OAC 3750-08[1].

Finally, the third category stipulated by Starik at al. (2000) includes groups that are "compliant", fulfilling seven to nine requirements on the compliance scale (See Table 2).

In addition to the Compliance Scale, there is a Proactivity Scale, which examines some of the activities that might be seen by an LEPC working towards hazard reduction, accident and/or pollution prevention, and related activities. Groups were categorized one of three ways on this scale: very proactive if they fulfilled five or more factors, somewhat proactive if they fulfilled at least three factors, and not proactive if they completed zero factors (Starik et al., 2000).

The proactive factors encourage the use of accident prevention or mitigation techniques through conventional or secondary means. These are means of preventing and controlling accidents through containment methods, control systems, and prevention methods that do not remove or reduce inherent hazard of materials or processes.

[1] A complete list of more than 3,000 chemicals regulated under EPCRA is available at EPA's website at the following address: http://www.epa.gov/osweroe1/docs/chem/list_of_lists_revised_7_26_2011.pdf. This "list of lists" includes all chemicals regulated under EPCRA sections 302 and 313, and those regulated under the Clean Air Act section 112(r) for accidental air release.

Table 2.

Starik et al. (2000) factors to determine compliance and proactivity level of LEPCs.[2]

Compliance Factors	Proactivity Factors
✓ Have a chairperson	➢ Meeting quarterly or more often
✓ Have a community emergency coordinator	➢ Making informed hazard reduction, accident prevention, or pollution prevention recommendations to industry/ local government
✓ Having an information coordinator	➢ Incorporating or having a strategy to incorporate risk management information (RMP) into ERP within the year*
✓ Holding regular meetings	➢ Updating the plan within the past year
✓ Advertising meetings to the public	➢ Practicing the plan within the past year
✓ Developing and emergency response plan (ERP)	➢ Incorporates "proactive" terms in mission statement**
✓ Submitting ERP it to the SERC	
✓ Publishing newspaper notice about availability of ERC	
✓ Reviewing the plan in the past year	

*RMPs are now "commonplace" and no longer an indicator of proactive engagement
** Not a part of previously developed assessment

LEPC support of these practices may come in a variety of forms, including any of the following: Operator training, accident and near-miss investigation, promotion of use of automatic shut-offs within facilities, secondary containment systems, deluge systems and/or other means to contain and maintain control of hazardous material (Greenburg, 2006). Chemical facilities may also reduce hazard level by changing from a less to more

[2] The factors included in these scales aren't scalable in a Guttman sense, as they may be completed in any order and any particular factor may be missing from an LEPCs tasks. Instead each factor included comprises one of the legislatively required steps for compliance with EPRCA and State regulations or additional tasks noted in the literature and in practice as "proactive" steps, respectively.

stable state of a hazardous input material (e.g. liquid or solid vs. gas), storing a smaller quantity of a hazardous material onsite, altering the temperature or pressure under which the hazardous material is used, and/or substituting a safer input material. LEPCs may foster such behavior on the part of industry, through the use of incentive programs, awards, and information or training. Inclusion of proactive terms in the LEPC mission statement was added by this researcher as an additional measure of LEPC commitment to proactive or hazard-reduction activities.

Objectives of Research and Significance

In general, the intent of this study is to identify and compare compliance and proactivity in local emergency planning committees, along with examining factors that are related to variations in compliance and proactivity. More proactive emergency planning may result in reduced risk to the public, through either efforts to reduce hazard levels, or better and more effective planning for accidents. There are three primary objectives. The first is to increase knowledge of emergency planning amongst researchers and academics, along with improved conceptualization of the definition of what makes an "effective," "compliant," and "proactive" LEPC in the literature. Secondly, this research will provide a "snapshot" of the activities of working LEPCs along with insight into the effectiveness and functionality of emergency planning, nearly 25 years after its inception as a nationally organized activity. Thirdly, this study will also examine whether LEPCs are fulfilling their legislatively intended function of informing the public. If the intention of EPCRA was to regulate the chemical industry by providing public access to data on chemicals in their neighborhood, this is a critical component of their mandated task.

LEPCs in Michigan, Pennsylvania, and Virginia have been the subject of published research studies. This is the first study the author is aware of to focus on a sample in the state of Ohio. USEPA has completed three nationwide surveys of LEPCs, which have been primarily practitioner surveys, without theoretical or statistical analysis beyond frequencies and cross-tabulations. This research study will take a unique approach by examining emergency planning by LEPCs on a sample in Ohio and looking for relationships between the respective levels of compliance and proactivity, and demographic and other factors. Are more compliant LEPCs located in more urban, populous counties? Are more proactive LEPCs those that have had more first-hand experience with accidents? Is the level of compliance and proactivity in the Ohio LEPC sample similar to that of LEPCs in the United States overall?

To the author's knowledge, a comprehensive examination of Ohio's LEPCs has not been performed prior to this, and the results will provide practical information to both state and local entities in addition to the academic community. Comparison of this study's results with those of nationwide LEPC research will help determine the generalizability of this study. There is at this point, no known reason to presuppose the results in Ohio would be any different than nationwide averages for LEPC compliance and proactivity.

If insight can be obtained into the relationship between compliance or proactivity and demographics such as county population size, urbanization of county, or hazard or accident experience, it might be possible to eventually develop a prescriptive or best practices approach to improve emergency planning. It is unknown at this point whether counties with more proactive LEPCs are "safer" from the perspective of less hazard or

fewer accidents. The researcher is hopeful that a clear relationship might exist between the active work of LEPCs and safer, more informed communities, as this was the intent of the legislation that created them. Inclusion of local stakeholders in an open, transparent forum is an American ideal of democracy in action. Emergency planning, within this framework, is intended to promote buy-in into an environment that communities can agree upon as safe and equitable.

This research will use correlation methodologies to examine the relationship between variables. An established scale is used to determine variation in a range of factors. This exploration applies a strategic framework to empirically identify factors related to why some LEPCs are more proactive and/or compliant than others. The factors to be studied will be discussed thoroughly within the context of emergency management and planning overall.

CHAPTER II

LITERATURE REVIEW AND THEORY

"What you don't have can't leak."
-Trevor Kletz

Preface to Literature Review

At the outset of this study, the researcher began with an interest in the Precautionary Principle (PP). Like sustainability, there are many definitions and constructions of the PP in the literature, but one of the most commonly referred to definitions comes from the Wingspread Conference on Precaution. The Wingspread Conference on the Precautionary Principle was a 1998 meeting of academics, treaty negotiators, environmentalists, and activists to discuss the use of the PP in environmental and health public policy decisions (http://www.sehn.org/wing.html, 1998). An excerpt from the Wingspread Statement defines the PP as follows:

> When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically. In this context the proponent of an activity, rather than the public, should bear the burden of proof. The process of applying the Precautionary Principle must be open, informed and democratic and must include potentially affected parties. It must also involve an examination of the full range of alternatives, including no action (http://www.sehn.org/wing.h-tml, 1998).

With this in mind, the researcher began conversations with faculty, discussions with fellow graduate students, and a review of the literature in relevant fields. This led to an investigation into the application of the PP in the hazardous chemical industry; that is the idea of Inherent Safety. Inherent safety is a concept that applies to reducing the quantity, quality, or character of hazards, rather than the mitigation of risk from hazard. This is an idea that has gained traction in some areas of EHS use. Further research led to an interest in Local Emergency Planning Committees (LEPCs) as organizations that are in some instances actively working to implement or promote the use of Inherent safety concepts, *a priori* the PP. Phone and in-person conversations were undertaken with LEPC practitioners and experts at other Universities. It became apparent that there is a range of activity level amongst LEPCs, potentially due to funding, experience, or location differences, among others. In the interest of reducing repetition, the terms "inherent safety", "proactive", and "precautionary" will be used interchangeably with the same meaning throughout this literature review.

As a brief review, LEPCs are primarily volunteer-run county-level organizations that were created under mandate in 1987 by SARA Title III. Their purpose was principally to manage the collection and dissemination of information about local chemical hazards, including TRI data. In addition, they are required to develop, practice, and test an emergency plan regularly in case of a chemical disaster. Anecdotal evidence and objective research shows variation in LEPC performance between jurisdictions within a state, and between states. One potential source of this variation may be funding differences between groups. Adequate financial support for managing disasters effectively is still lacking in emergency management programs according to Waugh

(Waugh 2000; Waugh 2007). While some LEPCs are essentially unfunded, others are able to secure more funding, increasing their capacity for effectiveness. Organizational capacity is a well-known antecedent to organizational effectiveness (Misener and Doherty, 2009).

The literature also points towards other factors as potential reasons for variation as well. The current body of knowledge about Local Emergency Planning Committees (LEPCs) focuses on effectiveness, and specifically on how LEPCs are performing relative to their stated mission. Relevant areas within the body of LEPC knowledge will be discussed as they contribute and relate to this research. Six central themes will be addressed in this literature review, including: 2.1 general review of emergency planning history and research, 2.1 informational regulation, 2.2 organizational theory and LEPC effectiveness, 2.3 disaster management frameworks, 2.4 compliance and proactivity, 2.5 theoretical presuppositions, 2.6 questions and hypotheses.

Emergency Planning

Researchers in various fields have studied emergency planning and hazardous chemical management. This chapter will include a brief overview of the study of emergency planning and hazardous chemical mitigation within several bodies of literature. A proportion of the literature available is also practitioner-oriented, as emergency management is a practical, evidence-based and results-driven field.

The origins of emergency planning as a field of study rest in the environmental policy literature. The environmental policy literature portrays an evolution of environmental regulation from "command and control" or "standards and enforcement" style regulation in early U.S. environmental legislation, to more "participatory

regulation". Beginning with the National Environmental Policy Act of 1970 (NEPA), environmental regulation took the format of rules and standards set by the EPA for pollution control, followed by enforcement by the government agency to ensure compliance. While there was marked success with this strategy (e.g. cleaner water, lead removal from gasoline, removal of Chloroflourocarbons [CFC's] from products), it wasn't always effective or popular as the political climate evolved in the 1980's. Experts complained that command and control regulation didn't offer economic incentive options (more carrot, less stick), and that it required too much of government to specify appropriate means and technologies to manage highly complicated pollutants and processes (Rosenbaum 1998).

One of the primary foci of emergency or disaster planning is management of EHS. Although there are as of 2012, more than a dozen laws enforced by the EPA regarding EHS in the U.S. including the Clean Water Act (CWA), the Clean Railroads Act of 2008, the Hazardous Materials Transportation and Uniform Safety Act (HMTUSA), the Resource Conservation and Recovery Act (RCRA), the Toxic Substances Control Act (TSCA), and the Chemical Facilities Security Act (CFSA),

> [M]ost of these laws are burdened by the daunting variety of materials to be regulated, by inadequate data on the distribution and effect of these substances on humans and the environment, by political and administrative impediments to implementation, and by widespread public criticism and distrust (Rosenbaum, 1998, p. 224).

In addition to market-based mechanisms as economic incentives, EPCRA was a bold step towards more participatory-based regulation. According to Goldman (1991, p.20-1) EPCRA "may be the most important advance in U.S. public information policy since the Freedom of Information Act (FOIA)… [and has] evolved within the larger historical

context of increasing pressures to democratize American regulatory processes." The development and contribution of voluntary regulatory processes is an important step in the history of emergency management as it shows a noteworthy shift in the regulatory framework.

Out of this historical precedent, EPCRA was amended to create LEPCs and the Toxics Release Inventory (TRI). This was an important step towards what has been described as "informational regulation"(Kleindorfer and Orts 1998). Informational regulation provides environmental information directly to local entities and citizens, promoting a more efficient, cost-effective, bottom-up approach (Case 2001). This is in direct contrast to previous "top down" models of command-and-control style environmental regulation.

Implementation of EPCRA mandated the creation of LEPCs along with supporting state level organizations, along with a series of criteria to fulfill the role of emergency preparedness in case of natural or man-made disaster. Compliance with these legislative mandates is complicated, at times tricky, and generally minimally funded or unfunded (O'Leary, 1995). The burden of implementation has been left at the local government level, without adequate financial support for the task. How this task has been managed will be discussed, along with the shifting emphasis and need for different types of emergency planning in a post 9/11 "homeland security" environment.

While a fair amount of research has been done on emergency response to natural disasters, research on response to chemical and man-made disaster is a growing field. Humanity's intensive development and use of hazardous materials and chemicals is

arguably a field most rapidly developed in the post-World War II era. Inevitably, any study of disaster management unfolded from necessity out of this newer field.

Tierney, Lindell, and Perry state that more research is needed to characterize the structure of local emergency preparedness networks (2001). It isn't completely clear how some factors, such as funding, personnel, community interest or use of technology influence preparedness. Why do different emergency management agencies vary in their approaches to emergency preparedness and choose to emphasize one particular planning strategy over another? The topic is still being explored, and is constantly evolving due to changing legislative requirements and demands on over-strapped localities.

Disaster Management Frameworks

The primary frameworks in the disaster management literature are examined as context for the functionality of LEPCs. There are two connected literature streams laid out concerning disaster management. The first is "foundational" concepts and frameworks discussed in the development of the field of disaster management. This historical component is an important stepping-stone towards more contemporary disaster management. Contemporary disaster management approaches include those more currently being debated in the literature. There is not clear consensus as to the best use of emergency planners extremely limited resources.

First a brief definition of each of the four functional areas of emergency management is introduced below. Mitigation is "sustained action taken to reduce or eliminate long-term risk to people and their property from hazards and their effects" (Federal Emergency Management Agency 2011). Mitigation can be thought of like insurance. The second functional area of emergency management is preparedness.

Preparedness (see Figure 2) is defined by the National Incident Management System (NIMS) as " a continuous cycle of planning, organizing, training, equipping, exercising, evaluating, and taking corrective action in an effort to ensure effective coordination during incident response" (Federal Emergency Management Agency 2011).

Figure 2. Preparedness Cycle (Federal Emergency Management Agency 2011)

Response is the third functional area of emergency management. The Department of Homeland Security (2008) defines response as " immediate actions to save lives, protect property and the environment, and meet basic human needs. Response also includes the execution of emergency plans and actions to support short term recovery". Finally, recovery is the activities undertaken by communities and individuals to return to "normal" after a disaster or incident occurs. This might include activities such as obtaining financial assistance, physical clean-up of affected areas, and other remediation steps.

A framework can be thought of as a basic conceptual structure or system of ideas, underlying a theory or notion. The field of emergency planning has developed several distinct research frameworks with which to examine disaster planning and mitigation.

Some of the earliest discussions of disasters in the literature were framed within three different approaches: natural hazards, civil defense, and comprehensive emergency management (CEM)/ integrated emergency management (IEM) framework. Current emergency planning concepts are built on the foundation of these ideas. The more recent approaches include disaster resistance, disaster resilience, comprehensive emergency management, sustainable emergency management, and vulnerability management. Each of these approaches can be "plotted" over the four functional areas of emergency management, according to their primary focus and intention (see Fig. 3). The figure below visually compares the relative emphasis and focus of each contemporary emergency management framework within the context of the four functional areas of emergency management. Each framework and its position within the context of the figure are described in detail below. The four quadrants represent the major areas of attention and energy for emergency managers to direct their efforts. The focus of the groups can vary, which is where the different approaches noted in the literature become relevant.

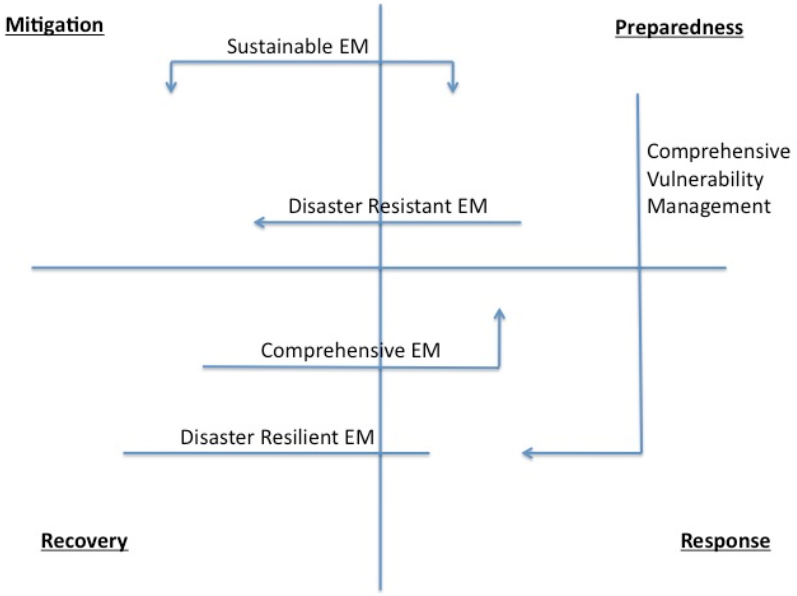

Figure 3. Emergency Management Approaches overlayed on Functional Areas (adapted from Zingale, 2008)

Foundational emergency management frameworks. The *natural hazards framework* focused on the impact of natural hazards as disasters (O'Keefe et al, 1976). This was problematic in that a natural disaster is not in and of itself a disaster. It is the when, where, and how of the event that make it potentially catastrophic. McEntire points out that some natural hazards, like floods, are actually environmentally beneficial (2005). The perspective from which the hazards are viewed in this framework is potentially self-limiting, as it does not allow for consideration of such perspectives. Another shortcoming of this viewpoint is its focus only on natural hazards, not on manmade or terrorist hazards (McEntire, 2005).

Alternatively, the *civil defense framework* bloomed from the Cold War era climate of "mutually assured destruction" from hostilities with the Soviet Union (McEntire 2005). The idea of a true Soviet threat to the American people forced cities to make evacuation plans for potential nuclear catastrophe. While historically important, the focus of this framework was often unrealistic, short-sighted, and fraught with uncertainty (Dynes 1994). As the name indicates, it focused primarily on emergency planning through the development of civil defense strategies.

Comprehensive emergency management (CEM) takes some of the strengths from the previous two frameworks and builds on them. The National Governors' Association adopted CEM as its national emergency management policy in 1979 (National Governors Association 1979). CEM was an attempt to coordinate and integrate the various types of disaster management strategies and actors involved into a cohesive unit in order to improve response to all types of disasters (Godschalk 1991). While an improvement on integrating mitigation and post-disaster coordination, this framework did little to attend to

disaster prevention or more proactive approaches (McEntire 2005). As illustrated in Figure 3 above, CEM focuses primarily on the areas of recovery and response, with minor emphasis on preparation (as indicated by the directional arrow), and no discussion of disaster mitigation. The CEM approach is considered to be the last of the "foundational" frameworks upon which more recent disaster frameworks are based (McEntire 2005).

Contemporary emergency management frameworks. Geis (2000) claims that "natural disasters" such as earthquakes, hurricanes, and flooding, are often the result of man tampering with nature, and are therefore not "natural" by design. For example, coastal and riparian land development in flood zones and hurricane prone areas, and development on earthquake fault lines are often the sites of natural disasters. Geis' implication is that if the land was undeveloped, this phenomenon would just be part of Earth's natural cycles and not disastrous in consequence. As a means to mitigate natural disasters, he promotes the idea of the "*disaster resistant* community" (DRC), as designed by former FEMA Director James Lee Witt. This proactive policy attempts to preempt disasters through the use of more effective building codes and land use plans. The DRC was designed as an "overarching guidance that informs development in hazard prone areas" (Mileti 1999). Disaster resistant communities also contain adequate community support systems (police, fire, EMS, transportation infrastructure) for the needs of the community. While this may seem obvious, the widespread nature of poor planning in disaster prone areas, such as floodplains and coastal areas signifies our failure to fully embody this concept to date. The take-away idea that "(a)n appropriately designed built environment that is sensitive to the natural risk conditions with respect to development

siting and function, the provision of services, and design and construction will be more hazard-resistant and less vulnerable than one that is not" bears repeating (Geis 2000). While there is strength to the *disaster resistant EM* framework, Figure 3 shows it is incomplete as its attention is primarily on preparedness with some emphasis on mitigation (as indicated by the directional arrow) and little to no consideration for response and recovery. "A DRC represents the safest possible community that we have the knowledge to design and build in a natural hazard context" (Geis 2000). The resistance idea infers that a community has been built and designed in an intelligent way so that natural hazards do not become natural disasters (Geis 2000).

The idea of resistance held strong into the early 1990's, but attention shifted towards the idea of community resilience in the latter half of the decade. The *disaster resilience* approach encompassed the more comprehensive idea of a community's ability to "bounce back" from disaster, rather than only resisting it (Mileti 1999). While resistance was recognized as an important step towards improved community safety, the idea was thought to not go far enough in addressing all aspects of disasters. The idea of resilience shifts the focus towards more than just emergency response or risk management, but instead towards managing risk on a community by community basis and creating resilient communities (Britton and Clark 2000). The resilience approach has taken a particularly strong hold in disaster management in New Zealand (Britton & Clark, 2000; McManus, Seville, Vargo, & Brunsdon, 2008). Despite its popularity, there is some disagreement with the above definition of resilience within the literature. Some scholars describe the resilience approach as more similar to the idea of hazard mitigation, management or planning (much like resistance) (Burby, Deyle et al. 2000), while others

see it emphasizing primarily community post-disaster clean-up efforts (Buckle, Mars et al. 2000). McManus, Seville, Vargo, and Brunsdon describe resilience as having three main attributes, "(s)ituation awareness, management of keystone vulnerabilities, and adaptive capacity" (2008). As Figure 3 shows, in this sense the *disaster resilience* concept is firmly situated in the recovery and somewhat in the response components of emergency management.

Out of the context of debate between the resilience and resistance approaches, comes the idea of *sustainable hazards management* or sustainability. This approach takes a broader view and a longer-term perspective in an attempt to correct some of the weaknesses of the previous approaches (McEntire 2005). In 1987 the Brundtland Commission introduced the idea that "(s)ustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development 1987). Mileti recognized that this idea could be extended to incorporate the needs of disaster planning, shifting the field's focus still more from "hazard management" to "disaster management" as the two are not interchangeable (1999). A hazard is not in and of itself a disaster if undisturbed. A community can function completely normally with hazards in their midst, if properly managed. The idea of "disaster management" focuses more on handling situations where hazards result in accidents.

Meo, Ziebro, and Patton describe the application of sustainability to chronic flash floods in Tulsa, Oklahoma (2004). The *Sustainable EM* approach looks at longer term management of hazards, and avoidance of potential disasters. As illustrated in Figure 3, the Sustainable EM approach emphasizes mitigation and preparedness with known and

calculable hazards and incorporates some thought into recovery and response plans over the long term (as indicated by Figure 3's directional arrows). Through the development of innovative policy, including bans on floodplain building, floodplain management plans, and storm water management plans, amongst others, the city of Tulsa was able to take a longer-term approach to managing its chronic flood problem (Meo, Ziebro et al. 2004). This new approach dramatically reduced flash floods in Tulsa.

The sustainability approach comes with its own nuanced strengths and weaknesses as well. As in any other field that the term "sustainability" is applied, there is still some confusion and lack of clarity as to the functional meaning for sustainability within the disaster management literature (McEntire and Floyd, 2003). While the sustainability approach has been utilized extensively in the natural hazards field (floods, earthquakes, etc.), it hasn't been used broadly to address human-made or terrorist-related disasters, specifically those involving EHS (McEntire, 2005). In addition, issues of environmental health and safety are often not clear-cut or one-dimensional. Actions and materials helpful in disaster management (such as foams used to fight forest fires) may have other negative unintended environmental consequences that detract from the sustainability of their use (Kreimer and Munasinghe, 1991). Overlaying the concept of sustainability and long-term safety on top of the current political climate of homeland security and management of immediate risk has also proved challenging, and has reduced the strength and popularity of this approach.

The final three approaches from the disaster management literature to be discussed are risk management, homeland security, and vulnerability. *Risk management* is a concept used in many circles, principally business and economics along with policy

development. Much of risk management focuses on the reduction of expected loss from disaster (McEntire 2005). This approach tries to take the probability of disaster into account as a part of the decision-making process (Mileti 1999). Risk focuses primarily on exactly what the name implies, *managing risk*. While this is a critical component to preparing for disaster, a critique of this approach is that it doesn't focus enough on mitigation or post-disaster plans. In addition, risk management is built upon calculated probabilities of risk, which are not always accurate representations of reality, nor always calculable. How do we calculate the probability of a "worst case scenario" such as the catastrophic typhoon and subsequent nuclear meltdown in Japan? One additional problem with the risk management approach is its overemphasis on the probability of events at the cost of losing focus on the consequences of events (Alexander 2002). This minimizes the actual discussion about processes for managing disasters and their aftermath.

Homeland security is a prevailing disaster management approach today due to the fear of terrorist attack on American soil. The terrorist attacks of 2001 changed American policy makers attitude from one of we're "safe at home" to one of "constant vigilance." This cultural shift is reflected in our emergency management policy and practice by shifting resources towards control of geographic borders, infrastructure protection, and attention towards our emergency response capabilities (McEntire 2005). This attentiveness towards securing and protecting our "homeland" has improved preventative and proactive efforts, hazard reduction activity, and renewed efforts securing our transportation infrastructure and port safety (Helmick 2008). While these shifts have been beneficial to these aspects of disaster management, they have focused exclusively on issues of terrorism, directing our limited emergency response resources on one area, to

the detriment of other types of disasters (i.e. earthquakes, tornadoes, forest fires, etc.) (Waugh 2004). This downplays not only the risk of natural hazards, but also trivializes the associated experts in these areas in matters of disaster management. The homeland security approach also minimizes some of the hard won hallmarks of emergency management of the last 20 years, such as cooperation, collaboration, and transparency, in favor of secrecy and top-down heavy-handed authoritative control (Waugh 2003).

As emergency managers, LEPCs are expected to be attentive to all four functional areas of EM, preparedness, response, recovery, and mitigation. A 2007 Working Group developed the following seven principles of EM. Blanchard et al. (2007) stated that emergency management must be:

1. Comprehensive
2. Progressive
3. Risk-driven
4. Integrated
5. Collaborative
6. Flexible
7. Professional

The vulnerability management approach has been heralded as a more "holistic, integrated, and balanced approach to disasters" than the previous piecemeal styles (McEntire 2005). McEntire also states that vulnerability management includes components of the risk, resistance, and resilience approaches by "work[ing] toward the reduction of risk and susceptibility while also raising our resistance and resilience to disaster" (2004). McEntire argues that when looked at on total, much of the disaster

research offers an unexpected measure of justification for a vulnerability management approach (2004). However, comprehensive vulnerability management is not inclusive of mitigation in its approach. As illustrated in Figure 3, this approach emphasizes the preparedness and response components of emergency management with less emphasis on recovery (as indicated by the directional arrow in Figure 3).

Disaster management literature helps to set the historical context within which LEPCs and other emergency planners are functioning in the U.S. Important as this field is, the primary focus is still on disaster preparedness and response/ recovery. It is possible to redesign the diagram in Figure 3 and re-examine the focused attention of LEPC activity in a different light. Figure 4 below again shows the four functional areas of emergency management, and the relationship between each.

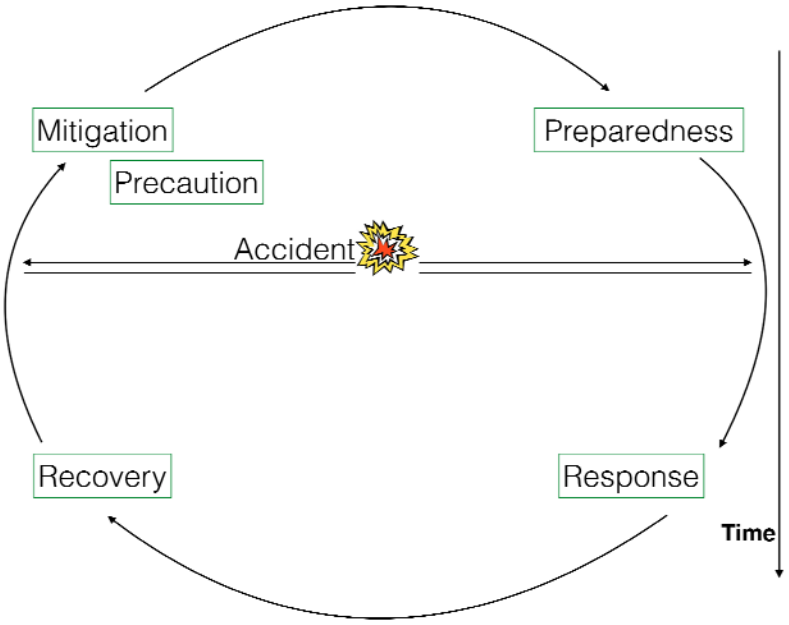

Figure 4. Functional Areas of Emergency Management and Precaution

Figure 4 illustrates that there is a relationship between each of the four areas of functional emergency management. The top two areas of the diagram, "Mitigation" and "Preparedness" include activities that occur prior to an accident, while "Recovery" and "Response" occur after an accident has happened. The curvilinear lines represent the fact that emergency management is a continuous cycle, each step following the next. As described above in the discussion on emergency management approaches, the majority of emergency management resources and capacity are currently directed towards preparedness, recovery, and response activities, and less so towards mitigation activities. Precaution is included in the Mitigation area, as concepts discussed in this study inclusive under the heading of "Precaution" or "Inherent safety" are activities that would work to actually mitigate and/or eliminate hazards, rather than prepare for them.

Informational Regulation

The response for any hazardous event, intentional or accidental, would be first and primarily local (Gablehouse 2005). It is for this reason that local communities need to evaluate and be aware of risks. In addition, because any chemical accident has the potential to get out of control, and due to the human limitations of first responders in even the best communities, it is useful to look at accident prevention as an important component of risk management. The more serious a prospective accident is, the greater it's potential to overwhelm first responders. LEPCs that are in a higher risk areas, either with greater quantity or more hazardous chemicals (e.g. combustibility, corrosiveness, etc.) present or those with larger populations, are hypothesized to be more likely to use a more proactive approach in response to this increased vulnerability.

An explicit responsibility of LEPCs is to develop and practice evacuation and emergency response plans. However, previous studies have noted that these plans are not adequately communicated to the public, and are only practiced annually. Even when emergency plans are practiced, it is difficult to simulate the extent and comprehensiveness of a full-scale disaster. Many events in a full-scale disaster are simply unknowable until the situation is at hand (Torno and Aiken County Emergency Services: Hazardous Materials Team 2006). This is further complicated from the fact that a large number of hazardous chemical events occur on highways as transportation accidents. One study noted that nearly 50% of accidents in Chester County, Pennsylvania occurred as fuel or other EHS spills on highways between 1987 and 1999 (Shorten et al., 2002).

In addition, research indicates EHS accidents are underreported (Shorten et al., 2002; Wendt et al., 1996). Wendt et al.'s (1996) study showed that when comparing results from three different reporting systems (EPA, Department of Transportation [DOT], and a state-run hazardous reporting system), the state-based system reported a greater number of incidents than either of the two Federal data collection systems. This was confirmed by another study in Canada, which found only 3 of 140 transportation accidents involving EHS present across multiple Canadian tracking databases (Trepanier, Leroux, & de Marcellis-Warin, 2007).

Besides basic lack of tracking of accidents, EPCRA only requires the reporting and collection of data from larger companies with substantial quantities of EHS. Many smaller "Mom and Pop" type facilities and industries are exempt from reporting requirements, and therefore function "under the radar" of government oversight. The

underrepresentation of what may not be an insignificant EHS hazard provides a substantial challenge to and limitation of emergency planning and disaster response.

LEPCs were implemented with stakeholder participation to increase community awareness of hazardous chemicals, with the intention that community awareness and increased knowledge would indirectly regulate local chemical usage. There is limited evidence that information disclosure to the public concerning local chemical releases is a successful strategy to improve chemical facility environmental performance (Graham and Miller 2001; Bierle 2003). This research suggests that there has been some mild success on the part of emergency planners in providing information to the public, and that as a result, firms have reduced the quantities of hazardous materials on-site, and by extension their emissions (Wolf, 1996). It was suggested that provision of information to the public through Material Safety Data Sheets (MSDS) and TRI information was "regulation by embarrassment" (Regan, 1993, p.34). Information requests from local industry officials, community or the media may therefore encourage regulatory compliance and proactivity on the part of industry and by emergency planning agencies.

Alternatively, there is much to suggest that community education or awareness is a priority not strongly acted upon by emergency planners. In one study, respondents stated that community awareness efforts were an area of less emphasis than technical and planning efforts (Rich, Conn et al. 1993). Other research shows that community right-to-know practices are just not a priority of LEPCs (Conn, Owens et al. 1990; Rest, Krimsky et al. 1991; Lindell and Perry 2001) or are completely disregarded (Conn, Owens et al. 1990; Adams, Burns et al. 1994; Starik, Adams et al. 2000). Consistently, it seems that

despite the regulatory intent, much of emergency planners' limited resources are not used to inform the public.

Alternatively, LEPCs can highlight the interdependence between the chemical facility and local residents in the community, who include the first responders. This interdependence can ideally lead to all parties focusing on accident prevention, through "inventory reduction and control, appropriate maintenance schedules, employee training on the safe handling of ...chemicals, safer storage, spill containment techniques, and improved facility security...[in addition to] dealing with process change and materials substitution" (Gablehouse 2005). Gablehouse (2005) also states that attitudes are more important than dollars, when it comes to most of these changes. If the community expects accident prevention to be a priority, facilities will give it more attention.

Due to the unpredictability of chemical emergencies, Gablehouse (2005) notes that in Colorado the emphasis has shifted to accident prevention, through a series of steps and communications with local chemical facilities. As members of local communities, LEPC members are stakeholders in the welfare of the region. Their concerns, according to Gablehouse, "mirror their community's concerns with facilities handling chemicals" (2005). Whitney and Lindell, on the other hand, state that LEPC resources in Michigan are spent mainly on plans to address and mitigate accidents when they occur (2000), not in preventing them.

In western Pennsylvania, Bowser (2009) found a positive correlation between increasing city size and allocation of emergency management resources. In addition, managers of larger cities perceived terrorism as a more serious threat than smaller ones, and also exercised their emergency plan(s) more frequently, according to the study.

Funding opportunities and restrictions were cited as a source of frustration amongst cities of all sizes in the investigation (Bowser, 2009).

Variation between LEPCs and between states may be due to a variety of factors, some of which have been elucidated through previous research. "…[S]tudies have shown substantial variation within and between states in the levels of local planning for hazardous materials emergencies" (Lindell and Meier 1994). Lindell and Meier (1994) describe "local planning" as activities that work towards meeting mandated requirements (i.e., compliance). Under EPCRA, all LEPCs are required to meet the same explicit requirements, but can decide locally how they are going to go about implementing them. Despite variation in implementation methods, the end results to meet compliance are consistent nationally.

Organizational Theory and LEPC Effectiveness

In order to comply with the regulatory framework within which they work, LEPCs need to be effective at what they do. LEPC effectiveness is a nebulous measure to operationalize and quantify, and has been seen handled in several different ways in the literature. The idea of effectiveness and its importance to the implementation of EPCRA will be discussed. Previous national studies of LEPCs have examined LEPC compliance and proactivity. Nationwide, LEPCs seem to be lacking in provision of information to the public, despite their intended policy goal of providing community right-to-know information (Adams et al., 2000; Starik et al., 2008).

In Michigan, a series of internal and external factors have been named as related to successful emergency planning outcomes (Lindell & Meier, 1994). Successful emergency planning outcomes include the submission of an emergency plan and

completion of critical planning tasks as outlined by state emergency planning law. Crucial factors towards this include member inputs, staffing and organizational structure, and resources available to members as internally important factors, and support of the community and recent hazard management experience as externally important factors.

Other researchers have found workplace climate as central to successful organizational outcomes (Lindell and Brandt 2000); Kopelman et al., 1990; (Lindell and Whitney 1995). Within an organizational setting, climate has also been correlated with technological updating and overall performance (Kozlowski and Hults 1987), along with accident prevention and safety program effectiveness (Zohar 1980). Climate quality within an organization was also significantly correlated with organizational antecedents and outcomes (Lindell and Brandt 2000). While each of these studies showed important contributions to understanding LEPC organizational function, they did not address LEPCs role in informing the public, or acting proactively to reduce hazard vulnerability.

The concept of effectiveness is at the core of much of the research on LEPCs. Merriam-Webster dictionary defines the term “effective” as “producing a decided, decisive, or desired effect” (2010). A review of the literature shows effectiveness defined in the following ways. Each of these concepts is an important component of LEPCs function within their community.

The literature points towards several factors that have been documented as influencing the effectiveness of LEPCs. Effectiveness has been defined skeletally in previous models as simply the submission of an emergency plan by the LEPC (Whitney &Lindell, 2000). Submitting an emergency plan is one of the primary functions given to LEPC under EPCRA. This research asserts further that proactivity is also a component of

effectiveness. For an LEPC to be "effective", it must meet both the criteria for "compliance" and "proactivity" as conceptualized below.

Lindell and Meier (1994) used literature from three fields to develop their definition of LEPC effectiveness: disaster planning, strategic planning, and team effectiveness. Strategic planning theory states that an organization's external and internal environment work in tandem with the group's values to impact the entire process through which priorities are agreed upon and strategic choices are made about how to reach the organization's goals (Bryson and Roering, 1987). These priorities therefore lead to an effective group. This includes much of the internal dynamics that influence group decision making, but seems to leave out some of the external forces that may differently impact team members.

Effectiveness is also equated with and made "measurable" by other researchers through analysis of emergency planning outcomes, the most objective of which is the submission and approval (by SERC) of a site-specific emergency response plan. Lindell and Perry (1990), however, state that submission of a plan is, in and of itself, not enough to indicate an effective LEPC or a prepared community, but can be seen as an important indicator of emergency preparedness. As noted earlier, additional emergency planning outcomes include completion of emergency planning drills, and work with industry and the community towards vulnerability reduction and sustainability. This research asserts that additional "tangible" extras, such as promotion of inherent safety and hazard reduction concepts are also measurable emergency planning outcomes. Lindell and Perry make important strides towards a well-operationalized definition of effectiveness.

Lindell and Whitney (1995) refer to what they call LEPC team climate, defined as "members perceptions of team tasks and conditions", along with the support of state emergency planning resources, as among the most important factors in the effectiveness of LEPCs. This research suggests that LEPC members' personal experience of membership within the LEPC is an important component of the success of the organization. It also suggests that LEPCs that make better use of state emergency planning resources are more effective. As a continuation of this, interaction with Federal Emergency Management Agency (FEMA) and other knowledgeable Federal or State authorities may also improve activity and or proactiveness of emergency planning organizations.

Lindell and Whitney (1995) also found membership in regional LEPC Associations, previous experience managing an emergency, and the use of automated technology influenced successful emergency planning outcomes. Later research found that institutional capacity (revenue, organizational efficiency and member activity level) also influenced the effectiveness of LEPCs (Whitney and Lindell 2000).

In 2000, Whitney and Lindell also suggest that as LEPCs are primarily volunteer-run organizations, organizational commitment or member motivation need also be examined in order to understand the drivers of participation. Having participating members is an essential component of an effective LEPC. In their study they found that organizational commitment comes in part from organizational goal identification. Participating in an organization that has clearly established goals improves member organizational commitment. In addition, Whitney and Lindell (2000) found that three types of leader behavior facilitate goal identification: leader consideration, leader

communication, and leader-initiating structure. Leadership within the organization appears to play an important role in organizational effectiveness. Finally, members' commitment to the LEPC is also theorized to be increased by their belief that the organization can accomplish its set goals. Social learning theory states that when individuals believe they can accomplish a goal, it actually increases their ability to do so (Locke & Latham, 2002). In other words, perception of competence increases organizational commitment.

Importance of decision-making to effectiveness. In addition to these factors, in order to understand how the effectiveness of an LEPC develops, I will introduce the concept of "framing". According to Beach and Connolly (2005), a frame is "a mental construct consisting of elements, and the relationship among them, that are associated with a situation that is of interest to a decision maker," in other words; it is the decision maker's interpretation of the context surrounding the decision. How LEPC members frame events; how their experience and history influences their work together as a group, may be important in their effectiveness.

For example, expert chess players, when presented with a chess board with pieces in reasonable locations from an ongoing chess game, can remember the locations upon removal of the pieces, and can accurately predict what moves might occur two to three steps ahead in the game. Novices, presented with the same scenario, can neither remember game piece locations on a game board, nor anticipate future moves. If other types of experts are similar to chess experts, they also may be able to "recognize meaningful patterns of events, and having recognized (framed) them can use them to perform the tasks that the situation demands" (Beach and Connolly 2005).

In an LEPC, expertise can be developed through several means, including past experience, education, and training. Fischer defines an expert as "someone with mastery over a body of knowledge and its relevant techniques" (2003). An LEPC with actual experience or expertise in handling an emergency, and/or with more extensive training may be better equipped to handle the demands of an emergency than an inexperienced, less-trained LEPC. This type of knowledge would likely be similar in LEPCs nationwide, as there is no reason to think that some portions of the country are better educated than others. There is generally a mix of expert and non-expert individuals located throughout the U.S.

In addition to the influence of expertise, a frame is also a particular way of constructing a worldview. The development of frames by individual LEPC members does not occur in a vacuum. Each member develops their frame for handling risk within the context of the group, so there is a shared frame amongst the members. Members "align" their frames through discussion and dialogue (Beach and Connolly 2005). Each LEPC also develops its frame within the context of the local and broader society and culture within which it is rooted (Trice and Beyer 1993). This shared culture is more subtle in its impact on group members, but equally important. The "framing" factors of expertise, education, training, and local context and culture may also be important in the effectiveness of LEPCs.

The area of LEPC effectiveness has been thoroughly studied, particularly by Whitney, Lindell, and Meier, and others, and contributes substantially to the understanding of the internal dynamics and characteristics of emergency planning organizations, including LEPCs. These internal dynamics are an important contributor to

the actions and measurable outcomes of LEPCs. Other factors also play a role, however. Emergency planning is a constantly evolving field in a rapidly changing, fast-paced 21st century culture. A wide variety of external pressures, including increased demands and in some cases decreased funding, are placed upon present day LEPCs and emergency management agencies. Under EPCRA, LEPCs were initially expected to manage EHS disasters. As necessity has required, they are also a part of the primary response network for natural disasters, and most recently, homeland security or terrorist threats. The convenience of the network of first responders threaded from county to county has made these emergency management networks an ideal first line of communication and defense.

Similar to public schools, fire and police services, LEPCs are experiencing increased expectations in what is a difficult-to-quantify field. LEPCs have their original responsibilities concerning gathering and promulgation of public EHS information, along with emergency planning. In addition, LEPCs have the relatively newly added responsibility of community terrorism/ accident preparation. There are serious, legitimate concerns about hazardous substance potential threat as weapons, and LEPCs have been saddled with the expectation of managing this threat, without much or any additional funding.

Funding problems are paramount in emergency planning organizations. It is possible to tabulate the number of accidents responded to, but not the number of accidents averted. Without numbers to back up these "invisible" successes, it is difficult to justify requests for additional funds from localities. Even where emergency planners can justify more funds, the money is simply unavailable in a lot of cases. Functioning with high expectations and limited capacity has been a problem since the advent of

LEPCs in 1987. In addition to resource strains, there are philosophical differences about the "best" allocation of those limited funds in the disaster management literature. In the practitioner studies, most LEPCs are noted to have extremely limited funds, so funding is considered a systemic problem.

Compliance and Proactivity

In addition to being more-or-less effective, LEPCs may also be more-or-less proactive in their actions. The active development and use of proactive or precautionary measures is a means of reducing inherent levels of hazard in the chemical industry, and therefore inherently reducing hazard in local communities. The development of the "precautionary principle," and the concept of "inherent safety" are indicators of a proactive approach to EM. LEPCs that are more proactive may use precaution as a guiding principle for chemical safety and emergency planning. Precaution as a guiding principle in decision-making is a critical area of emerging research in the areas of chemical safety and emergency management.

Statistically, normal accidents due to operator or machine error at facilities manufacturing, using, or storing hazardous chemicals are unavoidable (Perrow 1984). Due to the risk of *normal accidents* and the threat of deliberate attacks on chemical facilities, a movement towards the creation of safer and more secure facilities has been underway. This includes the increased use of safety controls (automatic shutoffs, alarms, etc.) and site security (guards, fences, etc.) along with inherently safer technologies (substitution of safer chemicals, lower temperature or pressure, limitation of impact by changing design or process conditions, and less material stored on site or materials stored in a safer form [liquid vs. gas] (Mannan, Rogers et al., 2003). The use of these

technologies is also a way for companies to stay ahead of the regulatory curve and reduce their liability by reducing on-site accident potential (Ashford and Zwetsloot 2000).

Section 112(r) of the Clean Air Act Amendments (CAA) of 1999

In 1994 the National Environmental Law Center (NELC) found that of 11 LEPCs surveyed in Great Lakes states, only 3 were promoting hazard reduction as a part of their emergency management plan (Stone, Gray et al. 1995). In total, four out of the eleven LEPCs were aware of the concepts "primary prevention" or "inherent safety" (Stone, Gray et al. 1995). The LEPCs promoting hazard reduction were surprisingly not those in counties with the highest number of chemical accidents. It is expected that the promotion of hazard reduction, or proactive steps, will have increased substantially more than 15 years after the implementation of the NELC survey.

The definition and operationalization of the terms "compliance" and "proactivity" are key to this research. There is a fair amount of writing on "organizational compliance" in the literature. This thread is primarily with regard to "organizational citizenship behaviors (OCBs), and can be traced back to Bateman, Smith, Organ & Near (Bateman and Organ 1983; Smith, Organ et al. 1983). This idea can be extrapolated back further to Chester Barnard's "willingness to cooperate" (Barnard 1938). I have briefly summarized and noted this to emphasize that this is not the definition of compliance or organizational compliance that I am using for the purposes of this research. While this is a valid and useful definition of compliance, I have used a far more simple and explicit definition of compliance. Compliance, for the purposes of this research, as used by Adams et al. (1994), Starik et al. (2000), and Templeton and Kirk (2008), is substantively defined as

meeting the objectives for LEPCs as outlined by SARA III. These objectives are explicitly stated in Table 1 (in Chapter 1) of this dissertation.

Similarly, the term "proactivity" has been used in the literature to indicate entities that are acting in an anticipatory or advance-acting capacity. It may include taking additional steps above and beyond those required in preparation or expectation of a future event or situation. This general idea has again been used by others studying LEPCs including Adams et al. (1994), Starik et al. (2000), and Templeton and Kirk (2008) to indicate a series of specific actions LEPCs may take above and beyond their statutory requirements, which might help better prepare these areas for future disasters. The criteria being defined as "proactive" are listed as factors in the right-hand side of Table 1 (in Chapter 1). These proactivity factors encapsulate activities engaged in by LEPCs that are "above and beyond" the basic LEPC obligations and further promote community chemical safety through various measures.

There may also be a "personal disposition towards proactive behavior" amongst members of more proactive LEPCs (Bateman & Crant, 1993, p.103). As stated by Lewin (1938), all behavior originates from both personal and situational sources. Many factors have been loosely linked to proactive behavior on the part of individuals. Of course, organizations are made up of individuals, and individual behavior matters. Bateman and Crant (1993, p.103) also noted that "need for achievement …dominance" and other leadership qualities were correlated with more proactive behavior amongst students. Parker, Williams, and Turner (2006, p.636) state that proactive ideas and problem solving amongst wire makers was significantly associated with "role breadth self-efficacy, flexible role orientation, job autonomy," and coworker trust. So the conditions

experienced by LEPC members, along with their personal traits, may influence their tendency towards more proactive action. This is an important avenue for further research.

This dissertation includes an examination of the relationship between external or structural characteristics and LEPC actions. Much of the literature on LEPCs focuses on psychological or organizational characteristics within the organization. I am interested in pursuing a different focus with my research agenda. I am investigating a relationship between structural characteristics and factors comprising indices for LEPC compliance and proactivity. The results of this research on LEPCs will provide insight into characteristics about external influences on organizational function and may also be generalizable to similarly structured organizations.

A Note on Theory

Portions of this dissertation may be considered to be a-theoretical. While it is based on a thorough review of the literature and discussions with experts, much of the theory is to be induced from the data, itself. There are at least two schools of thought when it comes to the relationship between theory and empirical research in the social sciences (Frankfort-Nachmias and Nachmias 2000). There is a more inductive approach to research and a more deductive approach. The deductive approach begins with a theory and then creates a hypothesis to test that theory. The inductive approach, the one to be used in this study, begins with an observation and pattern recognition and works its way up towards theory development. Induction is a more "bottom up" approach and involves the development of tentative hypotheses that can be tested and repeated to potentially form new theories.

The first deductive approach was put forward by Karl Popper (1968) and can be described as a *theory before research* approach (Popper 1968). This process of falsification can be summarized in the following five steps (Reynolds 1971):

1. Development of a theory or model.
2. Choice of an assertion derived from the theory to investigate.
3. Test the assertion empirically through research.
4. Use theory to examine empirical data. If the assertion is rejected by the data, re-evaluate the theory and start again.
5. If the assertion is not rejected by the data, work to improve the theory or test anew assertion.

The second school of thought, as advocated by Robert Merton, can be described as the *research before theory* approach (Nachmias and Nachmias, 2000). Merton (1968) states:

> It is my central thesis that empirical research goes far beyond the passive role of verifying and testing theory; it does more than confirm or refute hypotheses. Research plays an active role: it performs at least four major functions that help shape the development of theory. It initiates, reformulates, it deflects, and it clarifies theory.

The research before theory approach involves the following four steps in its process (Reynolds 1971):

1. Study of a phenomenon and its characteristics.
2. Detailed measurement of the characteristics (data collection) and how they fluctuate.
3. Analysis of the data, looking for systematic patterns.
4. Use the patterns to develop a theory about the phenomenon.

The research of this dissertation is more reflective of Merton's strategy than of Popper's. While it is based in the theory and work of other scholars, it is not derived directly from any one school of thought or aligned with one specific theory. Merton's justification of theory unfolding organically from the data itself is no less sound scholarship, when undertaken with thoroughness and clarity. In all likelihood, research is actually completed in more of a "spiral" or circular manner, where questions lead to hypothesis testing, which leads to theory development, "new" theories are tested, amended where necessary, and then the cycle continues (Berg 2001). Rather than choosing one approach or the other, it may be more a matter of where in the spiral research process a researcher picks up the intellectual thread.

Questions and Hypotheses

As noted in the literature review, some of the most recent scholarship on LEPCs has been on compliance and proactivity levels. Three nationwide studies have been conducted, two by private contractors for the EPA, one by the EPA themselves (Adams et al., 1994; Starik et al., 2000; USEPA, 2008), looking at a variety of factors, many pertaining to LEPC compliance with the regulations created from EPCRA, and proactive actions. Templeton and Kirk (2008) performed a study of LEPC compliance and proactivity, looking at how these factors are influenced in LEPCs in Virginia. The three EPA studies focused primarily on tracking and documenting the current activity of LEPCs nationwide, and on best practices. No statistical analysis was done, as these were surveys gathering data to inform the agency on current practices in the field. The earlier two studies, completed for the USEPA, used frequencies and cross-tabulations to show

that planning areas with larger populations have increased LEPC performance (Adams et al., 1994; Starik et al., 2000).

The results of the 2008 EPA study stated that "dedicated membership" and regular meetings were the most important contributors to LEPC success. This study also showed that the most active LEPCs had responded to an accident in the last five years and that only 20% of their respondents reported having some sort of operating budget.

Blackwood (2003) studied LEPC performance in relation to activity level, population size, size of LEPC (number of participating members), presence of sub-committees, funding, and paid staff. Specifically, he found that LEPC activity levels had actually gone down amongst study participants in Virginia when compared with previous research. The primary reasons noted for this decline were lower levels of funding, reduced public participation, and limited organizational structure of LEPCs themselves (Blackwood, 2003).

Templeton and Kirk (2008) also collected information on the activity and proactivity levels in Virginia LEPCs. They tested specific hypotheses on the relationship between the activity and proactivity levels in Virginia LEPCs, and number of facilities, population size of planning district, type of LEPC (city, county, or joint) respectively, and the combined influence of these factors. This study used a binary logistic regression to analyze their hypotheses, with 39% of the activity level variation in their model explained by number of facilities present in the planning area (R^2=.390, $p<0.001$) and nearly 36% of the proactivity level variation in their model explained by the same (R^2=.357, $p<0.001$). They found no statistically significant relationship between activity and proactivity levels and "perceived effectiveness". Perceived effectiveness was defined

in this study as a survey response to whether LEPC members subjectively felt their LEPC was effective. While this study showed a relationship between activity and proactivity levels and number of facilities, respectively, it left out other important factors that may be related. In addition to experience, funding and community characteristics may also play a role.

The research questions and hypotheses in this dissertation were derived from careful consideration of the fields discussed above. The compliance and proactivity levels are established using the indices cited in Table 1 (Chapter 1). Factors included in the compliance scale are activities that are legislatively required of the LEPC. Factors included in the proactivity scale are activities that might be considered "above and beyond" the mandated requirements to ensure chemical safety and security in their community. LEPC compliance and proactivity's respective relationship to each of the independent variables, including the number of chemical facilities reporting to a county's LEPC, the urban/rural characterization of the county, the population size of the county, the accident experience of the LEPC, and whether or not they receive funding for full or part-time staff will be examined. Each of these variables will be justified below. It is expected that LEPCs are more compliant or proactive, (i.e., positively related) if they have:

1. More regulated facilities in their county
2. Have a larger county population
3. Are more urban
4. Have accident experience within their recent (5-year) history

This study examines these factors for correlative relationships.

- Question 1: What are the levels of compliance and proactivity for LEPCs?
- Question 2: Are compliance and proactivity levels correlated with the number of chemical facilities, population size, metropolitan nature of community, and/or relative accident experience of LEPC, respectively?
- H(1a): The compliance score is higher in LEPCs with more regulated facilities within their jurisdiction.
- H(1b): The proactivity score is higher in LEPCs with more regulated facilities within their jurisdiction.

Justification: LEPCs responsible for more regulated facilities have more inherent hazard in their jurisdiction. It seems reasonable to expect that knowledge of large quantities of hazardous materials would elicit greater concern, and greater attentiveness to compliance and proactivity actions.

- H(2a): The compliance score is higher in LEPCs with larger populations in their jurisdiction.
- H(2b): The proactivity score is higher in LEPCs with larger populations in their jurisdiction.

Justification: LEPCs in areas with larger populations have more "at stake." As a pure numbers game, larger populations are likely more at risk due to densely populated areas. Any EHS accident that may occur would have greater likelihood of impacting larger numbers of individuals. It is logical to expect that LEPCs would act to ensure that emergency plans (compliance) are in place and it is reasonable to think that these LEPCs

might go above and beyond their expected duties to ensure public safety in areas with larger populations.

- H(3a): The compliance score is higher in LEPCs in more metropolitan, less rural areas.
- H(3b): The proactivity score is higher in LEPCs in more metropolitan, less rural areas.

Justification: Similar to the rationale for larger populations, LEPCs that include more metropolitan, less rural areas may have a stronger incentive to be compliant and/or proactive due to more densely populated areas. Metropolitan areas may have greater capacity (access to funding and resources) than more rural, isolated areas as well.

- H(4a): The compliance score is higher in LEPCs with more relative accident experience.
- H(4b): The proactivity score is higher in LEPCs with more relative accident experience.

Justification: LEPCs with more accident experience might have learned from their experience and are therefore more likely to be compliant or proactive based on heuristics. If an LEPC has dealt with more accidents in its jurisdiction, relative to other LEPCs, they have first-hand experience of how prepared they are in some accident scenarios (as each accident will be unique in many factors, e.g. timing, substance involved, location, etc.) It is reasonable to expect that this first-hand knowledge might inform their actions, resulting in more compliance with regulatory requirements and more proactive action to minimize risk to the community.

CHAPTER III

RESEARCH METHODOLOGY

Introduction

Chapter III summarizes the methodology used to research Ohio LEPC compliance and proactivity levels, along with related factors. An initial review of the area of study will be followed by a discussion of the choice of survey methodology and its application. This chapter will conclude with a description of the variables, survey instrument, and analysis methods undertaken. Results and analysis of results will be presented in the following chapters.

The creation of LEPCs dawned a new era in American emergency planning. The emphasis on local, participatory decision-making has honed the process of planning and managing disasters from a rough, patchwork of actors to a more cohesive coordinated system of local units. The compliance and proactivity of LEPCs are examined in relation to a *compliance-proactivity index* developed by Adams et al. (1994) and updated by Starik et al. (2000). LEPCs were surveyed and demographic data was collected to characterize basic similarities and differences between LEPC groups. Several factors are explored specifically in relation to LEPC compliance and proactive behavior: county population size, characterization of jurisdiction (rural, suburban, urban), number of

facilities regulated within the county, and number of chemical accidents within the last five (5) years. Each of these is suggested in the literature as a factor that may affect LEPC compliance or proactivity. The methodology used for this research is primarily a web-based survey of LEPC members, along with supportive data gathered from the 2010 U.S. Census.

Research Design

This project essentially captures a "moment in time" and provides descriptive information along with testing of the research hypotheses for probative causation. The survey method enabled the researcher to gather information from an accessible population in a convenient manner. Survey research is noted to be logical, deterministic, parsimonious, and has specificity (Babbie, 1990). The rapid turnaround and economy of design are also of great appeal in designing a research project of this nature (Babbie, 1990). In general, web based surveys are considered beneficial for their cost-effectiveness and convenience to respondents. Shih and Fan's (2008) meta-analysis showed that responses from a web-based survey are similar to survey responses gathered through traditional mail survey methods with several caveats. According to Shih and Fan (2008), survey response rates are slightly higher on average in mailed surveys than web surveys, but this rate varies with follow-up reminders and type of population addressed. For this study, all respondents were offered the option of a paper survey if the web survey was not a suitable option.

A cross-sectional Internet-based survey was used to collect information from a representative member of each of the sampled 87 LEPCs. There is one LEPC in the sample representing each of Ohio's 88 counties, with the exception of Montgomery and

Greene counties, which have combined their planning efforts into one LEPC. Ohio has been chosen as the sample area for practical reasons of research proximity (access) and as a convenience sample. All LEPCs within Ohio are subject to the same laws and regulations under the State Emergency Response Commission (SERC) and Ohio Emergency Management Agency (OEMA). It is reasonable to think that the results of the research study will be generalizable geographically to LEPCs functioning outside of Ohio that are demographically similar. The results of this study will be compared to the results of a previous nationwide study of LEPCs, as a means of assessing similarity or difference between this sample and the LEPCs in the United States overall and possibly enabling generalization.

Study Sample and Population

The study population consists of all LEPCs within the United States. There are at the time of the study more than 3,000 LEPCs listed in the USEPA database. Ohio was chosen as the location for this study sample for several reasons. Ohio's geographical position, bordering the Great Lakes, the largest body of freshwater in the world, makes it a place of global consequence. In addition, Ohio was also one of the top three states accounting for TRI releases, along with Texas and Indiana, according to a survey of the data in 1988 and again in 1999 (Graham and Miller, 2001). These three states account for a total of nearly 20% of all national releases. Ohio's high rate of TRI reported releases is primarily due to large numbers of small to medium sized facilities (around 1,550 facilities averaging 77,000 pounds of EHS per facility, or a total of approximately 119,350,000) (Graham and Miller, 2001). The most recent TRI data, from 2010, shows Ohio ranking fourth highest amongst all states nationally in TRI releases, with a total chemical release

(including on-site and off-site disposals and releases) of 159,028,131 pounds of EHS (United States Environmental Protection Agency, 2010) The top three highest chemical release states in 2010, according to TRI data, were Nevada (479,873,201 lbs. released), Utah (213,963,676 lbs. released), and Texas (209,685,795 lbs. released). So although Ohio is ranked lower nationally, the total number of pounds of chemicals released has increased within the last ten years.

All LEPCs within Ohio are accountable to the same state government bodies: the Ohio State Emergency Response Commission (SERC), the Ohio Emergency Management Agency (OEMA) and the Ohio Environmental Protection Agency (OEPA). This ensures some measure of "control" over the expectations and framework within which all LEPCs in the study are functioning. The variation from state to state with implementation of EPCRA is not unimportant, but is in general not of consequence to the characteristics being examined in this study. In general, one of the main implementation differences is the scale of each LEPCs jurisdiction LEPCS are organized by county in many states, but in others they are by metropolitan area or other designation.

The survey involved contacting representatives of each of Ohio's LEPCs at the time of the study. The sample of LEPCs included in the study was a convenience or purposive sample. LEPC members include representatives from the following groups and organizations: elected state and local officials; law enforcement personnel; emergency management personnel; firefighting personnel; first aid personnel; hospital personnel; health personnel; local environmental personnel; transportation personnel; broadcast and/or print media personnel; community groups; and owners and operators of subject

facilities. SERC appoints LEPC members to two-year terms of office, with opportunity to serve multiple terms.

The USEPA LEPC database, available on the USEPA website, was used as a sampling frame for the LEPC population. Each LEPC was contacted by phone using the name and number listed in the USEPA public database. A second, and for some, third round of phone calls was conducted before the name/ contact information of the best and/or current contact was found (frequently either the Information Officer or the LEPC Chairperson). Contact information (email address, phone number, knowledgeable respondent name) was confirmed during these phone conversations. All individuals contacted reported having access to email and the Internet at the time of the study, and all but one LEPC contacted agreed verbally that they would participate in the study once contacted with the materials. Participants were asked whether a web-based survey would prove problematic, but all agreed that they had adequate Internet access and would respond electronically, so no alternative means of survey implementation was necessary. In total 58 LEPCs responded and completed the online survey out of the original 87 LEPCs that were sent surveys. This gives a sample response rate of 67% of the original sample.

Validity and Generalizability

External validity is related to the generalizability of the study's findings. A grounded theory approach was used to study a sample of LEPCs. Strauss and Corbin (1984) articulate the term *theory* as "a plausible relationship among concepts and sets of concepts," as interpreted by Creswell (1998, p.56). Shadish, Cook, and Campbell's grounded theory of causal generalization was used (2002). Shadish, Cook, and Campbell

recommend closely adhering to five principles in order to make appropriate causal generalizations. These principles are used to control for construct validity and external validity when looking for probative causal connections. Shadish et al.'s (2002) principles are included below in Table 3.

Table 3.

Principles to control for validity when looking for probative causal connections

List of Principles
1. Surface similarity
2. Ruling out irrelevancies
3. Making discriminations
4. Interpolation and extrapolation
5. Causal explanation

Shadish, Cook, & Campbell (2002)

Each of the concepts included in Table 3 will be explained in detail, as they are important to the design of this study. The purposive or convenience sample used for this project is "not backed by statistical logic that justifies formal generalizations, even though [it]…is more practical than formal probability sampling" (Shadish, Cook, & Campbell, 2002, p. 356). The theory of generalized causal inference allows for a logic for probative causal research based upon what scientists actually do. The concept of *Surface Similarity* includes the use of *Campbell's Principle of Proximal Similarity*, which states that causal relationships found in one circumstance or situation are generalizable to another circumstance or situation that is similar on selected distinguishable features. Overall, the principle of *Surface Similarity* is an examination of the target of the study in comparison to the target of generalization, assessing for similarities (Shadish, et al., 2002). In this

case, the target of study, LEPCs in Ohio can be compared to the target of generalization, LEPCs in the United States. LEPCs throughout the U.S. were created using the same federal mandate (EPCRA) and are all expected to meet the same goals, regardless of their geographic location. They have a surface similarity in both their structure and function. Variations in geographic region, such as population density and hazards, also vary throughout the sample area.

Shadish et al.'s second principle of generalized causal inference, *Ruling Out Irrelevancies*, looks to distinguish any construct or variation that is irrelevant to the subject under study (2002). This principle looks for information that may differ between the study group and the group being generalized to, which is unimportant to the concepts and attributes being examined. The real differences that do exist between Ohio and other parts of the United States, may be of little consequence to this study. Irrelevant differences are discounted, as dealing with a hazardous chemical spill in a large city in Nebraska is likely similar in most ways to dealing with a hazardous chemical spill in a large city in Ohio.

The third principle, *Making Discriminations*, distinguishes features that may limit generalizability. Campbell and Fiske's (1959) argument states that any new construct is created with its author already having in mind how it differs from previous constructs. The very act of definition implies that one is creating distinctions, which must be verified (Shadish et al., 2002). The sample is within the boundaries of the state lines of Ohio, and there may indeed be some differences with the implementation of emergency planning and management methodologies in Ohio that are not consistent with other parts of the country. Hawaii or Alaska, for instance, may have unique circumstances to which the

generalizability of this study would not apply. Being an island state or a remotely located one may bring about unique circumstances that would not be seen in response to EHS emergencies in the continental United States.

The last two principles comprising the theory of generalized causal inference are interpolation and extrapolation, and causal explanation. The fourth principle, interpolation and extrapolation refers to generalizing "by interpolating to unsampled values within range of sampled… [items] and by extrapolation beyond sampled range" (Shadish et al., 2002, p.358). This principle states that frequently research includes external validity inferences and infers values between gathered data points, and above and below the observed range of data points for sampled values of a construct.

Finally, Shadish et al.'s (2002) fifth principle involves the generation and testing of theories about the target of generalization. This causal explanation can refer to deep similarity, or similarities not seen at the surface. An example of this might be an examination of heart attacks in humans. Women and men are now known to show very different symptoms during a cardiac event, but the internal problem is the same; a heart in distress due to inadequate blood supply. On the surface, a woman with stomach pains, shoulder blade pain, exhaustion may seem to have a very different problem than a man with gripping chest pains and left arm pain, however the "deep similarity" is the true cause of both instances. Causal explanation is an important contributor to construct validity and external validity. In this study, causal explanation will include careful examination of all data in multiple ways, multiple times. Examination of demographics, cross-tabulations, and correlations, in addition to logical, rational examination of the data are core components of searching for "deep similarity" between sample data and related

studies. By following these general guiding principles of probative causal inference, careful examination of this sample data can be completed with a non-probability, convenience sample.

The survey data was collected to characterize the population of LEPC's location(s) on *compliance-proactivity indices* (located in Table 1, Chapter 1). The terms *compliance* and *proactivity* are described in detail and examined in the context of their use by other researchers in Chapter II of this dissertation). An index is a combination of empirical variables used to represent the phenomenological abstract concept of interest (Bowen & Bowen, 1999).

The factors included in the Compliance Index are those required by SERC under SARA Title III as responsibilities of LEPCs, and therefore indicate compliance with SARA Title III's requirements. They are listed again in Table 4 below.

Table 4.

Compliance Index Factors

List of Compliance Index Factors (derived from SARA Title III)
Have a chairperson
Have a community emergency coordinator
Have an information coordinator
Hold regular meetings
Advertise meetings to the public
Develop an emergency response plan (ERP)
Submit ERP to the SERC
Publish newspaper notice about availability of ERP
Review ERP within last year

These factors are shown in no particular order, but will be combined additively with uniform weights to give each LEPC a Compliance "score", assuming we operationalize "Compliance" explicitly as the Ohio SERC's requirements of LEPCs as completing the above. In theory the compliance score may vary from zero, if the LEPC has not fulfilled any of the requirement, to nine, if it has fulfilled all of them. Similarly, the factors included in the Proactivity Index will be combined to yield a Proactivity "score" for each participating LEPC. The term *proactivity* is used to describe some of the activities that an LEPC might undertake that go above and beyond the requirements to achieve compliance. Completion of these items is the operationalized definition of *proactivity* for the purposes of this research. The proactivity factors are listed in Table 5 below.

Table 5.

Proactivity Index Factors

List of Proactivity Index Factors
Meet quarterly or more often
Report making informed hazard reduction, accident prevention, or pollution prevention recommendations to industry/ local government
Update ERP within the past year
Practice ERP within the past year
Incorporate proactive language into LEPC mission.

The Proactivity score was constructed similarly to the compliance score. In theory the Proactivity score may vary from one, if the LEPC has not fulfilled any of the requirements, to five, if it has fulfilled all of them.

LEPC Survey Instrument

The survey itself is comprised of questions extracted from previously published LEPC surveys used by Lindell and Brandt (2000) and Starik et al. (2000) along with original questions. The survey instrument in its entirety can be seen in Appendix B. Lindell and Brandt (2000) survey was originally developed to study LEPCs in Michigan. The Starik et al. (2000) survey was a national survey of LEPCs in the United States commissioned by the EPA. As stated above, many of the survey components used by Lindell and Brandt were also derived in part, from previous surveys published in the literature (2000).

Table 6 shows the relationship between the variables, research hypotheses, and survey questions. It is expected that the independent variables will all serve to positively influence both dependent variables (individually and collectively).

That is to say, it is expected that the more chemical accidents within an LEPC's jurisdiction, the larger the population size, the more urban (as compared to more rural), and the more chemical facilities functioning within a county, the higher the LEPC's respective Compliance and Proactivity scores will be. Each of these is hypothesized to independently impact the scores positively, along with an aggregate effect. The survey was divided into several sections, including the following:

- ✓Contact information
- ✓ About your locality
- ✓ About LEPC Meetings
- ✓ About LEPC Members
- ✓ About LEPC Activities

Table 6.

Variables, Research Questions, and Survey Items

Dependent/Independent Variable	Concepts theorized to influence LEPC Compliance	Associated Hypothesis	Literature Source	Associated Survey Question(s)
Dependent Variable:	* chairperson			Q. 7
LEPC Compliance Score	*community emer. coordinator	N/A		Q. 10
	*information coordinator			Q. 10
	*regular meetings			Q. 11
	*advertise meetings publicly		Starik et al, 2000	Q. 17
	*develop ERP			Q. 14
	*submit ERP to SERC			Q. 15
	*Public notice of ERP			Q. 17
	*Review plan w/in last year			Q. 14
Independent Variable:	Number of chemical facilities within LEPC jurisdiction	H1(a)	Templeton & Kirk, 2008	Q.21

Dependent/Independent Variable	Concepts theorized to influence LEPC Compliance	Associated Hypothesis	Literature Source	Assc Survey Question
Independent Variable:	Population size of jurisdiction	H2(a)	Adams et al., 1994, Starik et al. 2000	Q.2
Independent Variable:	Relative accident experience of LEPC	H4(a)	Lindell & Perry, 2001	Q.19
Dependent Variable: LEPC Proactivity Score	Quarterly meetings	N/A	Starik et al, 2000	Q. 11
	Make hazard rdxn recommendations			Q. 24
	Update plan w/in last year			Q. 14
	Practice plan w/in last year			Q. 18
	Proactive language in Mission Statement		Templeton & Kirk,	
Independent Variable:	Number of chemical facilities within LEPC jurisdiction	H1(b)	2008	Q. 21
Independent Variable:	Population size of jurisdiction	H2(b)	Adams et al., 1994,	Q. 2
Independent Variable	Urbanization of jurisdiction	H3(b)	Starik et al. 2000	Q. 3
Independent Variable	Relative accident experience of LEPC	H4(b)	Lindell & Perry, 2001	Q.19

Generally, this survey gathered data about each LEPC's activity and proactive efforts established using the criteria listed in Table 1, factors discussed in the literature review, and the conceptual framework. A total of thirty-five (35) items were presented on the questionnaire. A number of these asked for descriptive, categorical, or nominal information about the LEPC, some were objective "yes" or "no" questions about the LEPCs actions, and a few were Likert-type questions. An example of a Likert scale question included is: "How familiar are you with your LEPC's emergency response plan?" The response choices are: very familiar, familiar, somewhat familiar, slightly familiar, and not at all familiar. Other questions with Likert scale response choices used the "strongly disagree, disagree, agree, strongly agree" choice set.

The survey itself included a cover page and closing instructions, which are also included in Appendix B. The web venue "Survey Monkey" was used to create and administer the online survey. Responses were tracked and monitored on the SurveyMonkey website. All information on SurveyMonkey was available only via password on a secure server. All respondents' data was kept private and was not visible to other respondents. The cover page was the first page seen by respondents on the SurveyMonkey login page, and introduced the survey, stated the objectives and goals of the project, emphasized the value of participation, made a statement about result confidentiality in compliance with IRB Regulations, and included information for retrieval of survey responses. A copy of the IRB approval form is included in Appendix C.

Respondents were also reminded that participation in the survey is voluntary, and were provided with contact information for myself, my faculty advisor, Dr. William

Bowen, and the CSU IRB Board in the event that they had questions or concerns. It was stated on the login page that entering the access code and logging in to the survey website served as agreement with and understanding of the terms and conditions of the survey. The online survey format used radio buttons and textboxes; the copy of the survey included in Appendix B is a paper representation of this web-based document.

Permission was obtained to include components of Lindell and Brandt's (2000) survey instrument (see Appendix). Measures established in the survey questionnaire have been used and tested in several previous studies (James & Sells, 1981; Lindell & Brandt, 2000; Lindell & Whitney, 1995). As a component of the survey, a goal identification scale, developed by Lindell and Whitney, includes nine questions about chemical hazards in the community and how effective emergency planning is in reducing these hazards. Organization-level data, such as degree of community support and media awareness of LEPC activities, evacuation experience, and subcommittee structure within the LEPC are included in eight questions in the survey.

Survey Pre-test. A brief note on the organization of Ohio's emergency managers: for emergency management purposes, Ohio's counties are divided into nine regions by OEMA. Each of these nine regions is headed by a regional field coordinator, whom oversees the work of LEPCs within their region. The draft survey was sent to the manager of the regional field coordinators within the Ohio Emergency Management Agency (OEMA), and the OEMA director. The survey was field tested by three members of the OEMA and two members of the OEPA. OEMA is the supervisory body to LEPCs in Ohio, and the field coordinators directly oversee LEPCs within their region of the state. These individuals helped to establish face validity and improve format and quality,

and were able to provide feedback on the survey instrument without creating additional bias in the study population. Their feedback was helpful in attempting to control for issues with technical concepts or practitioner-specific language use in the survey instrument.

Field test respondents provided feedback that led to minor changes in the survey format, language, and length. They reported in comment that overall the survey appeared to include valid, relevant questions to the work of LEPC members, and that the length/time required for the final survey was reasonable for respondents to complete (approximately 20 minutes.) The length/ time commitment was important in attempting to obtain the highest possible response rate.

Institutional Review Board consent. All survey materials including introductory letter, survey instrument and required forms were submitted to the Cleveland State University (CSU) Institutional Review Board (IRB) for approval to conduct research with human subjects. Materials include discussion of participant privacy concerns and any risks presented by participation in the study. A brief description of the project, copy of the informed consent form and questionnaire was filed with the application. Approval was granted and is on file at CSU's IRB office under: IRB Protocol 28231-BOW-HS. (See Appendix C)

Data collection. The process of implementing the survey was a multi-step process following the Tailored Design Method, as outlined by Dillman et al. (2009). Once all of the contacts were made and the email addresses verified, an initial "prenotice" email was sent alerting the respondents that an email containing the LEPC survey would be arriving within the week. Email was sent from the researcher's

University email account to show its affiliation with a CSU student. All email was addressed individually to each respondent by name at the top of the letter. This "personal touch" was noted in the literature to improve web response rates (Dillman et al. 2009). As many individuals receive dozens if not hundreds of emails a day, any step that might be used to my advantage to improve response rates was taken. This was followed a few days later by an email containing a link to the survey, including a secure access code, along with an introductory letter. Email follow-up reminders were sent one week and two weeks after initial contact to non-respondents.

Questions and hypotheses. An examination of LEPCs was made based, in part, on two indices developed by Starik et al. (2000). These indices were designed to estimate the compliance and proactivity (or pro-activeness) of LEPCs (See *Table 2*).

- Question 1: What are the levels of compliance and proactivity for LEPCs?
- Question 2: Are the compliance and proactivity levels influenced by the number of chemical facilities, population size, metropolitan nature of community, and/or relative accident experience of LEPC?
- H(1a): LEPCs compliance scores is positively correlated with number of regulated facilities.
- H(1b): LEPC proactivity score is positively correlated with number of regulated facilities.
- H(2a): LEPC compliance score is positively correlated with population size of jurisdiction.
- H(2b): LEPC proactivity score is positively correlated with population size of jurisdiction.

- H(3a): LEPC compliance score is positively correlated with greater "urban-ness."
- H(3b): LEPC proactivity score is positively correlated with greater "urban-ness."
- H(4a): LEPC compliance score is positively correlated with more accident experience.
- H(4b): LEPC proactivity score is positively correlated with more accident experience.

Dependent variables. The dependent variables in this study are the *compliance score* and *proactivity score*, respectively constructed from Table 1. The variables used to construct these scores or indices were objectively gathered by responses to survey questions. The values were summarized additively, with uniform weights. The compliance can be rated on a scale ranging from organizations that are least compliant with regulatory requirements or "not compliant" fulfilling less than five (5) of the stated requirements to "mostly compliant" organizations that complete five to six of the listed requirements, to "compliant" groups that complete seven or more of the listed requirements, as described and used by Starik et al (2000) and later by. requirements.

Similarly, following along the work of Starik et al. (2000), LEPCs were determined to be "very proactive" if they completed at minimum three (3) of the objective measures for proactivity (Table 1) and "somewhat proactive" if they completed at least one (1) factor. While these categories in both proactive and compliance cases were considered for classification purposes, they were not used during statistical analysis. Straight index scores were used as calculated (e.g. a score of "5" on a compliance index

was used simply as the value "5" in the statistical analysis.) The two dependent variables are:

- Y_1 = LEPC Compliance Score
- Y_2 = LEPC Proactivity Score

Explanatory variables. Explanatory variables, extracted from the literature, along with their associated hypotheses, are listed in Table 6. The goal of the study is to elucidate which of these factors can account for variation seen in the dependent variables, *LEPC compliance and LEPC proactivity*. The explanatory variables have been operationalized from their conceptual basis, and included as questions within the survey questionnaire (Appendix 2). Each individual explanatory variable has an associated hypothesis, also listed above. The data for the explanatory variables were gathered via responses to the survey questionnaire. The explanatory variables are as follows:

- X_1 = number of facilities within jurisdiction
- X_2 = population size within jurisdiction
- X_3 = urbanization of jurisdiction
- X_4 = relative accident experience of LEPC

Each of these variables is being studied for its contribution to the overall level of compliance or proactivity of each LEPC and has been defined in the literature review in the context of other research and their expected relationship to each other. LEPCs in counties with larger numbers of facilities within their jurisdiction have a greater potential hazard (via quantity and/or location(s) of EHS) and it may follow that they would take greater measures towards preparedness. LEPCs in counties with larger populations have a larger number of individuals to protect, in contrast to a very sparsely populated county,

and therefore may take more or greater steps towards emergency preparedness. According to the literature, LEPCs in counties with more urban centers (greater urban-ness than rural-ness) may be more prone towards preparedness measures to protect cities. LEPCs that have staff more experienced in actual management of chemical emergencies may work more towards compliance and proactivity as their experience has informed them of weaknesses and strengths of their capabilities. Finally, LEPCs with greater funding for staff may have better compliance and proactivity scores as they simply have more capacity. More money enables more action and preparation. Paid staff are more able to devote time and energy to working towards emergency preparedness than volunteers helping out after other primary employment.

Coding and analysis of data. Raw data was stored in a series of spreadsheets. Data for each survey question that was associated with a factor for the Compliance Score was scored with a zero or one for absence or presence of the factor by that LEPC. The totals for all Compliance Score factors for each LEPC were summed to equal that LEPC's Compliance Score with a maximum possible score of eight (8). The Proactivity Scores were calculated using the same process on the Proactivity Score question data with a maximum possible score of four (4). Correlation tables and Chronbach's alpha were used to ensure internal consistency for each of the factors that make up the Scores. Any missing values were tabulated, and cases with less than 90% response to the index questions were not included in the final data set. All hypothesis testing was established at the 0.05 level of significance, with the exception of where analysis at the 0.01 level could be confirmed.

Coded data was sorted and summarized for descriptive measures, and are reported in the Results chapter of this document. PASW Statistical Software was used to statistically analyze data. Correlation matrices and factor analysis was used to ensure independence of variables. Bartlett's test of sphericity indicated data was not spherical.

Spearman's correlation test was run on the data set, in addition to descriptive data measures. Descriptive data and correlation results were also compared, where appropriate, with previous U.S. data gathered for the USEPA.

Bootstrapping

The bootstrapping technique was used to resample with replacement giving a new sample of N=4500. The new sample size was chosen to estimate a value closer to the total number of LEPCs within the United States. This technique allows the researcher to expand the sample, which is the best proxy of the population, in order to improve the statistics that result from the calculations. This technique makes the assumption that the sample collected is one of many possible samples that may have been gathered at the time of the research. Bootstrapping allows the researcher to estimate a sampling distribution for the statistic of interest (the mean) by taking repeated samples with replacement within the data set (Field, 2009). It essentially regards the data set as the population from which repeated samples are taken. By taking many repeated samples (N=4500), it is possible to estimate the sampling distribution and therefore the standard error, which allows the computation of confidence intervals and eventually tests of significance (Field, 2009). Data that was bootstrapped was used for hypothesis testing.

The dependent variable data are ordinal (categorical) in nature. The data collected from the indices provide information in reference to each other (ordered categorical data),

but not about the characteristics of the information between the data points. In order to accommodate this data, only appropriate analysis methodologies were utilized. Spearman's rank correlation test was used to analyze the relationship between the dependent variables and each of the respective independent variables.

CHAPTER IV

RESULTS

Introduction

Representatives from a convenience sample of 87 Ohio LEPCs were sent an invitation to complete an online survey about their work practices and experiences as a member of an LEPC. Of those, 58 responded and completed the survey, giving an overall response rate of 67%. Frequencies and cross-tabulations were computed to facilitate data analysis and comparison with a previously published USEPA study (2008). In 2008 the USEPA completed its most recent round of surveys on LEPCs nationwide. Data from this investigation is examined relative to national averages to analyze whether similar trends exist and to establish grounds for generalization to LEPCs nationwide.

The results of hypothesis testing are limited to measurement of LEPC compliance and proactivity, relative to the objectives being studied: number of chemical facilities within county, urban-rural characterization of county, chemical accident experience of LEPC, and population size of county. This study measures this relationship over the course of a period of time between one and five years. Future studies may provide a more longitudinal, comprehensive measure of these relationships by examining them over

longer period of time. Any results of this study compared with the 2008 USEPA nationwide study were only included when the questions were identical.

Validity and Reliability

In general, validity is a way to gauge whether the researcher is actually measuring the phenomenon that they are attempting to measure. Threats to validity are always a concern in social science research, and attempts were made to control for threats to the validity of this study. Internal validity or logical and/or causal flaws within the research can be impacted by several areas within the research including subject variability, population size missing factors, and poor data interpretation among others (Shadish, Cook and Campbell 2002). Attempts were made to control for validity through the use of several methods. A partial correlation test, shown below in Table 7, and Chronbach's alpha were used to establish measures of internal consistency. The partial correlation analysis showed that each of the variables being measured is independent and uncorrelated, and the Reliability analysis showed an acceptable result of $\alpha = 0.83$.

Table 7.

Correlation Matrix for Independent Variables

	Facilities	Pop. Size	"Urbanness"	# Chemical Accidents
Facilities	1	-.123 (.179)	-.076 (.284)	-.002 (.493)
Pop. Size	-.123 (.179)	1	-.051 (.353)	.045 (.368)
"Urbanness"	-.076 (.284)	-.051 (.353)	1	.053 (.346)
# Chemical Accidents	-.002 (.493)	.045 (.368)	.053 (.346)	1

Principle Component Analysis (PCA), the results of which are shown in Table 8, shows that the four independent variables are more or less equally distributed in their explanation of the total variance. The extracted results show that each of the four independent variables explain approximately one-quarter of the variation noted in the sample. The primary outcome of PCA is to use an orthogonal transformation to look for correlation between the variables. This analysis also showed the independent variables in the data set to be uncorrelated.

Table 8.

Total Variance Explained by Principle Component Analysis

Component	Eigenvalues	% Variance	Cumulative %
# of Facilities	1.14	28.499	28.499
Population Size	1.054	26.341	54.84
"Urbanness"	0.992	24.79	79.629
# Chemical Accidents	0.815	20.371	100

Survey Results

Demographic characterization of counties by population size. The respondents reported representing a range of county populations, in both size and urbanization (see Tables 9 and 10), with nearly 40% (23 groups) representing a population of 50,000 or less, almost one-quarter (13 groups) representing a population between 50,001 and 100,000, and around one-third representing a county between 100,001 and a half-million individuals. Five percent of respondents oversee a county with between a half-million and one million people, and only around 3 ½% of respondents

reported serving a population of more than one million individuals. When compared to US Census data from 2010, the percentages of each population category represented in this study are relatively similar to the percentage distribution of the state data by county. In comparison to the 2008 US EPA survey of LEPCs, Ohio contains a larger percentage of counties (LEPC jurisdictions) with populations in the 50,001-100,000 and 100,001-500,000 categories than the nation has overall. The U.S. overall contains a larger proportion of small (population less than 50,000) LEPC jurisdictions than Ohio (62.5% of U.S.; 39.7% of sample).

Table 9.

Population Size Served by LEPCs

Population Size	Sample Data (Ohio)	US Census Data for Ohio counties (2010)	2008 Nationwide Comparison Study
less than 50,000	23 (39.7%)	39 (44.3%)	62.50%
50,001 to 100,000	13 (22.4%)	21 (23.9%)	15.80%
100,001 to 500,000	17 (29.3%)	23 (26.1%)	17.20%
500,001 to 1,000,000	3 (5.1%)	3 (3.4%)	2.60%
more than 1,000,000	2 (3.5%)	2 (2.3%)	1.90%
n	*58*	88	939

Characterization of LEPC service areas. The service area most commonly represented in this sample was "Mainly Rural/ Some Suburban" with approximately one-half of the respondent LEPCs response, while the second most commonly reported area represented among respondents was "Mainly Rural" with one-quarter of the response. "Mainly Suburban" and "Mainly Urban" each accounted for less than 10% of the respondents, respectively, and finally "Mainly Suburban/ Some Urban" was characterized as the service area for 5% of the respondents. Comparatively as shown in Table 8, the distribution of LEPCs in the Ohio sample is primarily mainly rural/ some suburban (51.7%), while according to the USEPA 2008 study, LEPCs jurisdictions in the nation overall are more balanced towards an even split between mainly rural (45.8%) and mainly rural/ some suburban (41.3%.)

Table 10.

Characterization of LEPC Service Areas or "Urban-ness"

Characterization of Service Area	Ohio Sample_f (%)	2008 Nationwide Comparison Study (%)
Mainly Rural	15 (25.9%)	45.80%
Mainly Rural/ Some Suburban	30 (51.7%)	41.30%
Mainly Suburban	5 (8.6%)	3.70%
Mainly Suburban/ Some Urban	3 (5.2%)	6.60%
Mainly Urban	5 (8.6%)	2.60%
n	58	939

Characterization of LEPC membership. Sample LEPCs reported more than 22 different entities represented in community LEPCs, including emergency medical/hospital personnel, firefighters, emergency services personnel, law enforcement, regulated industry, public health agencies, Red Cross/ volunteer organizations, and state/local officials (all represented in more than 90% of groups surveyed.) A complete list of all represented entities is available in Table 11.

Table 11.

Representative Organizations Participating in LEPCs

Groups Represented:	Ohio Sample f (%)	2008 Nationwide Comparison Study (%)
Agriculture	22 (39.3%)	Not included
Chief Administrative Officer's Staff	25 (44.6%)	Not included
Civil Defense/ Emrgncy Management	52 (92.9%)	87.10%
Community Groups	34 (60.7%)	63.60%
Emergency Medical/ Hospitals	58 (100%)	83.40%
Environmental Agency	34 (60.7%)	45.50%
Firefighting	58 (100%)	93.20%
Labor Groups	1 (1.8%)	Not included
Law Enforcement	58 (100%)	90.70%
Local Industry	54 (96.5%)	68.30%

Groups Represented:	Ohio Sample f(%)	2008 Nationwide Comparison Study (%)
Municipal/ County Attorney's Office	11 (19.6%)	Not included
Newsmedia (print, A/V)	35 (62.5%)	54.00%
Planning/ Community Development	11 (19.6%)	Not included
Public Health	58 (100%)	83.70%
Public Works/ Engineering	39 (69.6%)	Not included
Red Cross/ Volunteer Groups	54 (96.5%)	80%
Schools	15 (26.8%)	Not included
State/ Local Elected Officials	51 (91.1%)	State: 11.3% Local: 83.3%
Truck/ Rail Carriers	7 (12.5%)	52.40%
Other (please specify)	13 (23.2%)*	14.1%**
n	58	939

* Other includes: concerned citizens, amateur radio, Coroners office, Military, US Coast Guard, Bank, JFS
** Other includes: local schools, colleges, universities, agriculture groups, public utilities

Two-thirds of respondent LEPCs reported having greater than 20 members, while the remaining one-third reported between 11-20 members. The average meeting attendance was stated as being 11-15 individuals for 41% of the groups, with around 30% of LEPCs in the sample reporting between 16-20 attendees, and around 10% of LEPCs

respectively noting meeting attendance as either more than 20 members or 6-10 members. One group acknowledged that its meetings generally included only 1-5 persons in attendance. So while most groups (two-thirds) in the sample reported having 20 or more members in their LEPC, more than 60% have meeting attendance of 15 or less participants.

Table 12.

LEPC Sample Membership and Meeting Attendance

Sample Membership/ Attendance	LEPC Group Membership	Average Reported Member Attendance at Meetings
	f (%)	f (%)
1-5 members	0 (0%)	1 (1.7%)
6-10 members	0 (0%)	6 (10.3%)
11-15 members	8 (13.8%)	24 (41.4%)
16-20 members	11 (18.9%)	20 (34.5%)
more than 20 members	39 (67%)	7 (12.1%)
n	58	58

LEPC membership numbers and meeting frequency. Meetings were reported as occurring quarterly in the last 12 months for 44% of groups, biannually for one-quarter of respondents in the sample, annually for 16% (9) of groups, and more frequently than

biannually for 15% of groups. In addition, one LEPC reported meeting monthly for a total of 12 times in the last year. 83.5% LEPCs in the sample meet on average at least quarterly or more frequently. This is only slightly more frequently than the USEPA study, which reported 72.4% of LEPCs meeting quarterly or more frequently. Nearly 10% of LEPCs in the USEPA study hadn't met in the previous year, due to lack of member participation.

Table 13.

LEPC meeting frequency

	Ohio Sample	USEPA 2008 Comparison Study
Number of Meetings	f (%)	f (%)
0 times	0 (0%)	80 (8.8%)
1-2 times	9 (16.4%)	64 (7%)
3-4 times	25 (43.6%)	352 (38.7%)
5-6 times	15 (23.6%)	148 (16.3%)
more than 6	8 (14.5%)	158 (17.4%)
Other (specify)	1 (1.8%)*	107 (11.8%)**
n	58	909

* monthly
** "as needed"

LEPC member training, staffing, and funding/support. Most LEPCs in the sample (76%) reported they do not have a formal orientation program for new members, but do form subcommittees to complete the organization's tasks (80%). Most respondent LEPCs also set annual goals and objectives for the organization as a whole (78%), assess their performance annually or more frequently (65%), and discuss the results of their performance appraisal within the LEPC (62%). Nearly half of the responding organizations reported setting annual goals and objectives for their subcommittees (49%).

As shown in Table 14 nearly two-thirds (65%) of surveyed LEPCs reported having paid full or part-time staff, either working strictly for the LEPC or subcontracting from the local EMA. Most respondents (84%) reported staff working part-time (less than 30 hours per week) including nearly one quarter of sampled LEPCs reporting staff working less than 5 hours per week.

Table 14.

LEPC Paid Staff

Does your LEPC have paid full/ part-time staff?	yes f (%)	no f (%)
How many hrs/week?	38 (65.5%)	20 (34.5%)
1-5 hrs	8 (21.0%)	
6-10 hrs	7 (18.4%)	
11-20 hrs	11 (28.9%)	
21-30 hrs	6 (15.8%)	
31-40 hrs	4 (10.5%)	
other (specify)**	2 (5.3%)	

* contract with EMA for support staff and administrative costs

All respondents to the survey also reported some sort of operating budget (see Table 15). The primary sources of operating funds for LEPC activities are state fees from EPCRA submission (84%) and Federal HMEP (Hazardous Materials Emergency Preparedness) grant funding (73%). Fewer groups received funding from other sources, including local direct funding (16%), other state direct funding (7%), local fees (9%), private industry support (7%), and in-kind/ indirect support (9%).

Table 15.

Sources of LEPC Operating Budgets

Source of Funding	Ohio Sample f (%)	2008 USEPA Comparison Survey
State fees from EPCRA Submission	48 (83.6%)	54.20%
Federal - HMEP grant funding	42 (72.7%)	39.70%
Local direct funding	10 (16.4%)	33.70%
Other state direct funding	4 (7.3%)	20.50%
Local fees	5 (9.1%)	8.70%
Private industry	4 (7.3%)	8.30%
In-kind/ Indirect support	5 (9.1%)	56.30%
No formal funding or direct support	0 (0%)	64.10%
Other (specify)	10 (16.4%)*	4.8%**

*Other grants, SERC Cost Recovery Program grants, other fines and penalties, donations
** other grants, donations, membership dues

This differs from the USEPA 2008 survey, which reported only 40.7% of respondents having an operating budget and a full 64.1% of LEPCs nationwide have no direct funding at all. If those results are accurate, more than half the population of United States LEPCs is functioning without an operating budget. By comparison, 100% of surveyed LEPCs in the sample have some form of operating budget.

Non-financial support in the form of technical assistance or guidance is reported by study subjects to come from a wide variety of sources. According to this study, greater than 94% of respondent LEPCs have received technical guidance from State of Ohio agencies in the last five years, including SERC, State EMA, or State EPA. The Federal EPA has provided guidance to 29% of Ohio LEPC respondents, and FEMA has provided aid to nearly 13%. Agencies noted to support LEPCs in fewer cases include Department of Homeland Security (DHS) (9%), Department of Transportation (DOT) (7%), and Department of Justice (DOJ) (4%). Less than one percent of respondents report receiving no technical guidance or support. By comparison, USEPA reports 27.2% of LEPCs nationwide included in their 2008 study received technical assistance or guidance from federal government agencies, primarily from USEPA (58.6%) and FEMA (51.7%).

LEPC outcomes: Emergency plans and member familiarity. The primary tangible outcome or "deliverable" of LEPCs is an approved emergency response plan (ERP); see Table 16 for related survey results. Of the organizations surveyed in this sample, the vast majority (more than 80% in each category) responded that their emergency plan has been updated, reviewed by the SERC, and exercised in some form within the last 12 months. Of the remaining groups, nearly one in ten groups report having reviewed/ updated their plan within the last 1-2 years. Of the remaining LEPCs,

only one group stated that it has been over 2 years since they've reviewed/ updated/ exercised their plan, and one group did not have knowledge of the last time their LEPCs plan was reviewed, updated, or exercise, respectively. When sample respondents were asked their personal familiarity with their LEPC's emergency response plan, 72% reported that they are "very familiar" with the plan, while 28% reported being "familiar" with the plan. None of the participants indicated lack of familiarity with the plan. This indicates that at least amongst those surveyed, there is good member participation in ERP knowledge.

Table 16.

Emergency Response Plan Exercise

	When did your LEPC last update its emergency plan?	When did SERC last review ERP?	When did LEPC last exercise its ERP?
Time Period	f (%)	f (%)	f (%)
less than 12 months	49 (83%)	50 (86.8%)	53 (94.3%)
1-2 yrs	7 (9.4%)	7 (11.3%)	2 (3.8%)
over 2 yrs	1 (1.9%)	0 (0%)	3 (5.1%)
Don't have an ERP	0 (0%)	0 (0%)	0 (0%)
Don't know when reviewed/updated	1 (1.9%)	0 (0%)	0 (0%)
Other (specify)	0 (0%)	1 (1.9%)*	0 (0%)
n	58	58	58

* ERP not reviewed by SERC

By comparison, in the USEPA 2008 survey, only 58.7% of participant LEPCs nationwide reported updating and submitting an ERP within the year prior to the survey. This would seem indicative of either higher compliance with plan submission in Ohio, or of a "sea change" in LEPC plan submission between 2008 and 2010. While there has been increased attention on emergency planning of late due to the increased number and severity of natural disasters occurring worldwide, Ohio hasn't been a focal point of these disasters. It is therefore unlikely that Ohio's higher compliance with updating and submitting ERP's is related to any outside influence that is different from LEPCs in other parts of the nation.

LEPC outcomes: Emergency plan exercises and accident experience. An additional requirement of LEPCs is that their emergency plan is exercised regularly using several methods over a five-year period. It is for this reason that LEPCs were asked to describe their plan exercises over the past five years, rather than the past year. The results are described below and illustrated in Table 17. The majority of respondents have practiced by using a "table-top hazmat exercise" (90%), and/or a "full-scale (multi-departmental) hazmat exercises" (90%). Nearly three-quarters of participating LEPCs stated they have exercised their plan using a "single function drill (e.g. communications drill)" during the last five years. Of the groups that stated they have exercised their emergency plan in some form, 96% reported having done so in the last 12 months. The remaining 4% of respondents report having exercised their plan within the last 1-2 years.

By comparison, in USEPA's 2008 survey, 71.3% of LEPCs that reported exercising their emergency plans reported doing so within the past year. This is also similar to previous nationwide surveys, which showed that approximately 69% in 1999

and 74% in 1994 had practiced their ERP that year. So nationwide, rates of plan exercise seem to be holding steady. Within Ohio, the number of LEPCs exercising their plans in a variety of ways seems to be notably higher than the average nationally. The reason for this difference is unclear, but may be related to greater funding level or more active groups.

Table 17.

How LEPCs are Exercising Their Emergency Plans

		Ohio Sample	USEPA 2008 Comparison Survey
Have exercised emergency plan	no	0 (0%)	23.20%
	yes	58 (100%)	76.80%
Single-function (communications) drill		41 (71%)	47.80%
Table-top Exercise		53 (90%)	83.50%
Full-scale Exercise		53 (90%)	68.90%
Actual response		34 (58%)	47.80%
Public briefing		16 (28%)	13.10%
Other (specify)		4 (7%)*	4.5%**

* in-house drill w/private industry & schools, multi-functional, multi-agency exercise in conjunction w/ state, 16-county functional exercise
** functional exercise

In the Ohio sample, nearly 60% of total respondents reported responding to an actual emergency during the past five years, while only around one-quarter of the subjects report having had a public briefing on emergency management in the same time

period. As shown in Table 18, approximately one-half of respondent LEPCs stated they have managed more than 15 chemical accidents within the past five years. All other representative counties in the study responded to fewer chemical accidents according to study subjects. Seventeen percent of counties responded to 1-5 chemical accidents, around 20% of counties experienced 6-10 chemical accidents, and almost 10% saw 11-15 accidents within the last five years.

Table 18.

Number of Chemical Accidents within Last Five Years

Chemical Accidents	Ohio Sample f (%)	USEPA 2008 Comparison Study (%)
none	1 (1.9%)	18.80%
1-5	8 (13.2%)	48.90%
6-10	11 (18.9%)	12.50%
11-15	5 (9.4%)	4.60%
More than 15	29 (49.1%)	15.20%
Other	4 (7.5%)*	not included

One-third of responding LEPCs revised their ERP (emergency response plan) as a result of their experience with chemical accidents. Only two percent of responding LEPCs changed their LEPC priorities, increased their meeting frequency, recognized a need for first responder training, or addressed HAZMAT equipment priorities, respectively in response to accident experience. One-half of LEPCs responding stated their experience with chemical accidents resulted in improved coordination in their LEPC

operations, but 43% of respondents felt that their experience with actual chemical accidents had no impact on the way their LEPC operates. This result seems cognitively dissonant in that the expectation is that experience with actual chemical accidents would improve response. This researcher posits that either LEPCs are adequately prepared for the type of emergencies they are managing (and therefore not gaining new knowledge from experience) or LEPCs aren't recognizing learning opportunities when they present themselves. Another possibility is that experience with one accident may be irrelevant to future accidents, as each experience is unique and diverse compared to the next. Exploring LEPCs post-accident review process is another potential future avenue for research.

By comparison, in USEPA's 2008 study of LEPCs nationwide, chemical accident experience most impacted LEPC functionality by improving coordination efforts with industry/ facilities (54%) and by revising their emergency plans based on lessons learned (42%.) Similar to the results of this research, the 2008 nationwide study also stated that 44% of LEPCs within the U.S. reported no impact from experience with chemical accidents in the last five years.

LEPC priorities and resources. *L*EPCs spend part of their time determining the size of Vulnerable Zones around chemical facilities. Participating sample LEPCs report using each of four different methodologies to complete this task: DOT's Emergency Response Guidebook, EPA's Technical Guidance for Hazards Analysis, Computer Models (CAMEO, ALOHA, WISER, ADASHI), and/or GIS. Most commonly, LEPCs reported using DOT's Emergency Response Guidebook (88%) and Computer models

(52%) in their determinations. Less commonly, groups stated that they've used GIS mapping (38%) and/or EPA's Technical Guidance book (29%) as well. LEPCs were able to select more than one response for this question. These results are not surprising, and support the idea that LEPCs are still limited in their use of technology when addressing local hazard planning.

When asked what resources are utilized by the LEPC for chemical information, emergency planning, drills, and actual emergencies, 92% of respondents reported using CAMEO computer modeling software, 81% reported using EPCRA Tier I and Tier II data, 56% reported using other GIS data, and 21% reported using RMP data. This finding reiterates the idea that use of technology in case of actual drills and emergencies is limited, and is similar to sources used in determining facilities' Vulnerable Zones.

In addition to obtaining information from books and electronic sources, LEPCs also rely on the services of supporting organizations and related groups for information and assistance in emergency planning. Survey participants were asked which organizations they interacted with in the last 12 months. Results indicated 100% of groups rely on State EMA, 98% depend on State EPA, and 92% trust LEPCs in adjacent jurisdictions with their concerns. Finally, 73% of LEPCs cited LEPCs in other jurisdictions (not adjacent to them geographically) and 60% stated EPA regional staff (USEPA Region V for this sample) were resources they used as well. Table 19 below shows LEPCs rating activities their group prioritized.

Table 19.

Activities prioritized by LEPCs within the past year

Activities	Strongly disagree *f* (%)	Disagree *f* (%)	Agree *f* (%)	Strongly Agree *f* (%)
Activities that award hazard reduxn	4 (7.7%)	20 (34.6%)	27 (46.2%)	6 (9.6%)
Chemical release prevention	2 (3.8%)	17 (28.8%)	29 (50%)	8 (13.5%)
Community emergency preparedness	0 (0%)	1 (1.9%)	31 (53.8%)	25 (42.3%)
Community hazard awareness	0 (0%)	6 (9.6%)	36 (62%)	17 (28.8%)
Community hazard reduction	1 (1.9%)	17 (28.8%)	32 (55.8%)	7 (11.5%)
Hazard vulnerability assessment	0 (0%)	3 (5.7%)	31(53.8%)	22 (38.5%)
Inherent safety opportunity audits	7 (11.5%)	12 (21.1%)	31 (53.8%)	7 (11.5%)

The top three responses, combining the "agree" and "strongly agree" rankings, were community emergency preparedness (98%), hazard vulnerability assessment (94%), and community hazard awareness (90%). Interestingly, although community hazard awareness was ranked very highly as a priority, the majority of respondents reported not having a public briefing within the last five (5) years.

Impact of recent disasters on LEPC activity. Next the survey participants were asked to provide information about their LEPC and whether any changes had occurred since the terrorist attacks of 9/11/01, as shown below in Table 20. In general, when asked whether there has been any change in their LEPCs overall activity since 9/11/01, one-third of respondents state their activity has stayed the same, one-half of respondents state their activity has "increased somewhat," and one in five groups state their activity has "increased greatly." When asked what has been the target of the LEPCs increased activity (post-9/11), 80% of respondents selected "emergency planning", one-half selected "educating the public" or "being proactive" respectively, and 20% chose hazard reduction or accident prevention, respectively.

Table 20.

LEPC Activity Post 9/11/01

Since the events of 9/11/01, the overall activity of your LEPC has:		Since the events of 9/11/01, which items has your LEPC increased its emphasis on (check all that apply):	
Activity Level Change:	f (%)	Activities	f (%)
Increased greatly	10 (17.6%)	Emergency planning	47 (80.4%)
Increased somewhat	29 (49%)	Hazard reduction	11 (19.6%)
Stayed the same	17 (29.4%)	Accident prevention	10 (17.6%)
Decreased somewhat	0 (0%)	Educating the public	32 (54.9%)
Decreased greatly	1 (2.0%)	Being proactive	31 (52.9%)
I don't know	1 (2.0%)	other (specify)	5 (7.8%)*

* no change, responder/ facility training, same goals before/ after 9/11/01

LEPC proactive efforts and familiarity. In order to gauge the familiarity of respondents with terminology used to represent some of the more proactive actions possible for LEPCs, they were asked to indicate familiarity with several terms, the results of which are indicated in Table 21.

Table 21.

LEPC Familiarity with Proactive terminology & incorporation into Mission Statement

	Which of the following terms are you familiar with:	Which are incorporated into LEPC mission statement?
Terms	f (%)	f (%)
Inherent safety	26 (45.1%)	18 (31.4%)
Precautionary principle	13 (21.6%)	7 (11.8%)
Primary prevention	30 (51%)	20 (35.3%)
Hazard reduction	53 (92.2%)	42 (72.5%)
Vulnerability management	47 (80.4%)	21 (64.7%)
Comments	1*	1*

*not commonly used terms in EM or LEPCs, none of the above, not sure

Nearly all of the survey respondents stated they were familiar with "hazard reduction", 80% were familiar with "vulnerability management", and approximately one-half were familiar with "primary prevention" and "inherent safety" respectively. Only one-quarter of study subjects recognized the term "Precautionary Principle". When asked which of these terms were incorporated into the mission of the LEPC, three-quarters of the groups chose hazard reduction, two-thirds chose vulnerability management, and one-

third chose primary prevention, or inherent safety. Precautionary Principle was only incorporated into 12% of respondent LEPC mission statements.

Finally, respondents were asked to rate their degree of agreement with the following: "The LEPC on which I serve has had a positive impact on chemical safety in my community (prevention, preparedness, and response.)". 82% of respondents selected either "agree" or "strongly agree," indicating a strong sense that these LEPC members feel that their LEPC is actively helping their community.

Compliance and proactivity levels. Using the criteria outlined in the Introduction in Table 2, participant LEPC responses were compiled additively and scored to determine group compliance and proactivity levels. The majority of respondents, who make up the majority of LEPCs within Ohio, were found to be both compliant with SERC and Federal rules and requirements and also very proactive, according to the criteria set out at the outset of this study. No respondents were found to be out of compliance, and only one was found to have zero proactive factors. Spearman's Correlation showed mild yet significant correlation between the compliance and proactivity dependent variables ($\rho = 0.026$, $\alpha = 0.05$). It is possible that the distinction between the two is not as clear as previously thought. It may be that proactivity is merely an extension of the compliance variable, as activity level has increased within the last decade due to societal circumstances (e.g. fear of terrorism, increased homeland security, etc.) In future research, a MANOVA test might help to untangle the correlation between the two dependent variables in this study. It is also possible that the weak correlation is an artifact of the large (N=4500) sample size generated from the bootstrapping. For the

purposes of this research, results will be considered with the possibility that the compliance and proactivity may not be viewed as separate entities.

Table 22 indicates the range of compliance and proactivity scores indicated based on the compliance-proactivity index. The dependent variables (of proactivity and compliance) included in the hypotheses are categorical ordered data, and it is necessary to use an appropriate methodology to analyze the data within the confines of its limitations. A Spearman's Rank correlation methodology was used to examine the data for relationships between dependent and independent variables.

Table 22.

Compliance and Proactivity Scores of Respondent LEPCs

Respective Index Score	Compliance	Proactivity
	f (%)	f (%)
0	0 (0%)	1 (1.7%)
1	0 (0%)	2 (3.4%)
2	0 (0%)	5 (8.6%)
3	1(1.7%)	11 (18.9%)
4	3 (5.2%	28 (48.3%)
5	4 (6.9%)	11 (18.9%)
6	3 (5.2%	n/a
7	34 (58.6%)	n/a
8	13 (22.4%)	n/a
n	58	58

Bootstrapping and Correlation Analysis

To improve robustness of the data analysis, the bootstrap technique was employed to resample the data with replacement. The bootstrap method is a means of computer-based simulation designed to improve statistical inference by "assigning measures of accuracy to statistical estimates" (Efron and Tibshirani 1998). Bootstrapping is a non-parametric method of data resampling, designed to approximate the sampling distribution of an estimator (Cassell, 2007). As a non-parametric method, it makes no assumptions about the distribution of the original data sample and assumes that it is one out of any number of random samples that may have been collected. Instead the bootstrap technique acts to take many random sub-samples of the "original sample" in order to increase the strength of the statistical argument. This is useful in this situation as the original data was drawn from a small sample of n=58. The bootstrap sample size can be set at any number, one commonly used sample value is 1,000. As a means of attempting simulation of the LEPCs in the United States, n=4500 was used for statistical analysis.

The mean and standard deviation computed from the bootstrapped data were used in a correlation analysis to examine the relationship between each of the dependent and independent variables.[3] Each of the hypotheses is described with justification for the expectations in the literature review section of this document. The relationships and results noted will be described below. Table 23 shows Spearman's Correlation results for

[3] Binary logistic regression analysis was used initially to test the hypotheses, with no significant results. Correlation analysis was chosen as a more appropriate statistic to measure the effects of the independent variables.

the four tested hypotheses. Of those listed, only "proactivity" and "number of facilities" is significantly correlated.

Table 23.

Spearman's Rank Correlation for Tested Hypotheses

	Number of Regulated Facilities	Population Size	Characterization of Jurisdiction	Accident Experience
Compliance	0.038*, Sig.=0.006,	-0.015, Sig.=.151	0.001, Sig.=.466	-0.002, Sig.=.458
Proactivity	0.009, Sig. =0.263	-0.023**, Sig.=0.065	0.015, Sig.=0.164	0.004, Sig.=0.400

*Significantly correlated at the 0.01 level. N=4500
**Nearly significant correlation, significance at 0.06 level.

- H(1a): LEPCs compliance scores is positively correlated with number of regulated facilities.
- H(1b): LEPC proactivity score is positively correlated with number of regulated facilities.

Compliance and number of regulated facilities was positively correlated (ρ = .038, α = 0.01). It is logical that the more regulated facilities an LEPC is working with, the more likely they would be compliant. More facilities means more hazard, and LEPCs work to help mitigate that hazard. The cross-tabulation below in Table 24 shows how the majority of LEPCs in the sample are relatively compliant and have less than 45 regulated facilities within their jurisdiction.

Table 24.

Cross-tabulation of Compliance scores by Number of Regulated Facilities in Jurisdictions

	Number of Regulated Facilities							
Compliance Scores	0-15	16-30	31-45	46-60	61-100	101-200	more than 200	Grand Total
3		1						1
4		2				1		3
5	3						1	4
6	1	1						2
7	8	11	7	2	4	2	1	35
8	5	3	1	2	1		1	13
Grand Total	17	18	8	4	5	3	3	58

Proactivity and number of regulated facilities was not significantly correlated. This was surprising, as one would expect that proactivity might go up in areas with more regulated facilities. It is also possible that LEPC participants are simply preoccupied with simply managing and reacting to hazards posed by greater number of regulated facilities within their jurisdiction. They may not have the capacity to be proactive, but only enough to keep up with the status quo. This is something to consider more thoroughly in future research.

- H(2a): LEPC compliance score is positively correlated with population size of jurisdiction.
- H(2b): LEPC proactivity score is positively correlated with population size of jurisdiction.

There was no significant correlation between compliance and population size or proactivity and population size. However, there was an almost significant correlation between proactivity and population size ($\rho = -0.023$). This lack of a significant finding was surprising. It was expected that areas with larger populations would be more compliant or proactive than other areas. This "lack" of finding may be due to there being generally high levels of both compliance and proactivity throughout the sample. Particularly when compared to the 2008 USEPA nationwide data, Ohio has higher levels of both compliance and proactivity than the United States does overall. Table 25 shows the cross-tabulation between compliance score and population size within an LEPC jurisdiction. The majority of LEPCs in the sample have populations of less than 500,000 within their jurisdiction and are relatively compliant with meeting the regulatory requirements for LEPCs.

Table 25.
Cross-Tabulation of Compliance Score and Population Size

	Population Size				
Compliance Score	0-50,000	50,001-100,000	100,001-500,000	500,001-1,000,000	more than 1,000,000
3		1			
4			2	1	
5	3				1
6	1	1			
7	14	9	10	2	
8	7	1	4		1

The near significant correlation ($\alpha = 0.065$) between proactivity and population size suggests there may be something here worth looking into further for future research. There is data in the public administration literature that suggests that more heavily populated areas have organizations with greater capacity (capacity meaning access to funding, staff, services). There may be a link to look into in future research between proactivity in LEPCs and organizational capacity. Table 26 shows the cross-tabulation of the proactivity scores by population size of the sample jurisdictions.

Table 26.
Cross-Tabulation of Proactivity Score and Population Size

	Population Size				
Proactivity Score	0-50,000	50,001-100,000	100,001-500,000	500,001-1,000,000	more than 1,000,000
0	1				
2	5				
3	6	4	4		1
4	13	8	12	3	1

- H(3a): LEPC compliance score is positively correlated with greater "urban-ness."
- H(3b): LEPC proactivity score is positively correlated with greater "urban-ness."

There was no significant correlative relationship between compliance score and characterization of the jurisdiction or between proactivity score and the same. It was

expected that more urban areas would be more compliant and more proactive than more rural areas.

- H(4a): LEPC compliance score is positively correlated with more accident experience.
- H(4b): LEPC proactivity score is positively correlated with more accident experience.

Neither compliance nor proactivity was significantly correlated with accident experience of LEPC. LEPCs with more accident experience within the past year were expected to be more compliant and proactive. Direct first-hand experience with accidents was expected to result in LEPCs more motivated to meet and possibly exceed compliance requirements in order to ensure their preparedness for future accidents. Again, relatively high rates of compliance and proactivity in the sample overall might account for less sensitivity to variation related to accident experience. Future research might also address a longer retrospective time horizon for accident experience. There may be a longer lag time between accident experience and organizational changes, depending on the pace of change within the organization.

A few other interesting findings not included in the hypothesis testing are included in the next few tables below. Table 27 shows a cross-tabulation between funding for staff and number of chemical accidents. The interesting finding is that more than 1/3 of respondents (23/58) had funding for staff and also reported responding to more than 15 EHS accidents/ spills within the past year. This suggests that funding is following number of accidents. The researcher cannot posit another logical reason to think areas with greater funding would have more accidents.

Table 27.

Cross-Tabulation of Staff Funding and Number of Chemical Accidents in Previous Year

	Funding for Staff		
# of Chemical Accidents	No	Yes	Grand Total
0	1	0	1
1-5	4	3	7
6-10	4	8	12
11-15	2	3	5
15+	10	23	33
Grand Total	21	37	58

For comparison, Table 28 below shows the cross-tabulation of funding for staff and number of EHS facilities within an LEPCs jurisdiction. If the increased funding is due primarily to increase hazard (i.e. more EHS facilities) it would seem the pattern would be similar between funding and number of facilities as it is between funding and number of accidents. This is another area of note to follow up in future research.

In Table 28, the cross-tabulation between LEPC staff funding and the number of regulated facilities within a county are not similar in trend to the results for number of accidents and funding. This suggests that perhaps funding is being allocated more heavily to areas with higher accident rates, rather than to areas with higher hazard (i.e. more EHS facilities).

Table 28.

Cross-Tabulation of Funding For Staff and Number of Facilities within a Jurisdiction

# of Facilities	no	yes	Grand Total
0-15	8	9	17
101-200	1	2	3
16-30	7	11	18
31-45	2	6	8
46-60	1	3	4
61-100	1	4	5
more than 200	1	2	3
Grand Total	21	37	58

Finally, LEPCs were asked subjectively whether they felt that their activities had changed at all since the terrorist attacks of 9/11/2001. The results of a cross-tabulation of an LEPCs' own assessment of their activity level change since 9/11/2001 and their proactivity score is shown below in Table 29. Most LEPCs responded that the activity levels of their group "increased somewhat" (32/58), and the majority of those (23/32) were considered extremely proactive, having completed at least four of the factors listed on the proactivity index.

Table 29.

Cross-Tabulation of Proactivity Score and Subjective Impact of 9/11/01 on LEPC Activities

Proactivity Score	I don't know	decreased greatly	stayed the same	increased somewhat	increased greatly	Grand Total
0	0	0	0	1	0	1
2	0	1	3	1	0	5
3	0	0	4	7	4	15
4	1	0	8	23	5	37
Grand Total	1	1	15	32	9	58

The implications of these research findings bring light to some of the changes in LEPC structure and actions since their inception 25 years ago. Much of the work of LEPCs is fraught with complexity and uncertainty. These minimally funded organizations are trying to make the best of an imperfect system to help ensure community safety and security. The implications will be discussed further in the Discussion chapter along with some additional questions and basis for future research.

CHAPTER V

CONCLUSIONS

Introduction

This chapter summarizes the importance of this topic and how this particular study contributes to greater understanding of emergency planning and its functions. In Section 5.1 a review of the research results and hypothesis tests will be followed by a discussion of additional findings not in the original research questions. Section 5.2 will discuss theoretical and practitioner implications. Section 5.3 will examine the limitations of this study and how it informs future research. Finally, in Section 5.4, the chapter concludes with suggestions for future research based on findings and final comments drawn from the research findings.

Emergency planning is an evolving field. Since the inception of EPCRA in 1987, the field has had to adapt to a world with greater threats of terrorism and a more tumultuous ecosystem with regard to severity and frequency of natural disasters. Events like the 2011 earthquake and tsunami in Japan and subsequent nuclear catastrophe illustrate some of the complexity and unforeseen complications that can occur when serious disaster strikes. It is estimated that around 20,000 people were killed in the catastrophe. In the United States, we have begun to adapt our emergency planning to a

more "all-hazards" approach to localize planning for many types of emergencies within a few coordinating agencies at each locality. The results of this study show that LEPCs are doing their best to keep up with the jobs they have been tasked with, and in the study sample, are faring better than has been reported in several previous national surveys.

Summary of Research Results and Results of Hypothesis Tests

In 1987, EPCRA took United States environmental policy in a bold direction towards “informational regulation” of environmental hazards. Inclusion of the public in hazardous chemical emergency planning was thought to improve the quality of emergency response by bringing together experts and local stakeholders in important decisions about disaster planning and management. Overall the LEPCs studied in this research were meeting the expectations and standards set out for them, with regards to emergency planning. Provision of information to the public was achieved in lesser numbers.

LEPCs in this study came from primarily smaller population counties with around 60% of the sample from counties with populations under 100,000 people. These counties are primarily considered “mainly rural/ some suburban”. In the United States overall, the largest represented area in general is slightly less populous, with around 60% being under 50,000 in each LEPC jurisdiction. All LEPCs that participated in the survey included diverse memberships, and most reported having good attendance at meetings, on average around 15 out of 20 members attending meetings. Most LEPCs in the sample reported meeting regularly, with more than 80% of the sample stating that they met at least quarterly. This is slightly higher than the national average of 72% meeting at least quarterly according to the USEPA’s 2008 survey.

The work of the LEPC is still primarily being done on a volunteer basis. While 65% of the sample responded that they do have paid staff, more than 80% of those with paid staff reported the work as part-time (less than 30 hours per week.) To break it down further, one-quarter of that 80% part-time staff is working less than five hours per week on a paid basis. So while there is funding for staff, it is minimal in most cases.

The Ohio sample does appear to have greater funding overall than the US LEPCs on average, with all groups in the sample reporting some form of operating budget. USEPA's 2008 study reports that only 40% of LEPCs stated that they have any operating budget nationwide. Even if the funding isn't adequate, some funding must be better than none. This may be an important distinction between LEPCs in the Ohio sample and LEPCs nationwide.

Hypothesis testing. Respective compliance and proactivity scores were calculated from an index for each LEPC in the sample. The components of the index were taken from individual survey questions and summarized additively with uniform weights to determine each score. The compliance-proactivity index itself was an instrument established by Starik et al. (2000) in a previous National LEPC survey commissioned by the USEPA. It has since been utilized and reported in the literature by Templeton and Kirk (2008). The compliance component of the index is a straight-forward assessment of the regulatory requirements for LEPCs to maintain compliance with the State Emergency Response Commission. The proactive component of the index will be discussed below.

Eight hypotheses were tested in the statistical analysis of the survey data. Correlation, rather than causation, was established where statistically significant

relationships were noted. Only one of the eight tested hypotheses resulted in a significant correlation, but each will be discussed briefly.

Hypothesis 1a. LEPC compliance scores are positively correlated with number of regulated facilities. This hypothesis was tested and confirmed at a statistically significant level, at a 99% confidence level. This indicates that LEPCs in areas with larger numbers of regulated facilities are correlated with higher compliance scores. This is a logical association as more facilities means greater hazard which is an excellent rationale for increased compliance.

Hypothesis 1b. LEPC proactivity score is not positively correlated with number of regulated facilities. This hypothesis was not significantly correlated and was therefore unsupported. This was surprising, as one would expect that proactivity might go up in areas with more regulated facilities. This is something to consider more thoroughly in future research.

Hypothesis 2a. LEPC compliance score is not positively correlated with population size of jurisdiction.

Hypothesis 2b. LEPC proactivity score is mildly positively correlated with population size of jurisdiction. There was no significant correlation between compliance and population size or proactivity and population size. However, there was an almost significant correlation between proactivity and population size ($\rho = -0.023$, $\alpha = 0.065$). It was expected that areas with larger populations would be more compliant or proactive than other areas. Future studies may focus on selecting a sample that purposively chooses matched sets of proactive/ not proactive and compliant/ not compliant groups in order to study variation in select variables.

Hypothesis 3a. LEPC compliance score is positively correlated with greater "urban-ness".

Hypothesis 3b. LEPC proactivity score is positively correlated with greater "urban-ness". There was no significant correlative relationship between compliance score and characterization of the jurisdiction or between proactivity score and the same. It was expected that more urban areas would be more compliant and more proactive than more rural areas. Urban areas theoretically have more resources to deal with historically higher levels of hazardous chemicals. Those resources would seem to lead to greater LEPC compliance and proactivity in urban areas, but the hypothesis wasn't borne out.

Hypothesis 4a. LEPC compliance score is positively correlated with more accident experience.

Hypothesis 4b. LEPC proactivity score is positively correlated with more accident experience. Neither compliance nor proactivity was significantly correlated with accident experience of LEPC. LEPCs with more accident experience within the past year were expected to be more compliant and proactive. Direct first-hand experience with accidents was expected to result in LEPCs being more motivated to meet and possibly exceed compliance requirements in order to ensure their preparedness for future accidents. Again, relatively high rates of compliance and proactivity in the sample overall might account for less sensitivity to variation related to accident experience. Future research might also address a longer retrospective time horizon for accident experience. There may be a longer lag time between accident experience and organizational changes in response to that experience, depending on the pace of change within the organization.

Other findings. The Emergency Response Plan (ERP) is one of the primary measurable outcomes from LEPC activity, and an important component of disaster planning in general. In addition to creating a plan for complex and varied emergency scenarios, LEPCs are expected to update and exercise that plan on a regular basis to maintain compliance and keep their state funding. Overall, the Ohio sample was updating and exercising their emergency plans as expected (more than 80% of the time) and performing fairly well. This would seem a good indication of emergency preparedness. With 80% of the study sample updating and exercising their ERP as expected, this was well above the 58% noted in the National 2008 results. This is another important difference between the Ohio sample and other US LEPCs. One caveat to this positive measure was the expectation to complete a public briefing.

In the five-year rotation of emergency plan exercises, the public briefing was noted as being the least likely type of exercise to have occurred; only 28% of sampled LEPCs stated they had completed a public briefing in the last five years. Again, this shows that informing the public is one of the weaknesses of LEPC activity. The original intent of SARA III, the law that mandated the formation of LEPCs, was to use stakeholder participation to encourage industry compliance with chemical laws, and work towards reduction of chemicals in highly populated areas. This is an impossible goal with an uninformed populace. This is an area of major failure for LEPCs, as currently functioning.

Groups in the sample responded to chemical spills and emergencies far more often than the nation overall. Nearly 50% of the Ohio sample LEPCs reported responding to 15 or more accidents in the past year, while only 15% of LEPCs nationwide responded

to the same number. Ohio appears to be a more active state with regards to number of accidents than the nation overall. This makes sense given what is known about Ohio's chemical facilities. TRI data from 2010 shows Ohio ranking fourth highest amongst all states for chemical releases (USEPA, 2010).

When asked to prioritize LEPC activities, LEPCs in the sample chose "community emergency preparedness" (98% of respondents), "hazard vulnerability assessment" (94% of respondents), and "community hazard awareness" (90% of respondents) as either activities they "agree" or "strongly agree" are important to their LEPC. Assessing vulnerabilities and preparing for emergencies corroborates other findings in the survey, but prioritizing community hazard awareness is a surprise. This seems incongruent with the lack of public briefings on emergency drills within the last five years noted amongst three-quarters of the sampled groups.

Since 9/11/01 terrorist attacks, sampled LEPCs did note some changes in the activity level and emphasis of their organizations. Most notably, 65% of LEPCs stated that their activity level increased somewhat or greatly with the top three emphasized activities being emergency planning (80% of response), educating the public (55% of response), and being proactive (53% of response). Again, providing information to the public is emphasized as a priority activity since 2001, but evidence for this priority in action is unclear or absent.

Proactivity. The proactivity index used in this study is the only one the researcher noted published in the literature reviewed on proactive LEPC activity. The results of this study suggest that the index is under-conceptualized. As also suggested by Templeton and Kirk (2008), quantifying as complex an idea as "proactivity" on a simple

index score doesn't capture the complexity and nuance of the activity included in the concept. There are a myriad of activities that may also be considered proactive that were not included in the scale. Broader themes of public education and outreach, member training, and collaboration with other LEPCs might be considered in future conceptualizing of the idea. More clearly capturing the idea of proactivity may help guide future practical LEPC directions and also research on the topic. Specifically, as proactivity has been defined in this and previous studies mentioned by USEPA, Templeton and Kirk (1998) and others, LEPCs are achieving many of the conditions defined as proactive. "Proactive" activities such as meeting more frequently, updating and practicing an ERP more frequently, and making accident prevention recommendations to industry and local government are being completed by many of the groups studied in this project.

Given the current complexity and level of hazard we live in, this proactivity may not go far enough. By taking a more precautionary approach, and focusing on mitigation and hazard reduction activities, LEPCs can move communities to safer, long-term sustainable future. By reconceptualizing proactivity as precaution, as defined by the precautionary principle and some of the related inherent safety concepts, emergency management activity can be viewed through a different lens which may provide more nuance into how emergency management functions and a more sustainable future.

Theoretical and Practitioner Implications

Local Emergency Planning Committees were created with the original intent of using a stakeholder-based model of decision-makers as local participants in the emergency planning process. Hazard information was to be made publicly available to

encourage local participation. In order for LEPCs to function as intended, informing and educating the public and emergency planning participants is a critical step. Without information and access, the public is unable to address accident/ exposure risk within their community. Since the terrorist attacks of 2001, access to information has been made more difficult. Public Internet access to Risk Management Program Rule (RMP) data has been redacted indefinitely. The USEPA recently issued a statement saying that in light of concerns about ease of access to chemical hazard quantity and location information, information will continue to be withheld from the internet, and will have to be obtained in person by qualified parties in order to maintain security due to heightened safety concerns. Information security is a very valid concern under terrorist threat, but lack of access to information undermines the very principles upon which SARA III was built.

The results of this study corroborate the inherent difficulties LEPCs experience with the community education component of the edict. This research found LEPCs in the study sample to still value or give "lip service" to the idea and merit of informing the public enough to include it in their mission statements and name it as a priority activity, but their actual communication activities were limited at best. Most groups hadn't had a public meeting to review their emergency plans within the last five years, and many hadn't published information regularly to notify the public of meetings. In this study, 90% of respondent LEPCs still state that they value community hazard awareness as a priority. Despite this intention, only 28% reported exercising their emergency plan with a public briefing in the past five years. This leads the researcher to question what is causing this gap between LEPC priorities and actions. The current socio-political climate of terrorist fears has certainly encumbered the idea of informing the public. Emergency

Management is looking for ways to best balance community right-to-know with national security concerns. Practitioners need to work to align their organizational values and goals with their activities and practices. Undoubtedly, these groups have very limited resources of both time and money, and need to focus their limited faculties on priority goals first (first of which is likely maintaining and updating their ERP). Based on their stated priorities and on those set out by EPCRA, more attention needs to be given to community education and information to improve LEPC community outcomes.

This indicates that while LEPCs are complying with the letter of the law, they are not in compliance with the spirit of the law. SARA III's intent was to use informational regulation to use stakeholder pressure to improve chemical safety in communities. This is simply not being done, despite emergency managers expressing a desire to still prioritize communication with the public.

In addition to concerns with information access, over the last several decades EHS facilities have been moving out of highly-populated areas towards more undeveloped "greenfield" areas (Falit-Baiamonte & Osleeb, 2000; Rabe, 1994). EHS facilities have been pushed to site themselves in less densely populated regions as a part of the "NIMBY" (not in my backyard) and "LULU" (locally unwanted land use) movements. This trend may be viewed as beneficial by neighborhoods that no longer see the blight of chemical facilities and factories near where they live and work. But what is the consequence of this relocation to emergency management? Are the capabilities of emergency managers in these areas on par with those in denser urban areas?

The results of this dissertation show a correlation between number of EHS facilities in a county and the compliance of that county's LEPC. This would seem a

positive result, as it shows a relationship between more facilities (hazard) and greater compliance. This would seem to be a step towards balancing resources towards communities most in need. There is also a negative correlation between number of accidents and population size, meaning there is a relationship between larger county population size and fewer accidents reported in the last five years.

This leads to a few interesting questions. If there is indeed a relationship between population size and number of accidents, how does this relate to the trend of facilities moving out of populous areas? Do these LEPCs in more populous areas have greater access to resources? Public administration literatures cites numerous examples of organizations in more heavily populated areas having greater access to resources, both tangible and intangible, which leads to greater performance. If there are fewer accidents reported in the last five years in areas with greater population, than the converse is true that there are relatively more accidents in areas with smaller populations (compared to areas with greater population). These less densely populated areas are likely areas EHS facilities have trended towards locating in recent decades. Less populated areas may also be more likely to contain less compliant or proactive LEPCs, who may also be less educated and potentially less well-funded. This is certainly an area in need of further investigation, as the above questions indicate.

All emergency planners have been stretched thinner and thinner, figuratively, with additional responsibilities of homeland security in addition to chemical safety tasks, and little to no additional funding. Where can underfunded, overburdened, remotely located LEPCs turn to for aid in critical instances of emergency planning? This researcher proposes they turn to collaboration. Collaborative efforts allow individual group

weaknesses to be combined to form stronger networks of emergency management. Collaborative environmental management (CEM) is one branch of collaboration that has been described heavily in the natural resource planning literature, and often involves formal collaboration between the public, private, and non-profit sectors to initiate some local environmental change (Koontz et al., 2004). Collaboration has been noted amongst emergency planning agencies between LEPCs and County Emergency Management Agencies (EMAs), often in the form of shared staff or resources. Collaboration can lead to greater success for all involved parties. As LEPCs continue to see more demands on their time and limited opportunities for funding, collaboration will need to be relied on more heavily as a means of meeting the tasks they have been mandated to complete. Collaboration with more private citizens and nonprofits along with knowledgeable first responders, industry representatives, and other emergency managers will help inform the planning process and better prepare communities to respond to chemical disasters. Collaboration can also help LEPCs work towards building and sharing "best practices." Learning from the experiences of LEPCs state and nation-wide will build stronger mitigation and response capabilities.

One of the most significant potential barriers to collaboration is access to information. As RMP information access has become more limited and restrictive, collaboration between involved parties and the public is also therefore limited. This may call for more proactive, creative solutions on the part of regulated industry to ensure emergency plans contain complete hazard information within proper security protocols.

Based on the results of this study, the researcher would strongly recommend that the State of Ohio and USEPA consider re-evaluating how emergency management is

handled. If SARA III is to be upheld as written, more attempts need to be made at a national level to include stakeholders in the process and inform the public about local hazards. At a state level, the latitude for implementation of the law allows Ohio and other states to choose to focus on the emergency management approach they best see fit, within the guidelines of SARA III.

Currently, the approach is very much an after the fact response and recovery approach. The assumption is that "normal" accidents will happen (Perrow 1984) and that an emergency managers job is to be best prepared to deal with those accidents when they do. Shifting LEPCs from a risk reduction/ risk management framework to a hazard elimination framework would radically re-prioritize their emergency management activities. Instead of being best prepared to manage accidents, a re-envisioned state or local emergency management agency could work to prevent accidents from ever occurring, through incentivizing inherent safety activities or more heavily fining the use and storage of large quantities of EHS, informing the public about hazards in their area, and planning communities with large and at-risk populations away from hazard zones. Taking steps towards a more long-term sustainable goal of informed, active, safer communities could in the long term be less costly for emergency managers and a more efficient use of their limited resources. It is unrealistic to think we will live in a society without chemicals. They are an intimate part of all of our daily lives. But the existence and use of chemicals should be undertaken with the utmost care and sustainable vision for their long-term consequence.

Limitations of This Study and Threats to the Validity of Inferences

Results of this study may be cautiously generalized to other LEPCs within the United States within certain parameters. There are likely many similarities between LEPCs in the study sample and LEPCs elsewhere. Many of the characteristics used to compare the study sample with the United States overall show similarities that lead to the idea that much of what is noted in the study sample is generalizable to any LEPC in the country. Demographic characteristics such as community size and characterization (rural to urban) can be used to classify LEPCs on the basis of similarities for generalization purposes. LEPCs in the study sample did have several characteristics that appeared differently than previously stated U.S. averages. LEPCs within the sample had higher rates of both funding and compliance. This may indicate that many of the issues identified in this study might be more pronounced in other areas of the country that have lower levels of funding and compliance.

Once related to the quantity of chemicals present within the sample area (overall), the sample in this study may just represent one end of the spectrum of nationwide LEPC possibilities. As stated earlier, the Ohio region ranks fourth nationwide for TRI releases and quantity of hazardous chemicals stored and utilized. More chemical hazard may account for the higher than nation-wide average numbers found in this study. That being said, the results also indicate that the bulk of LEPC energy is still directed towards emergency plan preparation and other preparedness and response activities, and less so towards community education and information efforts. If these activities were examined from the perspective of the disaster management frameworks discussed in the literature, the sample LEPC works most lines up with the “risk management” and “homeland

security" frameworks. This author proposes that a more sustainable framework might include greater emphasis on prevention and precautionary measures. Taking action to promote removal of hazards by reducing quantities of chemicals stored, storing them in more stable forms (e.g solid vs. liquid) and simplifying chemical and facility processes are more efficient uses of emergency managers limited resources when examined from a long-term perspective in an increasingly complex, chaotic world.

Recommendations for Future Research

In general, the level of proactivity and compliance within the sample was relatively high. The majority of LEPCs could be considered compliant and at least moderately proactive. In future studies, it would be useful to address this issue by selecting a sample through different measures. Selecting matched sets of contrasting proactive/ not proactive or compliant/ not compliant groups would allow for comparison of other variables of interest while ensuring the contrast of the dependent variables.

As discussed earlier, a reconceptualization of the term "proactivity" more in line with the Precautionary Principle or the tenants of Inherent safety would give different insight into the priorities and emphases of LEPCs, particularly in a larger nationwide study. In a post-9/11, global climate change world with concerns of increasing terrorist threat uncertainty as well as climate uncertainty, are emergency managers turning to more precautionary or preventative means of eliminating hazards and informing the public, or has the added burden of homeland security responsibilities taxed an already overburdened set of organizations.

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APPENDICES

APPENDIX A

LIST OF ACRONYMS

ADASHI - Automated Decision-Aided System for Hazardous Incidents

ALOHA - Areal Locations of Hazardous Atmospheres

CAMEO - Computer Aided Management of Emergency Operations

DHS - Department of Homeland Security

DOJ - Department of Justice

DOT - Department of Transportation

EHS - Extremely Hazardous Substances

EMA - Emergency Management Agency

EPA - Environmental Protection Agency

EPCRA - Emergency Planning and Community Right to Know Act

ERP - Emergency Response Plan

FEMA - Federal Emergency Management Agency

GIS - Geographic Information Systems

HMEP - Hazardous Materials Emergency Preparedness

LEPC - Local Emergency Planning Committee

NIMS – National Incident Management System

OEMA - Ohio Emergency Management Agency

OSHA - Occupational Safety and Health Administration

RMP - Risk Management Plan

SARA III -Superfund Amendments and Reauthorization Act of 1986

SERC - State Emergency Response Commission

USEPA - United States Environmental Protection Agency

WISER - Wireless Information System for Emergency Responders

APPENDIX B

LEPC SURVEY

[Date _____]

This questionnaire asks for information regarding the current practices of your LEPC. Our project focuses on the resources used by your LEPC and its practices. You have been contacted because you are listed as a current member of an Ohio LEPC either within EPA's database or by a roster from your LEPC.

Our objective for the project is to identify how LEPCs are currently functioning in Ohio. The results of this project will provide important information about how Ohio LEPCs are working. This current study is funded in part by a grant from the Maxine Levin Goodman Discretionary Fund, at the Levin College of Urban Affairs at Cleveland State. The study director is Erica Matheny, a PhD Candidate at the Levin College of Urban Affairs, under the advisement of Dr. William Bowen.

We hope that you will find the time to participate in our current study. The questionnaire should take less than 20 minutes to complete. Your participation in the study is voluntary. The information obtained during the survey will be held in a password-protected computer and will only be accessible by the researchers on the project. The results will only be reported in summary; no individual responses will be made public. In no way will your responses be identifiable to you personally.

If you have any questions about your rights as a research subject, please contact the CSU Institutional Review Board at (216) 687-3630. By completing and submitting this survey online, you are agreeing that you understand your rights as a participant in this study.

If you have any questions regarding the study or this questionnaire, please contact Erica Matheny, 330-285-4790, or Dr. William Bowen, Levin College of Urban Affairs, CSU (216-687-9226.) Ms. Matheny is the director of the study, under the advisement of Dr. Bowen.

I. Contact Information **☐ Check here if you'd like a summary of the results**

Name & Position _____

LEPC affiliated with _____

Address _____

Telephone/ Fax _____

Email _____

II. About Your Community

2. What size population does your LEPC serve?
   < 50,000
   50,001 – 100,000
   100,001 – 500,000
   500,001 – 1,000,000
   > 1,000,000

3. How would you describe your LEPC's service area?
   Mainly Rural
   Mixed Rural/ Suburban
   Mainly Suburban
   Mixed Suburban/ Rural
   Mainly Urban

III. About LEPC Members

4. Which of the following organizations participate in your LEPC? Check all that apply.

☐ Civil Defense/Emergency Services	☐ Firefighting	☐ Schools
☐ Chief Administrative Officer's Staff	☐ Law Enforcement	☐ Labor Groups
☐ State/Local Elected Officials	☐ Public Health	☐ Newsmedia
☐ Emergency Medical/Hospitals	☐ Local Industry	☐ Agriculture
☐ Municipal/County Attorney's Office	☐ Truck/Rail Carriers	☐ Community Groups
☐ Planning/Community Development	☐ Environmental Agency	
☐ Red Cross/Volunteer Groups	☐ Public Works/Engineering	

☐ Other (please list): _____

5a. How many members make up your LEPC? ____ **members**

b. On average, how many usually attend meetings of the LEPC? ____ **members**

6. How long has the current LEPC chair...	0-12 mos.	1-2 yrs	3-4 yrs	5+ yrs
been a member of the LEPC	□	□	□	□
been chair of the LEPC	□	□	□	□

7. a. Does your LEPC have any paid full or part-time staff? □ Yes □ No
   b. How many hours per week do they work for the LEPC? _____ **hours**

8. Does your LEPC...
   have a formal orientation program for new member □ Yes □ No
   have any subcommittees □ Yes □ No
   set annual goals and objectives for itself □ Yes □ No
   set annual goals and objectives for its subcommittees □ Yes □ No
   assess its performance annually or more frequently □ Yes □ No
   discuss this performance appraisal within the LEPC □ Yes □ No
   present the performance appraisal orally or in writing to local officials □ Yes □ No

IV. About your LEPCs Activities

9. How many times did your LEPC meet during the last year (2008)?

   _____

10. Where does your LEPCs operating budget come from? (check all that apply)
    State fees from EPCRA submission
    Federal – HMEP grant funding
    Local direct funding
    Other state direct funding
    Local fees
    Private Industry
    In-kind/Indirect support
    Other
    No formal funding or direct support

11. In the past five years, did your LEPC receive technical assistance or guidance from any of the following agencies?
    Federal EPA
    Department of Homeland Security
    Department of Transportation
    Department of Justice
    Federal Emergency Management Agency
    State agencies (SERC, OEMA, OEPA)

12. When did your LEPC last review and update its emergency response plan?
    Less than 12 months
    1-2 years
    over 2 years
    Do not have an emergency response plan
    Do not know when last reviewed/updated

13. When did the State Emergency Response Commission (SERC) last review your emergency response plan?
    Less than 12 months
    1-2 years
    over 2 years
    No Review

14. How familiar are you with your LEPC's emergency response plan?
    Very Familiar
    Familiar
    Somewhat Familiar
    Slightly Familiar
    Not at all Familiar

EXERCISE ERP

15. *H*as your LEPC exercised its emergency plan through a:
    a. single function (e.g., communications) drill ..... □ Yes □ No
    b. "table-top" hazmat exercise ..... □ Yes □ No
    c. full scale (i.e., multidepartmental) hazmat emergency exercise..... □ Yes □ No
    d. Actual emergency ..... □ Yes □ No
    e. Public briefing..... □ Yes □ No
    f. Other _(please list)_____

16. When did your LEPC last exercise its emergency plan?
    Less than 12 months
    1-2 years
    over 2 years
    Exercised, do not know when

17. In the past five years, approximately how many chemical accidents to which emergency agencies responded have occurred in your LEPC's service area?
    None
    1-5
    6-10
    11-15
    15 or more

18. How did these chemical accidents impact the way your LEPC operates? (check all that apply)
    No impact
    Revised ERP
    Improved coordination
    Extended LEPC
    Increased meeting frequency
    Greater attention/effort towards accident prevention

19. How many facilities in your area exceed the Threshold Planning Quantity of Extremely Hazardous Substances?

_____ **facilities**

20. For how many facilities have you determined the size of their Vulnerable Zones using
DOT's *Emergency Response Guidebook*_____ **facilities**
EPA's *Technical Guidance for Hazards Analysis* _____ **facilities**
computer models *(e.g., CAMEO or ALOHA)*_____ **facilities**
GIS_____ **facilities**
other methods_____ **facilities**
(Please list)_____.

21. Which of the following resources does your LEPC employ for chemical information, emergency planning, drills, and actual emergencies?
CAMEO
Risk Management Program (RMP) data
Other GIS data
EPCRA Tier I & Tier II data
Other resources (please list)_____

22. Please rate the degree to which your LEPC has used each of the following resources in SARA Title III emergency planning.

	Not at all				Very great extent
a. National Response Team *Hazardous Materials Emergency Planning Guide (NRT-1)*	**1**	**2**	**3**	**4**	**5**
b. EPA technical guidebooks or planning manuals	**1**	**2**	**3**	**4**	**5**
c. State emergency planning agency hazardous materials planning manuals & training courses	**1**	**2**	**3**	**4**	**5**
d. Chemical Manufacturers Association videotapes, handbooks, & training courses	**1**	**2**	**3**	**4**	**5**
e. FEMA or EPA training courses or broadcasts	**1**	**2**	**3**	**4**	**5**
f. State environmental agency *Toxic Release Inventory* data	**1**	**2**	**3**	**4**	**5**
g. guest speakers	**1**	**2**	**3**	**4**	**5**
h. other training films or videotapes	**1**	**2**	**3**	**4**	**5**

23. Please rate the degree to which your LEPC was active in each of the following areas *during 2008.*

	Not at all				Very great extent
a. Hazard vulnerability assessment	**1**	**2**	**3**	**4**	**5**
b. Community emergency preparedness	**1**	**2**	**3**	**4**	**5**
c. Chemical release prevention	**1**	**2**	**3**	**4**	**5**
d. Community hazard awareness	**1**	**2**	**3**	**4**	**5**
e. Community hazard reduction	**1**	**2**	**3**	**4**	**5**
f. Inherent safety opportunity audits	**1**	**2**	**3**	**4**	**5**
g. Activities that reward hazard reduction	**1**	**2**	**3**	**4**	**5**

24. Since the events of 9/11, the overall activity of your LEPC has:
Increased greatly
Increased somewhat
Stayed the same
Decreased somewhat
Decreased greatly
Don't know

25. Since 9/11, has your LEPCs increased its emphasis on:
Emergency planning
Hazard reduction/ Accident prevention
Educating the public
Being proactive

26. Since 9/11, has your LEPC changed the way chemical hazard information is made available to the public due to homeland security concerns?
Yes
No

27. The LEPC on which I serve has had a positive impact on chemical safety in the community (prevention, preparedness, and response.)
Strongly agree
Agree
Neither Agree nor Disagree
Disagree
Strongly Disagree
No

28. Which of the following terms are you familiar with or do you believe your LEPC incorporates into its mission?

	I'm Familiar	**LEPCs mission**
Inherent safety	☐	☐
Precautionary principle	☐	☐
Primary Prevention	☐	☐
Hazard Reduction	☐	☐

29. Rank your LEPC's contact (telephone, letter, email, or face-to-face) with each of the following *during 2008*, from most frequent (#1) to least frequent (#9). (#0 for not applicable)

_____ FEMA regional staff
_____ EPA regional staff
_____ State emergency management agency
_____ State environmental agency
_____ LEPCs in adjacent jurisdictions
_____ LEPCs in other jurisdictions of your state
_____ LEPCs in other states
_____ Regional or Multi-jurisdictional LEPC Association
_____ Other _____

Does your LEPC have a website? If so, please list here: _____

30. Is there any other information that you feel is important for us to know regarding your LEPCs work?

_____

_____

_____

_____

_____

Thank you very much for your participation in our research. If you are interested in receiving a summary of this research when it is completed, please indicate so near your name on the first page of the survey.

APPENDIX C

IRB APPROVAL FORM

Cleveland State University

Institutional Review Board for Human Subjects in Research
Application for Project Review

I. Title Page

Date (mm/dd/yyyy): **04/10/2008** **Transaction Number (office use only):** 28231-BOO-HS
Project Title: **Ohio Local Emergency Planning Committees (LEPCs): Toward a Theory of Environmental Nonprofit Organizational Performance**

PRINCIPAL INVESTIGATOR OR ADVISOR
Name: (Last, First): **Bowen, William** Title: **Professor**
Department: **URBAN STUDIES & PUBLIC AFFAIRS** Campus Address: **UR 219**
Electronic Mail Address: **w.bowen@csuohio.edu**
Office Phone: **(216) 687-9226** Home Phone: **(216) 591-118**
Has the investigator completed the CITI course in the protection of human subjects? ☒ Yes ☐ No

CO-PRINCIPAL OR STUDENT INVESTIGATOR
Name: (Last, First): **Matheny, Erica** Title: **Student**
Department: **Urban studies & Public Affairs**
Electronic Mail Address: **e.matheny@csuohio.edu**
Office Phone: **(330) 285-4790** Home Phone: **(330) 836-7135**
Has the investigator completed the CITI course in the protection of human subjects? ☒ Yes ☐ No

If this is a student investigator, please indicate status:
☐ Undergraduate ☐ Master level student ☒ Doctoral level student
and level of involvement in the research:
☐ Assisting Faculty Research ☐ Thesis ☒ Dissertation ☐ Classroom project: Class name/number ____

ADDITIONAL INVESTIGATORS? ☐ **Yes** ☒ **No** **(If yes, please complete the "Additional CSU Investigators" form.)**

PROPOSED PROJECT DURATION (research may not begin prior to IRB approval):
From (mm/dd/yyyy): **05/01/2008** To (mm/dd/yyyy): **05/01/2009** (date following anticipated approval; maximum one year later)

Please be aware that ***data collected prior to approval or outside of authorized dates may not be used.*** If your study (i.e. collection of data) will extend beyond the one year authorization, ***it is your responsibility to notify the IRB prior to expiration and request an extension.***

***Type of funding or support: **Departmental**

FOR IRB USE ONLY

Initial Evaluation	**Final IRB Action**
☐ Approve as is	☐ Exempt Status: Project is exempt under 45 CFR 46.101 ____
☑ Requires Revision before evaluation or final action	☑ Expedited Review: Approval Category 7
☐ Full IRB review required	☐ Regular IRB approval
Revisions completed and approved 5/16/08	☐ Other: ____

Conditional approval

Reviewer: Neuendorf Signature: K.A. Neuendorf Approval Date: 5/16/08

Cleveland State University Office of Sponsored Programs and Research IRB
Form updated 11/30/2007
All other forms are obsolete
dpo

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